

Specifications
for

**Ontario Tech University
Shawenjigewining Hall
4th & 5th Floor Renovations**

Oshawa, Ontario

April 7, 2026

Issued for Bid

PART 1 - THE CONSULTANTS

1.1. THE CONSULTANT

- 1.1.1. Architecture Counsel Inc.
4 Clinton Place
Toronto, Ontario M6G 1J9

Telephone: (416) 603-1515
Web: architecturecounsel.com

1.2. MECHANICAL CONSULTANT

- 1.2.1. BPA
200 King Street, West, Suite 310
Toronto, Ontario M5H 3T4

Telephone: (416) 499-8000
Web: bpa.ca

1.3. ELECTRICAL CONSULTANT

- 1.3.1. BPA
200 King Street, West, Suite 310
Toronto, Ontario M5H 3T4

Telephone: (416) 499-8000
Web: bpa.ca

1.4. HARDWARE CONSULTANT

- 1.4.1. Spyder SC Inc.
26 Dale Crescent
Cookstown, Ontario L0L 1L0

Telephone: (905) 909-8880
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END OF SECTION

PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP					
DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS					
INTRODUCTORY INFORMATION					
Section No.	Section Title	Rev. No.	Date	Consult.	Page No's
00 00 01	PROJECT TITLE PAGE	--	2026-02-27	ACI	1 Only
00 01 05	LIST OF CONSULTANTS	00	2026-02-27	ACI	1 Only
00 01 10	TABLE OF CONTENTS	00	2026-02-27	ACI	1 thru 4
00 01 15	LIST OF DRAWINGS	00	2026-02-27	ACI	1 Only
00 01 20	LIST OF SCHEDULES	00	2026-02-27	ACI	1 Only
PROCUREMENT REQUIREMENTS					
00 30 00	AVAILABLE INFORMATION	00	2026-02-27	ACI	1 Only
CONTRACTING REQUIREMENTS					
*00 70 00	"AGREEMENT BETWEEN OWNER AND CONTRACTOR", "DEFINITIONS" AND "GENERAL CONDITIONS", STANDARD CONSTRUCTION DOCUMENT CCDC 2 – 2020				Not Enclosed
00 71 00	AMENDMENTS TO DEFINITIONS	00	2026-02-27	ACI	1 and 2
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GENERAL REQUIREMENTS SUBGROUP					
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01 10 00	GENERAL REQUIREMENTS	00	2026-04-07	ACI	1 thru 5
01 20 00	PRICE AND PAYMENT PROCEDURES	00	2026-04-07	ACI	1 thru 3
01 30 00	ADMINISTRATIVE REQUIREMENTS	00	2026-02-27	ACI	1 thru 9
01 40 00	QUALITY REQUIREMENTS	00	2026-02-27	ACI	1 thru 5
01 50 00	TEMPORARY FACILITIES AND CONTROLS	00	2026-02-27	ACI	1 thru 4
01 60 00	PRODUCT REQUIREMENTS	00	2026-02-27	ACI	1 thru 5
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06 61 16	SOLID SURFACING FABRICATIONS	00	2026-02-27	ACI	1 thru 6
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07 84 00	FIRESTOPPING AND SMOKE SEALS	00	2026-02-27	ACI	1 thru 12
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08 14 00	WOOD DOORS	00	2026-02-27	ACI	1 thru 4
08 31 13	ACCESS DOORS AND FRAMES	00	2026-02-27	ACI	1 thru 3
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08 80 00	GLASS AND GLAZING	00	2026-02-27	ACI	1 thru 7
<i>DIVISION 09 – FINISHES</i>					
09 21 16	GYPSUM BOARD ASSEMBLIES	00	2026-02-27	ACI	1 thru 14
09 51 13	ACOUSTICAL PANEL CEILINGS	00	2026-02-27	ACI	1 thru 7
09 60 13	INTERIOR TACTILE WARNING SURFACING	00	2026-02-27	ACI	1 thru 4
09 65 16	RESILIENT SHEET VINYL FLOORING	00	2026-02-27	ACI	1 thru 8
09 65 66	RESILIENT ATHLETIC IMPACT FLOORING	00	2026-02-27	ACI	1 thru 4
09 68 13	CARPET TILE	00	2026-02-27	ACI	1 thru 5
09 84 13	FIXED SOUND - ABSORPTIVE PANELS	00	2026-02-27	ACI	1 thru 5
09 91 00	PAINTING	00	2026-02-27	ACI	1 thru 15
<i>DIVISION 10 – SPECIALTIES</i>					
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<i>DIVISION 11 – FURNISHINGS</i>					
12 22 13	DRAPERIES	00	2026-02-27	ACI	1 thru 4
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13 48 00	ACOUSTIC ISOLATED FLOATING FLOORS	00	2026-02-27	ACI	1 thru 3

FACILITY SERVICES SUBGROUP					
DIVISION 20 – MECHANICAL GENERAL REQUIRMENTS					
*20 04 00	MECHANICAL GENERAL PROVISIONS	00	2026-04-10	BPA	1 thru 20
*20 05 00	BASIC MECHANICAL MATERIALS AND METHODS	00	2026-04-10	BPA	1 thru 28
*20 05 48	SOUND AND VIBRATION CONTROL	00	2026-04-10	BPA	1 thru 8
*20 07 00	INSULATION	00	2026-04-10	BPA	1 thru 10
*20 09 00	MOTORS, STARTERS, CONTROL CENTRES AND WIRING	00	2026-04-10	BPA	1 thru 4
*20 09 50	VARIABLE SPEED DRIVES	00	2026-04-10	BPA	1 thru 6
*20 12 00	PHASING/WORK INCLUDED	00	2026-04-10	BPA	1 Only
*20 20 00	SEPARATE AND IDENTIFIED PRICES	00	2026-04-10	BPA	1 Only
*20 25 00	ALTERNATIVE EQUIPMENT AND SUPPLIERS	00	2026-04-10	BPA	1 thru 7
*20 94 00	MECHANICAL DEMOLITION	00	2026-04-10	BPA	1 thru 5
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DIVISION 22 – PLUMBING					
*22 11 00	PLUMBING AND DRAINAGE SYSTEMS	00	2026-04-10	BPA	1 thru 6
*22 30 00	PLUMBING SPECIALTIES	00	2026-04-10	BPA	1 thru 4
*22 33 00	DOMESTIC WATER HEATERS	00	2026-04-10	BPA	1 and 2
*22 40 00	PLUMBING FIXTURES	00	2026-04-10	BPA	1 thru 3
*22 63 00	MEDICAL GAS PIPING	00	2026-04-10	BPA	1 thru 10
DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING					
*23 05 93	TESTING AND BALANCING (TAB)	00	2026-04-10	BPA	1 thru 5
*23 21 13	HYDRONIC PIPING SYSTEMS	00	2026-04-10	BPA	1 thru 6
*23 23 00	REFRIGERANT PIPING	00	2026-04-10	BPA	1 and 2
*23 31 00	SHEET METAL	00	2026-04-10	BPA	1 thru 12
*23 31 10	DUCT CLEANING	00	2026-04-10	BPA	1 thru 5
*23 34 00	FANS	00	2026-04-10	BPA	1 and 2
*23 36 30	AIR TERMINAL CONTROL UNITS - DIGITAL	00	2026-04-10	BPA	1 thru 3
*23 37 13	AIR TERMINALS - GRILLES, REGISTERS, DIFFUSERS	00	2026-04-10	BPA	1 and 2
*23 60 00	REFRIGERATION CONDENSING UNIT	00	2026-04-10	BPA	1 thru 3
*23 76 00	DIRECT EXPANSION AIR CONDITIONERS	00	2026-04-10	BPA	1 thru 3
*23 76 01	SPLIT HEAT PUMP	00	2026-04-10	BPA	1 and 2
*23 82 00	HYDRONIC TERMINAL UNITS	00	2026-04-10	BPA	1 and 2
*23 82 19	FAN COIL UNITS	00	2026-04-10	BPA	1 and 2
DIVISION 25 – INTEGRATED AUTOMATION					
*25 08 00	EMCS INSPECTION AND ACCEPTANCE TESTING	00	2026-04-10	BPA	1 thru 3
*25 30 00	EMCS INSTRUMENTATION	00	2026-04-10	BPA	1 thru 15

*25 50 00	ELECTRONIC CONTROLS AND MONITORING	00	2026-04-10	BPA	1 thru 26
*25 58 00	FIRE CONTROL CENTRE INTERFACING	00	2026-04-10	BPA	1 and 2
<i>DIVISION 26 – ELECTRICAL</i>					
*26 05 00	GENERAL CONDITIONS	00	2026-04 07	BPA	1 thru 8
*26 05 01	COMMON WORK RESULTS - ELECTRICAL	00	2026-04 07	BPA	1 thru 4
*26 05 20	WIRE AND BOX CONNECTORS (0-1000V)	00	2026-04 07	BPA	1 Only
*26 05 21	WIRE AND CABLES	00	2026-04 07	BPA	1 thru 3
*26 05 28	GROUNDING - SECONDARY	00	2026-04 07	BPA	1 and 2
*26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	00	2026-04 07	BPA	1 and 2
*26 05 31	SPLITTERS, JUNCTION BOXES, PULL BOXES AND CABINETS	00	2026-04 07	BPA	1 and 2
*26 05 31	OUTLET AND CONDUIT BOXES AND FITTINGS	00	2026-04 07	BPA	1 and 2
*26 05 34	CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS	00	2026-04 07	BPA	1 thru 3
*26 27 26	WIRING DEVICES	00	2026-04 07	BPA	1 and 2
*26 28 13.01	FUSES - LOW VOLTAGE	00	2026-04 07	BPA	1 and 2
*26 28 23	DISCONNECT SWITCHES - FUSED AND NON-FUSED	00	2026-04 07	BPA	1 Only
*26 51 00	INTERIOR LIGHTING	00	2026-04 07	BPA	1 and 2
*26 60 01	ELECTRICAL IDENTIFICATION	00	2026-04 07	BPA	1 thru 3
*26 60 02	TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS	00	2026-04 07	BPA	1 thru 6
<i>DIVISION 28 – ELECTRONIC SAFETY AND SECURITY</i>					
*28 13 00	ACCESS CONTROL	00	2026-04 07	BPA	1 Only
*28 31 00.01	MULTIPLEX FIRE ALARM SYSTEM - BASE BUILDING	00	2026-04 07	BPA	1 and 2

LEGEND

* - Specifications prepared by Consultants other than Architecture Counsel Inc. have been prefixed with an asterisk. These Specifications are not included under, nor governed by Architecture Counsel Inc.'s seal.

Consultant's Abbreviations:

OTU Ontario Tech University
ACI Architecture Counsel Inc.
SSC Spyder SC Inc.
BPA BPA
BPA BPA

Owner
Architectural
Hardware Consultant
Mechanical Consultant
Electrical Consultant

END OF SECTION

PART 1 - GENERAL

1.1. ARCHITECTURAL DRAWINGS

1.1.1. Architectural Drawings forming part of the Contract Documents are those listed on Drawing No. A000 dated "February 27, 2026" with the following statement in the revision column:

1.1.1.1. "Issued for Bid".

1.2. MECHANICAL DRAWINGS *

1.2.1. Mechanical Drawings forming part of the Contract Documents are those listed on Drawing No. M0-000 dated "February 27, 2026" with the following statement in the revision column:

1.2.1.1. "Issued for Tender".

1.3. ELECTRICAL DRAWINGS *

1.3.1. Electrical Drawings forming part of the Contract Documents are those listed on Drawing No. E-000 dated "February 27, 2026" with the following statement in the revision column:

1.3.1.1. "Issued for Tender".

1.4. STRUCTURAL DRAWINGS *

1.4.1 Structural Drawing forming part of the Contract Documents are listed on Drawing No. A000 dated "February 27, 2026" with the following statement in the revision column:

1.4.1.1 "Issue for Bid"

LEGEND

** - Drawings prepared by Consultants other than Architecture Counsel Inc. have been prefixed by asterisks and are not included under, nor governed by, Architecture Counsel Inc.'s seal.*

*** - Drawings to be issued at a later date.*

END OF SECTION

PART 1 - GENERAL

1.1. DATES

1.1.1. Schedules are dated as indicated herein.

PART 2 - SCHEDULES (Bound with Specifications)

2.1. HARDWARE SCHEDULE **

2.1.1. Door Hardware 08 71 00 (34 pages) dated 26 Feb 26.

LEGEND

** - Documents provided by the Owner have been prefixed by an asterisk and are not included under, nor governed by, Architecture Counsel Inc.'s seal.*

*** - Schedules prepared by Consultants other than Architecture Counsel Inc. have been prefixed by 2 asterisks and are not included under, nor governed by, Architecture Counsel Inc.'s seal.*

**** - Schedules to be issued at a later date.*

END OF SECTION

DOOR HARDWARE

08 71 00



PROJECT:

Ontario Tech 5th & 4th Floor Fit-Out
40 Founder Drive
Oshawa, ON

ARCHITECT:

**Architecture
Counsel**

4 Clinton Pl,
Toronto, ON

Prepared By: Kaitlyn Mallany

Date: November 25, 2025

Revised: February 6, 2026 **Added Scope (4th Floor)**

February 10, 2026

February 12, 2026

February 26, 2026

March 2, 2026 **ADO & Push Button Change**

Architectural Hardware Finishes

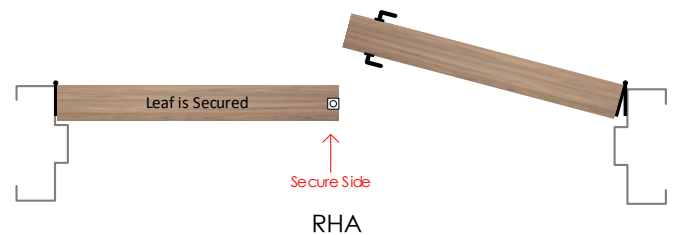
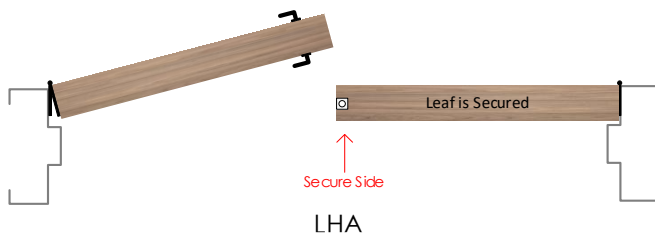
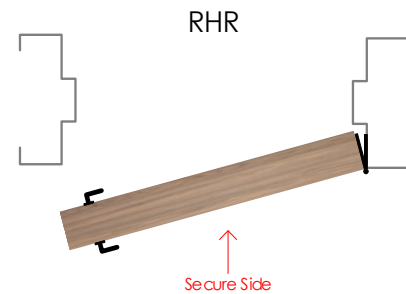
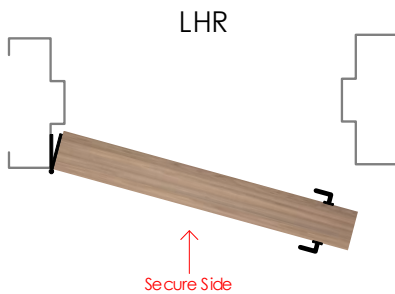
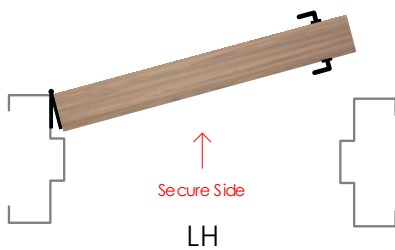
	Steel	Stainless Steel	Brass/Bronze	Aluminum	Paint/Powder Coat	US/CAN
Clear Anodized				628	689	US28
Satin Nickel	646		619	670		US15
Polished Nickel	645		618	669		US14
Satin Stainless Steel		630				US32D
Polished Stainless Steel		629				US32
Satin Chrome	652		626	702		US26D
Polished Chrome	651		625	672		US26
Satin Brass	633		606	667	678	US4
Polished Brass	632		605	666	677	US5
Satin Bronze	639		612	668	680	US10
Oil Rubbed Bronze	640		613	703	695	US10B
Flat Black / Anodized Black	631		622	671	693	US19

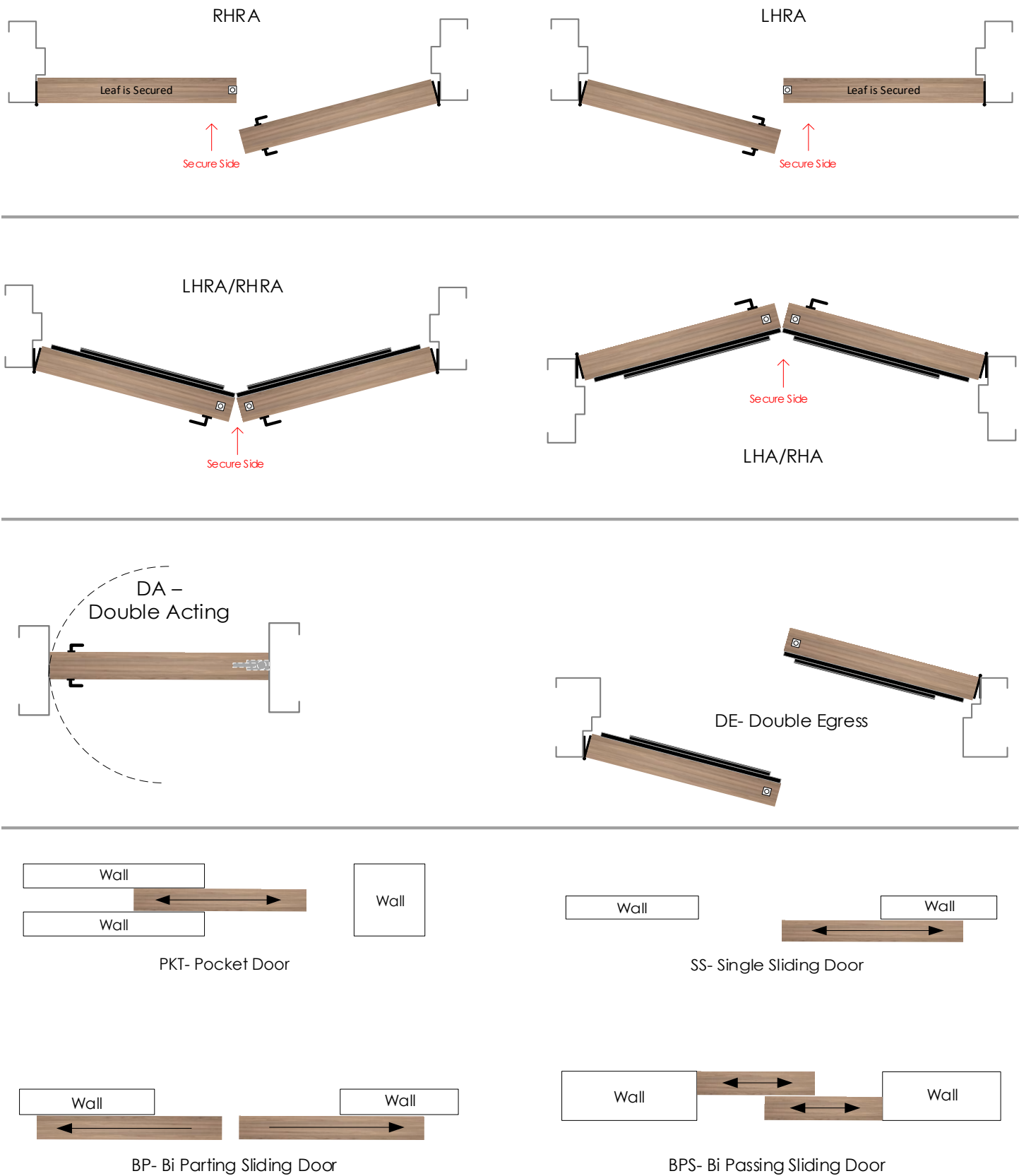
Door Handing's

Abbreviations

RH = Right Hand	RHA = Right Hand Active	SS = Single Slider
LH = Left Hand	LHA = Left Hand Active	BP = Bi-Parting Slider
RHR = Right Hand Reverse	RHA/LHA = Right & Left Hands Active	BF = Bi-Folding Slider
LHR = Left Hand Reverse	RHRA/LHRA = Right & Left Hand Reverse Active	TS = Telescopic Slider
RHRA = Right Hand Reverse Active	DA = Double Acting	PKT = Pocket Slider
LHRA = Left Hand Reverse Active	DE = Double Egress	

NOTE: The handing of a swing door is determined by placing yourself on the secured or keyed side of the door.





Products & Alternatives

NOTE: Only those products / brands listed here are acceptable and should be used to form a bid price. No unsolicited products will be considered. If acceptable alternates are listed here those too can be used to form a bid price provided, they are exactly the same as the specified item. If using an alternate product to form a price it is the bidder's responsibility to ensure that product is identical in every way to the specified item. If no alternates are listed, no alternate products are acceptable.

Product Type	Product#	Manufacturer	Alternate Manufacturer 1	Alternate Manufacturer 2
Butt Hinge	TA714 Series	McKinney		
Mortise Locks	8200 Series	Sargent		
Electric Strikes	1006 Series	HES		
Overhead Stops	690 Series	Sargent		
Kick Plates	GSH 80A	Gallery		
Smoke / Sound Seals	S88 Series	Pemko		
Floor Stops	GSH 209	Gallery		
Exit Devices	80 Series	Sargent		
Electric Strikes	9400 Series	HES		
Auto Door Bottoms	411 Series	Pemko		
Door Closers	1431 Series	Sargent		
Door Operator	SW200i	Besam		
Vertical Column Switches	CM-7436VR/4	Camden		
Logic Relays	CX-33	Camden		

Symbols



- Door has a fire rating and all associated hardware must have a fire label to suit. Must comply with local requirements.



- Door is automatic and is equipped with an auto operator. Door must meet local barrier free codes



- Door has an electrical requirement and requires power to be brought to the appropriate location above the door or to the latch, for either security or barrier free applications. Refer to security & electrical drawings for further information.



- Door requires security card access. Refer to security / electrical drawings for further information.

Abbreviations

Door:

HMD = Hollow Metal Door
IHMD = Insulated Hollow Metal Door
ALD = Aluminum Door
SSD = Stainless Steel Door
ISSD = Insulated Stainless Steel Frame
STL = Steel Door
IC-ALD = Insulated Clad Aluminum Door
SCWD = Solid Core Wood Door
HCWD = Hollow Core Wood Door
FGD = Frameless Glass Door
FRP = Fiberglass Reinforced Plastic Door
OHD = Overhead Door

Frame:

HMF = Hollow Metal Frame
ALF = Aluminum Frame
Cased Open HMF = Cased Open Hollow Metal Frame
SSF - Stainless Steel Frame
STL = Steel Frame
WDF = Wood Frame
Cased Open WDF = Cased Open Wood Frame
Cased Open Drywall = Cased Open Drywall

Fire Ratings:

0 HR – Zero Hour Fire Rating / Smoke Barrier
20 MIN – 20 Minute Fire Rating
¾ HR – 45 Minute Fire rating
1 ½ HR – 90 Minute Fire Rating
2 HR – 120 Minute Fire Rating
3 HR – 180 Minute Fire Rating

Disclaimer

Weblinks:

Weblinks do change from time to time as manufacturers move around their websites, please inform us if you have a none functioning weblink.

Level 5 Openings

HARDWARE SCHEDULE

Heading# 1

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

7	Total Openings							
1	Door#	D513	Location:	Student Collab Area 512	To	Office 513	Handing:	LH
1	Door#	D521	Location:	Corridor 518	To	Office 521	Handing:	LH
1	Door#	D522	Location:	Corridor 518	To	Office 522	Handing:	LH
1	Door#	D523	Location:	Corridor 518	To	Office 523	Handing:	LH
1	Door#	D525	Location:	Corridor 518	To	Office 525	Handing:	RH
1	Door#	D527	Location:	Corridor 518	To	Office 527	Handing:	RH
1	Door#	D529	Location:	Corridor 518	To	Office 529	Handing:	LH

By Hardware Supplier					
21	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
7	Office Lockset	63-8205-LNJ	626 / US26D / Satin Chrome	Sargent	
7	Floor Stop	GSH 209	626 / US26D / Satin Chrome	Gallery	
7	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
By Owner					
7	Permanent Cylinder	Provided by Owner			

.....End of Heading.....



Heading#

2

Opening Information

Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

6	Total Openings							
1	Door#	D514	Location:	Corridor 515	To	Research Lab 514	Handing:	RH
1	Door#	D524	Location:	Corridor 518	To	Lab Entrance 524	Handing:	RH
1	Door#	D516	Location:	Corridor 518	To	3D Printer Room 516	Handing:	LH
1	Door#	D517	Location:	Corridor 518	To	Meeting Room 517	Handing:	LH
1	Door#	D520	Location:	Corridor 518	To	Research Lab 520	Handing:	LH
1	Door#	D530	Location:	Corridor 518	To	Lab Support Room 530	Handing:	LH

By Hardware Supplier

18	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
6	Storeroom Lockset	63-8204-LNJ	626 / US26D / Satin Chrome	Sargent	
6	Electric Strike	1006CS	630 / US32D / Satin Stainless Steel	HES	
6	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
6	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
6	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	

By Automatic Operator Supplier

6	Auto Operator	SW200i-41" Header- Pull Arm	630 / US32D / Satin Stainless Steel	Besam	
12	Vertical Column C/W Wave Sensor	CM-7436/A4	628 / US28 / Clear Anodized	Camden	
6	Logic Relay	CX-33	N/A	Camden	

By Security Supplier

6	Card Reader	To Suit Building System, By Security Supplier			
6	Door Contact	To Suit Building System, By Security Supplier			
6	Access Controller	To Suit Building System, By Security Supplier			
6	Rex Sensor	To Suit Building System, By Security Supplier			
6	Power Supply	In Central IT Location			

By Owner

6	Permanent Cylinder	Provided by Owner			

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit with pull cords to back boxes for actuators, lights / sounders are to be provided by the electrical contractor. Electrical contractor to provide low voltage wires to actuator locations as required.
- Electrical contractor to confirm quantity of wires and wire locations with auto door operator supplier prior to pulling wires.

-----End of Heading-----

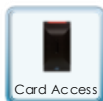
Heading# 3

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

2	Total Openings							
1	Door#	D514A	Location:	Research Lab 514	From	Observation 514A	Handing:	RHR
1	Door#	D514B	Location:	Research Lab 514	To	Simulation Room 514B	Handing:	LH

By Hardware Supplier					
6	Butt Hinge	TA714 – 127 x 114		652 / US26D / Satin Chrome	McKinney 
2	Passage Set	8215-LNJ		626 / US26D / Satin Chrome	Sargent 
2	Floor Stop	GSH 209		626 / US26D / Satin Chrome	Gallery 
2	Smoke / Sound Seal	S88BL x 5233		Black	Pemko 

.....End of Heading.....



Heading#

4

Opening Information

Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

2 Total Openings

1	Door#	D519A	Location:	Corridor 518	From	Classroom 519	Handing:	LHR
1	Door#	D519B	Location:	Corridor 518	To	Classroom 519	Handing:	RHR

By Hardware Supplier

6	Butt Hinge	TA714 – 127 x 114 x NRP	652 / US26D / Satin Chrome	McKinney	
2	Exit Device	63-8813 x J x LNJ	626 / US26D / Satin Chrome	Sargent	
2	Electric Strike	9400	630 / US32D / Satin Stainless Steel	HES	
2	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
2	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
2	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	

By Automatic Operator Supplier

2	Auto Operator	SW200i-41" Header- Pull Arm	630 / US32D / Satin Stainless Steel	Besam	
4	Vertical Column C/W Wave Sensor	CM-7436/A4	628 / US28 / Clear Anodized	Camden	
2	Logic Relay	CX-33	N/A	Camden	

By Security Supplier

2	Card Reader	To Suit Building System, By Security Supplier			
2	Door Contact	To Suit Building System, By Security Supplier			
2	Access Controller	To Suit Building System, By Security Supplier			
2	Rex Sensor	To Suit Building System, By Security Supplier			
2	Power Supply	In Central IT Location			

By Owner

2	Permanent Cylinder	Provided by Owner			

Notes:

-
- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit with pull cords to back boxes for actuators, lights / sounders are to be provided by the electrical contractor. Electrical contractor to provide low voltage wires to actuator locations as required.
 - Electrical contractor to confirm quantity of wires and wire locations with auto door operator supplier prior to pulling wires.

.....End of Heading.....

Heading# 5

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	D524A	Location:	Lab Entrance 524	To	Lab Equipment Room 524A	Handing:	RH

By Hardware Supplier					
3	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
1	Storeroom Lockset	63-8204-LNJ	626 / US26D / Satin Chrome	Sargent	
1	Door Closer	1431-O	689 / US28 / Painted Aluminum	Sargent	
1	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
1	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
1	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
1	Auto Door Bottom	411_SL x 965	628 / US28 / Clear Anodized	Pemko	
By Owner					
1	Permanent Cylinder	Provided by Owner			

.....End of Heading.....

Heading# 6

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

4	Total Openings							
1	Door#	D524B	Location:	Lab Entrance 524	To	Research Lab 524B	Handing:	LH
1	Door#	D524F	Location:	Research Lab 524D	To	Vor Cor Lab 524F	Handing:	RH
1	Door#	D524G	Location:	Research Lab 524D	To	EEG Lab 524G	Handing:	RH
1	Door#	D524E	Location:	Research Lab 524D	To	HDEMG Lab 524E	Handing:	LH

By Hardware Supplier					
12	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
4	Passage Set	8215-LNJ	626 / US26D / Satin Chrome	Sargent	
4	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
4	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
4	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
4	Auto Door Bottom	411_SL x 965	628 / US28 / Clear Anodized	Pemko	

Notes:

- Rough-in for 120V at header of frame for future ADO

.....End of Heading.....

Heading# 7

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

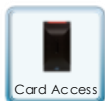
1	Total Openings							
1	Door#	D524C	Location:	Research Lab 524B	To	Data Analysis Room 524C	Handing:	RH

By Hardware Supplier					
3	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
1	Classroom Lockset	63-8237-LNJ	626 / US26D / Satin Chrome	Sargent	
1	Door Closer	1431-O	689 / US28 / Painted Aluminum	Sargent	
1	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
1	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
1	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
1	Auto Door Bottom	411_SL x 965	628 / US28 / Clear Anodized	Pemko	
By Owner					
1	Permanent Cylinder	Provided by Owner			

Notes:

- Rough-in for 120V at header of frame for future ADO

-----End of Heading-----



Heading#

8

Opening Information

Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	1 HR

2	Total Openings							
1	Door#	D526	Location:	Corridor 518	To	Research Lab 526	Handing:	LH
1	Door#	D533A	Location:	Corridor 532	To	Research Lab 533A	Handing:	LH

By Hardware Supplier

6	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
2	Storeroom Lockset	63-8204-LNJ	626 / US26D / Satin Chrome	Sargent	
2	Electric Strike	1006CS	630 / US32D / Satin Stainless Steel	HES	
2	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
2	Kickplate	GSH80A – 203 x 927 x MS	630 / US32D / Satin Stainless Steel	Gallery	
2	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
2	Auto Door Bottom	411_SL x 965	628 / US28 / Clear Anodized	Pemko	

By Automatic Operator Supplier

2	Auto Operator	SW200i-41" Header- Pull Arm	630 / US32D / Satin Stainless Steel	Besam	
4	Vertical Column C/W Wave Sensor	CM-7436/A4	628 / US28 / Clear Anodized	Camden	
2	Logic Relay	CX-33	N/A	Camden	

By Security Supplier

2	Card Reader	To Suit Building System, By Security Supplier			
2	Door Contact	To Suit Building System, By Security Supplier			
2	Access Controller	To Suit Building System, By Security Supplier			
2	Rex Sensor	To Suit Building System, By Security Supplier			
2	Power Supply	In Central IT Location			

By Owner

2	Permanent Cylinder	Provided by Owner			

Notes:

-
- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit with pull cords to back boxes for actuators, lights / sounders are to be provided by the electrical contractor. Electrical contractor to provide low voltage wires to actuator locations as required.
 - Electrical contractor to confirm quantity of wires and wire locations with auto door operator supplier prior to pulling wires.

.....End of Heading.....

Heading# 9

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	D528	Location:	Corridor 518	To	Lab Change Room 528	Handing:	RH

By Hardware Supplier					
3	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
1	Indicator Privacy Set	V20-8265-LNJ	626 / US26D / Satin Chrome	Sargent	
1	Door Closer	1431-O	689 / US28 / Painted Aluminum	Sargent	
1	Floor Stop	GSH 209	626 / US26D / Satin Chrome	Gallery	
1	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
1	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	

.....End of Heading.....

Heading# 10

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	0 HR

1	Total Openings							
1	Door#	D533B	Location:	Research Lab 533A	To	Environmental Chamber 533B	Handing:	LH

By Hardware Supplier					
3	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
1	Classroom Lockset	63-8237-LNJ	626 / US26D / Satin Chrome	Sargent	
1	Door Closer	1431-O	689 / US28 / Painted Aluminum	Sargent	
1	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
1	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
1	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
1	Auto Door Bottom	411_SL x 965	628 / US28 / Clear Anodized	Pemko	
By Owner					
1	Permanent Cylinder	Provided by Owner			

Notes:

- Rough-in for 120V at header of frame for future ADO

.....End of Heading.....

Heading# 11

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	D533C	Location:	Research Lab 533A	To	Exercise & Environmental Physiology Lab 533C	Handing:	LH

By Hardware Supplier					
3	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
1	Classroom Lockset	63-8237-LNJ	626 / US26D / Satin Chrome	Sargent	
1	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
1	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
1	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
1	Auto Door Bottom	411_SL x 965	628 / US28 / Clear Anodized	Pemko	
By Owner					
1	Permanent Cylinder	Provided by Owner			

Notes:

- Rough-in for 120V at header of frame for future ADO

.....End of Heading.....

Door added February 12th



Heading# 12

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	D531	Location:	Corridor 532	To	Graduate Workspace 531	Handing:	LH

By Hardware Supplier					
3	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
1	Classroom Lockset	63-8237-LNJ	626 / US26D / Satin Chrome	Sargent	
1	Electric Strike	1006CS	630 / US32D / Satin Stainless Steel	HES	
1	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
1	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
1	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
By Automatic Operator Supplier					
1	Auto Operator	SW200i-41" Header- Pull Arm	630 / US32D / Satin Stainless Steel	Besam	
2	Vertical Column C/W Wave Sensor	CM-7436/A4	628 / US28 / Clear Anodized	Camden	
1	Logic Relay	CX-33	N/A	Camden	
By Security Supplier					
1	Card Reader	To Suit Building System, By Security Supplier			
1	Door Contact	To Suit Building System, By Security Supplier			
1	Access Controller	To Suit Building System, By Security Supplier			
1	Rex Sensor	To Suit Building System, By Security Supplier			
1	Power Supply	In Central IT Location			
By Owner					
1	Permanent Cylinder	Provided by Owner			

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit with pull cords to back boxes for actuators, lights / sounders are to be provided by the electrical contractor. Electrical contractor to provide low voltage wires to actuator locations as required.
- Electrical contractor to confirm quantity of wires and wire locations with auto door operator supplier prior to pulling wires.

-----End of Heading-----

Level 4 Openings

Door added February 12th



Heading# 13

Opening Information

Opening Type:	Pair	Opening Size:	2-965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	D410	Location:	426	to/from	410	Handing:	DE

By Hardware Supplier

6	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
2	Exit Device	NB-WD8610 x J	626 / US26D / Satin Chrome	Sargent	
2	Door Closer	351-P10	689 / US28 / Painted Aluminum	Sargent	
2	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
2	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	

-----End of Heading-----

Heading#

14

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

7	Total Openings							
1	Door#	D444	Location:	442	To	Office 444	Handing:	RH
1	Door#	D445A1	Location:	443	To	Office 445A	Handing:	LH
1	Door#	D445A2	Location:	443	To	Office 445A	Handing:	LH
1	Door#	D446a	Location:	443	To	Office 446	Handing:	RH
1	Door#	D445b	Location:	Research Lab 445B	To	Office 446	Handing:	RH
1	Door#	D470	Location:	Social & Waiting 410	To	Office 470	Handing:	LH
1	Door#	D473	Location:	Nursing Lab Suite Lobby 471	To	Office 473	Handing:	RH

By Hardware Supplier					
21	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
7	Office Lockset	63-8205-LNJ	626 / US26D / Satin Chrome	Sargent	
7	Floor Stop	GSH 209	626 / US26D / Satin Chrome	Gallery	
7	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
By Owner					
7	Permanent Cylinder	Provided by Owner			

-----End of Heading-----



Heading# 15

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	D445B	Location:	443	To	Research Lab 445B	Handing:	LH

By Hardware Supplier					
3	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
1	Storeroom Lockset	63-8204-LNJ	626 / US26D / Satin Chrome	Sargent	
1	Electric Strike	1006CS	630 / US32D / Satin Stainless Steel	HES	
1	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
1	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
1	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
By Automatic Operator Supplier					
1	Auto Operator	SW200i-41" Header- Pull Arm	630 / US32D / Satin Stainless Steel	Besam	
2	Vertical Column C/W Wave Sensor	CM-7436/A4	628 / US28 / Clear Anodized	Camden	
1	Logic Relay	CX-33	N/A	Camden	
By Security Supplier					
1	Card Reader	To Suit Building System, By Security Supplier			
1	Door Contact	To Suit Building System, By Security Supplier			
1	Access Controller	To Suit Building System, By Security Supplier			
1	Rex Sensor	To Suit Building System, By Security Supplier			
1	Power Supply	In Central IT Location			
By Owner					
1	Permanent Cylinder	Provided by Owner			

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit with pull cords to back boxes for actuators, lights / sounders are to be provided by the electrical contractor. Electrical contractor to provide low voltage wires to actuator locations as required.
- Electrical contractor to confirm quantity of wires and wire locations with auto door operator supplier prior to pulling wires.

-----End of Heading-----

Heading# 16

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	D469C	Location:	Nursing Lab 469A	To	Storage 469C	Handing:	RH

By Hardware Supplier					
3	Butt Hinge	TA714 – 127 x 114	652 / US26D / Satin Chrome	McKinney	
1	Storeroom Lockset	63-8204-LNJ	626 / US26D / Satin Chrome	Sargent	
1	Door Closer	1431-O	689 / US28 / Painted Aluminum	Sargent	
1	Floor Stop	GSH 209	626 / US26D / Satin Chrome	Gallery	
1	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
1	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	
By Owner					
1	Permanent Cylinder	Provided by Owner			

.....End of Heading.....



Heading#

17

Opening Information

Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	D471	Location:	Social & Waiting 410	From	Nursing Lab Suite Lobby 471	Handing:	LHR

By Hardware Supplier

3	Butt Hinge	TA714 – 127 x 114 x NRP	652 / US26D / Satin Chrome	McKinney	
1	Storeroom Lockset	63-8204-LNJ	626 / US26D / Satin Chrome	Sargent	
1	Electric Strike	1006CS	630 / US32D / Satin Stainless Steel	HES	
1	Overhead Stop	698S	626 / US26D / Satin Chrome	Sargent	
1	Kickplate	GSH80A – 203 x 927 x Tape	630 / US32D / Satin Stainless Steel	Gallery	
1	Smoke / Sound Seal	S88BL x 5233	Black	Pemko	

By Automatic Operator Supplier

1	Auto Operator	SW200i-41" Header- Pull Arm	630 / US32D / Satin Stainless Steel	Besam	
2	Vertical Column C/W Wave Sensor	CM-7436/A4	628 / US28 / Clear Anodized	Camden	
1	Logic Relay	CX-33	N/A	Camden	

By Security Supplier

1	Card Reader	To Suit Building System, By Security Supplier			
1	Door Contact	To Suit Building System, By Security Supplier			
1	Access Controller	To Suit Building System, By Security Supplier			
1	Rex Sensor	To Suit Building System, By Security Supplier			
1	Power Supply	In Central IT Location			

By Owner

1	Permanent Cylinder	Provided by Owner			

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit with pull cords to back boxes for actuators, lights / sounders are to be provided by the electrical contractor. Electrical contractor to provide low voltage wires to actuator locations as required.

-
- Electrical contractor to confirm quantity of wires and wire locations with auto door operator supplier prior to pulling wires.

-----End of Heading-----

Heading# 18

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	D472	Location:	Nursing Lab Suite Lobby 471	To	Simulation Room 472	Handing:	LH

By Hardware Supplier					
3	Butt Hinge	TA714 – 127 x 114		652 / US26D / Satin Chrome	McKinney 
1	Passage Set	8215-LNJ		626 / US26D / Satin Chrome	Sargent 
1	Floor Stop	GSH 209		626 / US26D / Satin Chrome	Gallery 
1	Smoke / Sound Seal	S88BL x 5233		Black	Pemko 

Notes:

- Rough-in for 120V at header of frame for future ADO

.....End of Heading.....

Heading# 19

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44	STC Rating	None
Door Material:	SCWD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	D503	Location:	Student Collab Area 512	From	503	Handing:	RHR

By Hardware Supplier

X		re-use the existing hardware and frame			

Notes:

- Re-use the existing hardware and frame; client just needs a new door with sidelight.

.....End of Heading.....

MISC. NOTES

- Awarded bidder shall provide two control keys.
- All cylinders shall be master-keyed in accordance with the owner's direction.
- Awarded bidder shall coordinate and conduct a keying conference with the owner.
- Supplier to provide 2 change keys per cylinder and 2 master keys.
- Template all overhead stops to the maximum allowable door swing.
- General Contractor (GC) shall coordinate between the ADO supplier and the access control supplier to ensure proper door wiring.

END OF SCHEDULE

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. AVAILABLE INFORMATION AVAILABLE TO BIDDERS *

1.2.1. Following Available Information is bound in Specifications appended to this Section.

1.2.2. Following Report is for information only.

1.2.3. Available Information forms part of Contract Documents.

1.3. REPORTS *

1.3.1. Altitude Room System Proposal:

1.3.1.1. A copy of an altitude room system proposal, prepared by a consultant for the Place of the Work is bound herein. Refer to following:

1.3.1.1.1. "Hypoxico Altitude Training Systems Ontario Tech University Altitude Room System Proposal", prepared by Hypoxico, Inc.

1.3.2. Submit a Base Bid Price which includes and accommodates work implied in, or reasonably inferable from, investigation documents. Owner's investigation consultant will be interpreter of documents. Consultant will be arbiter of a change to Contract Price and/or Contract Time.

LEGEND

** - Documents provided by the Owner have been prefixed by an asterisk and are not included under, nor governed by, Architecture Counsel Inc.'s, seal.*

END OF SECTION

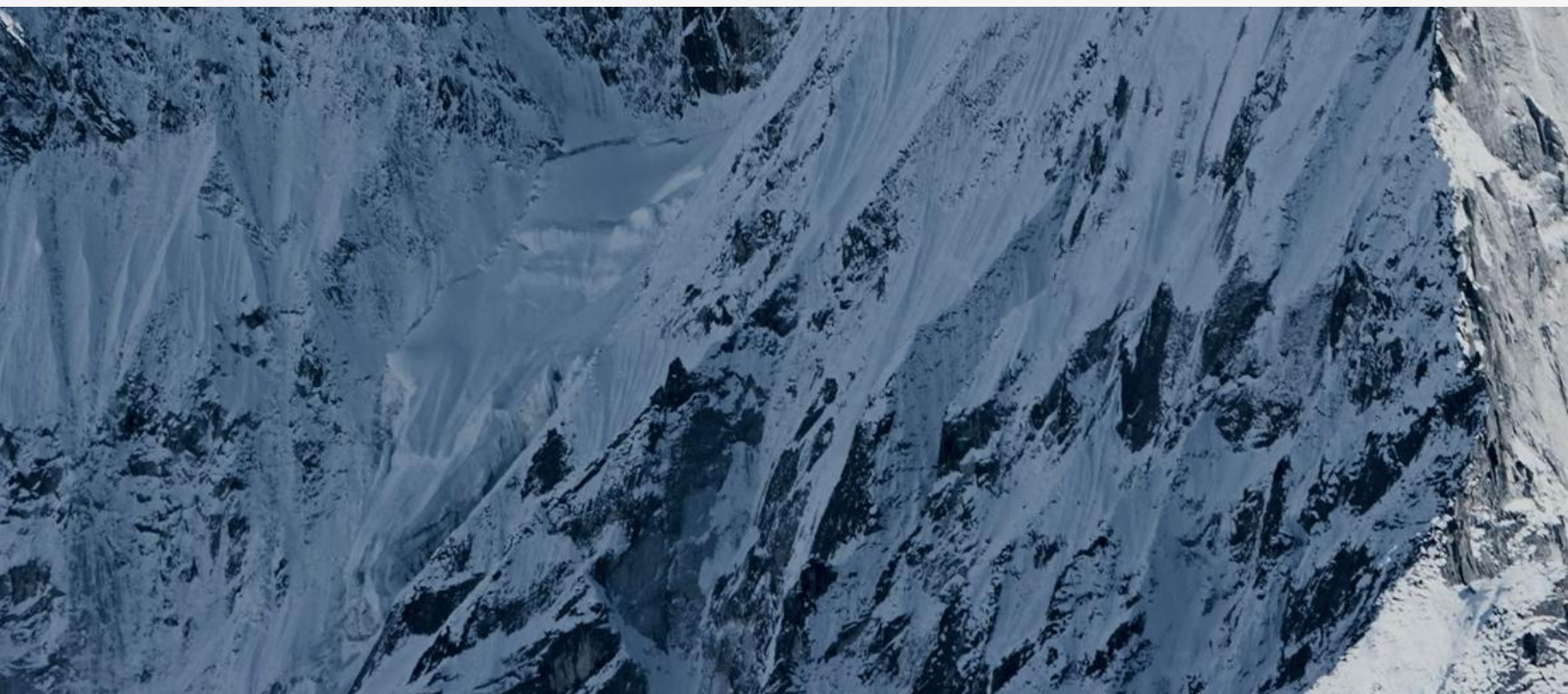


HYP₂OXICO

ALTITUDE TRAINING SYSTEMS

**Ontario Tech University Altitude Room
System Proposal**

Prepared for Faisal Bashir of Architecture Counsel



Altitude Room Conversion (New Construction)

To supply a newly constructed altitude room in your facility, Hypoxico proposes to provide the following:

- **Hypoxico-1500-B-OTU-X Complete System**
 - **15hp Compressor with integrated dryer and tank**
 - **Membrane-based filtration and gas separation cabinet**
 - **Condensate collection and filtration system**
 - **Touchscreen Control Panel**
 - **O₂ / CO₂ / Barometer Sensor Array**
- **Compressed Air, Hypoxic Supply, and Hyperoxic Exhaust Connections**
- **Complete installation, testing, calibration, commissioning, and training**

Our proposal is based on email and video conversations with Faisal Bashir of Architecture Counsel, the mechanical and electrical engineers working on this project, and the researchers and staff at Ontario Tech University. Initial assumptions include:

- Altitude Room: 10.75' x 14.5' x 11.75' ceilings = 1830 ft³
- Altitude Range: Up to 19,000' (10.1% O₂ Concentration)
- Number of Active Users: 3
- Number of Passive Users: 3
- Mechanical Room: Adjacent to altitude room (through shared wall)
- Location: Oshawa, Ontario, Canada (Average Elevation of 350')

Facility & Infrastructure Requirements (to be completed by customer):

To maintain the altitude environment within the room, there must be minimal leakage and very little introduction of ambient air, especially from any HVAC system (see additional details on following pages). All ventilation will come from the Hypoxico system. The following is required from the facility and/or local building contractors:

ALTITUDE ROOM:

- **Building out a well-sealed room with above dimensions or smaller, with maximum leakage rate of 20% total volume per day**
- **Closed-loop dedicated HVAC system (ductless split heat pump suggested)**

MECHANICAL /COMPRESSOR ROOM:

- **Minimum 8' x 10' footprint for equipment (components can be separated)**
- **3ph fused disconnect for compressor (data sheet can be provided)**
- **Two (2) 120V/1ph/15A receptacles for additional equipment**
- **Climate controlled space to include minimum 3.8 ft² make-up air vent and ability to offset/duct 41,000 BTU/hr rejected heat from compressor**
- **Large plenum or adjacent space to pipe "exhaust" air into**
- **Floor drain to connect condensate filter**
- **Freight Elevator and Clear Path to Mechanical Room Available**

Inclusions: Services Provided by Hypoxico

- Pre-installation construction guidance with contractors and/or facilities personnel
- Delivery of all equipment via LTL shipment(s) and/or Hypoxico van
- Final placement of all equipment provided as part of quote
- *Plumbing of high pressure lines between compressor and filtration cabinet with copper and propress fittings within mechanical room
- Plumbing of all condensate lines from compressor and filters to condensate filter
- **Plumbing of supply and exhaust lines from filtration cabinet to altitude room and adjacent space, respectively
- ***Wiring of communications lines between filtration cabinet, touchscreen, and sensor
- Compressor start-up coordination with local service representative
- Complete system testing, calibration, balancing, and commissioning
- Training of relevant personnel at time of commissioning to include digital manuals

*Assumes equipment is placed in same mechanical room. Longer piping runs may need to be handled by a local contractor.

**Assumes this can be run through shared walls of stud/gypsum construction. Longer runs and/or penetrations through concrete walls will need to be handled by a local contractor.

***Assumes conduit is provided between touchscreen location in altitude room and the mechanical room.

Optional Inclusions (not included in pricing):

Hypoxico **optional services** are available at an additional cost for the following:

- Penetration rough-in's of piping/wiring on separate site visit
- Longer compressed air and/or supply/exhaust piping runs
- Flush-mounted touchscreen in/near altitude room
- Ongoing annual / biannual service and maintenance trips or plans

Exclusions: Services NOT Provided by Hypoxico

Hypoxico does **not** offer optional services for the following exclusions:

- Electrical supply to compressor, mechanical room, and altitude room
- Obtaining building permits, licenses, inspections and fees associated in your region (if applicable)
- Penetrations through concrete or exterior walls (if applicable)
- Noise dampening of mechanical room (if applicable)
- Cooling and ventilation of mechanical room, including ducting of compressor rejected heat (if applicable)
- Running ethernet cable (if applicable)
- Future service and maintenance of compressor (this is usually done through the local service representative)

Room Conversion Requirements

Any room that is to be used to simulate altitude must be extremely well-sealed to protect the atmospheric envelope within. Hypoxico's system will supply all fresh air to the room through one or more PVC supply lines (plumbed from the mechanical room). Our system will take compressed ambient air and after passing it through gas separation components, will deliver filtered, clean, hypoxic (low oxygen) air to the room. Additional ventilation is accomplished by means of a bypass fan, mixing ambient air directly with the hypoxic supply.

Because this supplied hypoxic air is the basis upon which the room is brought and kept at simulated altitude, it is imperative that any introduction of outside, ambient air to the room from other sources is minimized. This should be a top priority when designing the room using either new construction or converting an existing room. The following are common sources of leakage and/or possible points of ambient air introduction:

Heating, Ventilation & Air Conditioning

The HVAC system for the altitude room is perhaps the most important component to ensure the simulated altitude environment is not compromised. Any solution that does not include air exchange to or from outside the room will work (i.e., radiant heating in the floors, thermal radiators, or electric baseboard heat). Any system that introduces vented or conditioned air from outside the room, however, will destroy the altitude atmosphere. Our recommendation is to utilize a closed-loop mini-split style HVAC system for the altitude room. A licensed HVAC contractor should be consulted to size the system appropriately, based on the volume of the room and the number of users, and install the components per local code requirements.

Ceiling & Lighting

The ceiling should be of solid construction. A drop ceiling can be utilized *only if the space above it is sealed and segregated from the rest of the building* (effectively making that space part of the altitude room). Similarly, recessed light fixtures can be used, provided they are insulated and sealed from the space behind or above them. Surface-mounted light fixtures are good solutions to eliminate air leakage into / out of the altitude room.

Electrical Outlets

While individually each outlet may represent a small point of leakage, cumulatively, the effect of unsealed outlets in the room will add up. Spray foam and/or rubberized gaskets should be used to prevent additional leakage at these locations.

Windows & Doors

Windows and especially the door(s) are oftentimes one of the largest points of leakage for a room. Just as it is important from an energy efficiency standpoint to install properly sealed windows and doors in a building, the altitude room door(s), and any windows, should be similarly well-sealed for optimal efficiency of the altitude system. Utilizing exterior-style doors, with weatherstripping around the top and sides, as well as a sweep along the bottom is recommended. Multiple options exist to incorporate mechanical or acoustical sweeps on existing doors, such that as the door is engaged to open, the sweep unseals. Likewise, as the door closes, the sweep re-engages to seal the room and better maintain hypoxic conditions. In some designs, this mechanical engagement of the seal extends around the entire perimeter of the door. Windows to the exterior should be well-sealed and will not be functional (cannot be opened) while the room is at altitude.

Floor

Most types of flooring (concrete, carpet, laminate, rubberized, etc.) are acceptable, provided that the surface (or subsurface) is sealed. Any gaps between the floor and the wall construction – behind base molding, for example – should be filled in and sealed.

Control Panel Wiring

Usually Hypoxico's installer will mount the panel in a mutually agreed upon location. If desired for aesthetic reasons, the cables can be installed in advance such that they are hidden.

Hypoxico is happy to assist any of the design and construction team in planning for a properly sealed altitude room. Minimizing leakage and eliminating the introduction of large amounts of ambient air to the space is critical for an optimized and efficient simulated altitude system.

Warranty Information

WARRANTIES. Hypoxico, Inc. herein referred to as "Hypoxico," warrants that the equipment delivered hereunder will be reasonably free of defects in material, workmanship, and design, and furnished in a professional and workmanlike manner in accordance with reasonable industry standards for a period of twelve (12) months from date of start-up, not to exceed twenty-four (24) months from the date of shipment from Hypoxico, whichever occurs first. Should any failure to conform with the above warranties occur during the specified period under normal use, and the equipment has been proven to Hypoxico's satisfaction to have been properly stored, installed and maintained, and purchaser has complied with all procedures outlined in the Hypoxico Service Manual, then Hypoxico shall, with prompt notice by purchaser, correct such nonconformities at its option either by repair or replacement of the non-conforming equipment. Hypoxico warrants any equipment repaired or replaced pursuant to the above warranty, under normal use, to be free from defects in workmanship and material for a period of ninety (90) days after the start-up of such repaired or replaced equipment or for a period ending on the expiration of the original equipment warranty, whichever is longer. Unless otherwise expressly agreed, Hypoxico shall not be responsible for labor charges, loss or damage resulting from improper operation, maintenance or repairs made by personnel other than those authorized in writing by Hypoxico, or damage to equipment caused by the use of non-authorized replacement parts. The effects of corrosion, erosion and normal wear and tear are specifically excluded from Hypoxico's warranty. Repair or replacement (whichever Hypoxico determines, in its sole discretion, to provide) shall be Hypoxico's sole obligation and purchaser's exclusive remedy for any nonconformity, noncompliance, defect or deficiency in equipment furnished hereunder, and shall be conditioned upon purchaser's return of the defective equipment to Hypoxico.

The express warranty contained herein above is exclusive and in lieu of all other representations and warranties, expressed or implied, and Hypoxico expressly makes no warranties, express or implied, except as specifically stated above. Such warranties, if any, are in lieu of all other warranties, written or oral, statutory, express or implied, including without limitation, nor do they constitute any warranty of merchant ability or fitness for a particular purpose.

Hypoxico shall in no event be liable for any incidental, special, or consequential, indirect, punitive, or exemplary damages whatsoever, including, but not limited to, damages for loss of profits, business interruption, loss of information, and the arising out of the performance or breach therein of this agreement of any nature, even if Hypoxico has been advised of the possibility of such damages.

Both parties represent and warrant that neither the services, deliverables, end products nor the provision of information, processes, or other similar tools, techniques, and know-how in the development by either party of such services, deliverables or end products, nor their use, sale, re-sale or distribution by either party infringes any patent, copyright, trade secret, trademark, or other intellectual property rights of any third party. Hypoxico's liability, if any, for defective Goods, is limited to replacement, repair or refund of the defective Goods, at Hypoxico's option.

Any aforementioned warranties shall not apply to any service, deliverable or end product that has been altered or changed, improperly maintained, installed, operated, or used, abused, neglected or involved in negligence by Customer or its end-users after receipt.

Moreover, Hypoxico may recommend the installation of such product(s) by a third-party. HOWEVER, Hypoxico makes no warranties whatsoever of any type regarding the installation of such product(s) by such third-party installer. Any warranties to Customer must come direct from third-party installer, and Customer herein agrees to waive any and all claims and damages relating to installation by third-party installer of any type whatsoever.

The Definitions which forms part of Standard Construction Document - CCDC 2 - 2020 with Supplementary Conditions are hereby amended as follows:

PART 1 - DEFINITIONS

1.1. MODIFIED DEFINITIONS

1.1.1. Delete following definition in its entirety and substitute new definition:

“Consultant

The *Consultant* is the person or entity identified as such in the Agreement. The *Consultant* is Architecture Counsel Inc. The term *Consultant* means the *Consultant* or the *Consultant's* authorized representative. For greater certainty, BPA is the *Consultant's* authorized representative with respect to mechanical matters and BPA is the *Consultant's* authorized representative with respect to electrical matters.”

1.2. NEW DEFINITIONS

1.2.1. Add following new definitions:

“Cash Allowance Disbursement Authorization (CADA)

A *Cash Allowance Disbursement Authorization* is an authorization to the *Contractor* to expend monies from Cash Allowances included in the *Contract Price*.

Day

Day means a calendar day.

Install

Install means completion of following activities, including associated labour, services, plant, *Construction Equipment* required to:

- Remove *Products* from storage and locate for placement,
- Position and adjust *Products* for final placement,
- Affix and anchor *Products* in final placement, in accordance with manufacturers' instructions and *Contract Documents*,
- Commission and adjust *Products* for proper operation.

Make Good, Made Good, Making Good

- *Make Good, Made Good, Making Good* means repairing, restoring, refurbishing, rehabilitating, or performing filling operation on any existing components disturbed due to work of this *Contract*, to at least the condition existing at the commencement of the *Work*, in terms of construction integrity, finishes, alignment with existing adjoining surfaces, compatibility of materials, sound attenuation criteria, exfiltration/infiltration requirements, air/vapour barrier and thermal continuity.

Provide

Provide means to *Supply* and *Install*.

Submittals

Submittals are documents or items required by the *Contract Documents* to be provided by the *Contractor*, such as:

- *Shop Drawings*, samples, models, mock-ups to indicate details or characteristics, before the portion of the *Work* that they represent can be incorporated in the *Work*; and

- As-built drawings and manuals to provide instructions to the operation and maintenance of the *Work*.

Supply

Supply means completion of following activities, including associated labour, services, plant, *Construction Equipment* required to:

- Fabricate or purchase *Products*,
- Deliver *Products* to the *Place of the Work*,
- Unload *Products*,
- Store *Products* in accordance with manufacturers' instructions."

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

- 1.1.1. Read and conform to:
 - 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
 - 1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SPECIFICATION FORMAT

- 1.2.1. Specifications are addressed to Contractor. Specifications are not intended as detailed description of installation methods but serve to indicate particular requirements in completing the Work.
- 1.2.2. Where Contract Documents do not provide sufficient information for complete installation of item, then as supplement, comply with manufacturer's written instructions for quality of work.
- 1.2.3. Portions of Specifications are written in short form. Therefore, it shall be understood that where item of the Work is stated in heading followed by material, equipment, component, or operation, words "shall be", "shall consist of" or similar words or phrases are implied which denote supply, fabricate and supply, install, provide or commission of such materials, equipment or operations for component of the Work designated by heading.
- 1.2.4. Where items in Contract Documents are referred to in singular, provide as many as required to complete the Work. Words used in 1 gender only shall mean females as well as males and conversely.
- 1.2.5. Drawings, Lists or Schedules of Items are intended to show scope and arrangement of work. For location of item described refer to such Drawings, Lists or Schedules unless location stipulated in Specifications.

1.3. DISCREPANCIES/CONFLICTS/OMISSIONS

- 1.3.1. If discrepancies or conflicts in, or omissions from Drawings, Specifications or other Contract Documents are suspected, or if there is doubt as to meaning or intent thereof, notify Consultant at once. Where there is conflict between Contract Documents, the most stringent requirement shall prevail.
- 1.3.2. Drawings, Specifications and other Contract Documents are intended to be in compliance with federal, provincial and municipal laws, by-laws, regulations and other requirements of authorities having jurisdiction. Perform work in conformity with such requirements. If discrepancies, conflicts or omissions are suspected, notify Consultant at once.
- 1.3.3. Comply with Consultant's written instructions or explanations. Consultant has final say when interpreting the Contract Documents, Building Inspector or authority having jurisdiction is not considered final say.
- 1.3.4. Promptly and not later than within 10 Working Days of becoming aware of circumstances which may require a change in the Work or other directions, give written notice to Consultant outlining such circumstances and request written instructions. Do no work in affected area, or that would prevent Consultant from properly assessing situation or evaluating change, without its prior written instructions. Consultant will act promptly to give Contractor instructions so the Work is not unreasonably delayed.

1.4. DESCRIPTION OF THE WORK

- 1.4.1. Work of this Contract includes supplying labour, materials, equipment, services and other related expenses to execute complete construction of facility specified under Contract Documents.
- 1.4.2. Term "NIC" means Work of this Project which is not being performed or provided under this Contract; term means "Not In this Contract" or "Not a Part of the Work to be Performed or Provided by Contractor".

- 1.4.3. "NIC" work may be specified or indicated on Drawings as an aid to Contractor in scheduling amount of time and materials necessary for completion of Contract.

1.5. SCHEDULING

- 1.5.1. Base sequence and scheduling of construction on maintaining continuous operation and access to the Work during construction.
- 1.5.2. Phase construction as described herein. Notify Owner in writing 7 Days prior to beginning work in an occupied area. Owner will accommodate request within 7 Days of notification. Co-ordination with authority at the Place of the Work is crucial. Submit a progress schedule before commencement of the Work. Coordinate any suggested changes to schedule with Owner. Ensure schedule includes adequate time for Product delivery and Shop Drawing preparation, review and resubmission.
- 1.5.3. Allow for un-scheduled interruption to schedule of the Work and suspend parts of the Work affected to permit Owner to relocate furniture and equipment from Place of the Work, into finished spaces. Owner will coordinate this interruption.

1.6. PHASING OF PROJECT

- 1.6.1. Project is divided into 3 distinct phases. Coordinate phasing with Owner.

1.7. COMPLETION DEADLINES

- 1.7.1. Phase and schedule the Work to meet deadlines originally committed to by Contractor.

1.8. INTERRUPTIONS IN THE WORK SCHEDULE

- 1.8.1. Suspend parts of the Work affected as required to allow Consultant to review mock-ups and to establish standards of workmanship for remainder of Work. Provide 2 Working Days notice.

1.9. OWNER OCCUPANCY

- 1.9.1. Owner reserves right to occupy and use portions of premises, whether partially or entirely completed, or whether completed on schedule or not, provided such occupancy does not interfere with Contractor's continuing work. Provide required safety protection at fire exits at all times.
- 1.9.2. Partial occupancy or installation of equipment by Owner does not imply acceptance of the Work in whole, or in part, nor shall it imply acknowledgment that terms of Contract are fulfilled.
- 1.9.3. Owner intends to Supply and Install following items:
- 1.9.3.1. Garbage and recycling stations.
- 1.9.3.2. Branding and signage.
- 1.9.3.3. New furniture.
- 1.9.3.4. Relocate existing furniture and equipment.

1.10. PLACE OF THE WORK

- 1.10.1. Confine extent of construction activities to area indicated on Drawings as Place of the Work and/or within area defined by property lines. Confine equipment, materials, debris, offices, storage sheds and storage areas to area previously defined.
- 1.10.2. Contractor has complete and exclusive use of Place of the Work for performance of the Work except for full access to Mechanical Room at all times. Assume responsibility for premises assigned, for performance of the Work.
- 1.10.3. Should Contractor require boundaries of Place of the Work be temporarily extended, obtain instructions from Consultant.

1.10.4. Certain restrictions are specified as to use by Contractor of various portions of Place of the Work. Become familiar with these restrictions and establish work plan to accommodate these restrictions. No claims for extra costs due to such restrictions will be considered by Owner.

1.10.5. Assume responsibility for care, custody and control of property which is assigned for performance of the Work. Assume responsibility for and Make Good damage to existing property attributable to performance of the Work.

1.11. DEMOLITION, SECURITY AND ACCESS

1.11.1. Coordinate demolition times, security requirements and access with Owner.

1.12. SITE DIMENSIONS

1.12.1. Before proceeding with Shop Drawings, fabrication, or supply of each new part of the Work, examine installed parts of the Work and verify as-built site dimensions to coordinate previously built construction with pending construction.

1.13. EXISTING AREAS AND WORK OF OTHER CONTRACTORS

1.13.1. Commencement of parts of the Work, in existing areas and in areas provided by Other Contractors, will be deemed to signify Contractor's acknowledgment and acceptance of those parts of the Work.

1.13.2. Immediately report defects, which affect quality and performance of the Work, in writing to Consultant.

1.13.3. Existing premises will remain occupied during the Work. Execute the Work to cause minimum interference with activities in existing premises and maintain maximum safety to occupants. Take reasonable measures to minimize and control noise, dirt and dust during the Work.

1.13.4. Before entering existing premises to carry out the Work or to obstruct or take out of use any area of existing premises, or to cause any other interference, request meeting with Consultant in order to reach agreement as to time and length of time you may interfere, possess, obstruct or remove from use any such area or services.

1.13.5. Maintain temporary entrances to building(s) including enclosed hoardings as required. Maintain access to existing service entrance(s) at all times, including ready access for fuel oil trucks and delivery vehicles. Bridge excavations with construction to safely support any load that could be imposed or provide personnel to assist in deliveries to building(s) as required.

1.13.6. Contractor must use following base building contractors:

1.13.6.1. PA System:

CP-Stoneman Inc.
3300 Highway 7, Suite 600
Vaughan, Ontario L4K 4T2
Telephone: (844) 277-4800
Attention: Tarek Marroushi; tarekm@cp-stoneman.com

1.13.6.2. AV/IT Cabling:

Advanced Construction Industries Ltd.
1730 McPherson Ct., Unit #28
Pickering, Ontario L1W 3E6
Telephone: (905) 421-8888
Mobile: (416) 725-4574

1.13.6.3. Fire Alarm System:

Siemens Canada Limited SI B
1577 North Service Road East
Oakville ON, L6H 0H6

Mobile: 416-617-3786
Attention: Gerry Thibeault; Gerry.thibeault@siemens.com

1.13.6.4. BAS System:

Johnson Controls
Toronto HVAC Branch
56 Leek Crescent, Richmond Hill

Mobile: 416-738-7190
Attention: Jeff Kay; jeff.james.kay@jci.com

1.14. SIGNS, ADVERTISING AND PUBLICATIONS

1.14.1. Do not erect or display devices, signs or advertisements of labour, materials or services provided to the Work. Signs relative to fire, danger and safety are exempted from this requirement.

1.14.2. Do not permit Subcontractors to display any advertising of their Work, of any kind, without Owner's written acceptance. Do not consent to mentioning the Work in any advertising or articles in any publication relating to the Work without approval of copy and written permission from Owner.

1.15. PROCEDURE AND SUPPLY OF CRITICAL MATERIALS

1.15.1. Supply Products in ample time to be installed into the Work together with templates, measurements and other information required for placement.

1.16. RESTRICTIONS

1.16.1. Confine the Work to the Work site limits indicated on Drawings and/or within area defined by property lines. Carry out Work on Municipal property under regulations of respective Municipality and authorities having jurisdiction including without any limitations any associated fees, permits, insurance or bonding required.

1.16.2. Bring following restrictions to attention of workers on the Work and enforce them:

1.16.2.1. Restrict construction personnel to Place of the Work and necessary access routes to it. Restrict non-construction personnel from site, except for Contractor-authorized visitors.

1.16.2.2. Noisy and disruptive work may require off hours scheduling and shall be coordinated with Owner.

1.16.2.3. Perform the Work between hours of 7:30 a.m. and 7:00 p.m., Monday to Friday. Obtain prior written approval to do work on other Days and times.

1.16.2.4. Execute the Work taking into consideration movement of occupants.

1.17. EXISTING SITE SERVICES

1.17.1. Before commencing the Work, establish location and extent of existing services in area of the Work and notify Consultant of findings.

1.17.2. Consult public and service companies' records and become fully informed of locations and extent of buried and overhead services and utilities.

1.17.3. If disruption of services which affects operation of existing building is necessary, give minimum 5 Working Days notice to Consultant and Owner. Provide temporary services and obtain prior

review from Consultant and Owner with regard to timing and methods for providing temporary services.

- 1.17.4. Should any piping, sewers, cables, or similar services be encountered during work of this Contract that are not known from Owner's and utility companies' records, notify Consultant and do not proceed with removal or cutting until directed.

1.18. TEMPORARY SHUTDOWNS OF CONSTRUCTION OPERATIONS

- 1.18.1. Contractors and Subcontractors shall be aware at all times that ongoing functions and activities of existing facility will continue. Owner may at any given time request that any work of Contract be temporarily ceased.
- 1.18.2. Temporary reasonable shutdowns and interference are for emergency and/or sensitive health and security reasons and they shall not be construed as cause of elimination or restriction of Contractor's Working Schedule, claims for delay of Work, nor additional costs.
- 1.18.3. Contract Price shall include and allow for such temporary shutdowns.

1.19. NO SMOKING POLICY

- 1.19.1. Cooperate, respect and comply with Smoke Free Workplace policy requirements of Place of the Work. This policy applies to everyone who visits and works on this Project.
- 1.19.2. Ensure Contractor's staff, Subcontractors and Suppliers performing work on site on Contractor's behalf are instructed to comply with Smoke Free Workplace policy requirements.

ACOUSTIC PARTITIONS/CEILINGS

- 1.19.3. Partitions and/or ceilings with sound attenuation insulation are designated as "Acoustic Partitions and Ceilings". Provide sound rated partitions and ceilings in locations indicated to meet required minimum Sound Transmission Class (STC) ratings. If not stated otherwise, STC rating is 47.
- 1.19.4. Coordinate work of various Subcontractors to avoid "short circuiting" of the STC rating for "Acoustic Partitions and Ceilings". Carefully locate and treat ducts, grilles, diffusers, electrical outlets, boxes and other similar mechanical and electrical devices. Where electrical boxes are situated back-to-back serving each side of the partitions, locate them at least 250 mm (10") apart laterally and if interconnected, use flexible connections.
- 1.19.5. Ensure to seal around cutouts for lights, cabinets, pipes, ducts, electrical boxes and other similar items. Avoid back-to-back penetrations of the diaphragm, flanking paths and door/ borrowed light openings. Refer to Section 09 21 16 for additional requirements.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

- 1.1.1. Read and conform to:
 - 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
 - 1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. REFERENCES

- 1.2.1. Abbreviations and Acronyms:
 - 1.2.1.1. CD: Change Directive.
 - 1.2.1.2. CO: Change Order.
 - 1.2.1.3. PC: Proposed Change.
 - 1.2.1.4. VAT: Value Added Taxes.

1.3. CASH ALLOWANCES

- 1.3.1. Disbursements from Cash Allowances are intended for work not shown or described in the Bid Documents shall be authorized by Consultant in writing, as applicable.
- 1.3.2. Extend to Owner refunds, trade and quantity discounts which may be received in purchasing under Cash Allowances, except cash discounts for prompt payment.
- 1.3.3. In submitting final adjustments of Cash Allowances, include duplicate, summary statements and copies of receipted invoices substantiating purchases under Cash Allowances.
- 1.3.4. Cash Allowance No. 1: For provision of AV/IT cabling.
- 1.3.5. Cash Allowance No. 2: For provision of PA System.
- 1.3.6. Cash Allowance No. 3: For provision of interior signage.
- 1.3.7. Cash Allowance No. 4: For relocation of Owner's FFE.
- 1.3.8. Cash Allowance No. 5: For provision of Access Control
- 1.3.9. Cash Allowance No. 6: For provision of CCTV

1.4. TOTAL OF CASH ALLOWANCES

- 1.4.1. Total of cash allowances \$122,000.00

1.5. CASH FLOW SCHEDULE

- 1.5.1. Prior to commencement of the Work, submit a detailed cash flow projection schedule indicating anticipated billings on a month-by-month basis for duration of the Work, including timing of holdback release.
- 1.5.2. Update cash flow schedule monthly, recording cumulative as well as monthly totals.

1.6. PROGRESS BILLING BREAKDOWN

- 1.6.1. Prior to commencement of the Work, submit a detailed progress billing breakdown for Consultant's review.
- 1.6.2. Ensure progress billing breakdown includes itemized values, (each excluding VAT), applied against each of following:
 - 1.6.2.1. mobilization.
 - 1.6.2.2. supervision.
 - 1.6.2.3. bonds.

- 1.6.2.4. insurance.
- 1.6.2.5. commissioning/training.
- 1.6.2.6. Cash Allowance amount.
- 1.6.2.7. each Section of Specifications (Divisions 2 - 49 inclusive).
- 1.6.2.8. as-built Drawings broken down by disciplines (\$10,000.00).
- 1.6.2.9. approved Change Orders in writing by Owner and Contractor.

1.7. UNIT PRICES

- 1.7.1. Ensure unit prices include labour, materials, Products, equipment, services and respective overhead, profit (excluding VAT), disbursements and related charges and represent actual addition for extra Work or credit for deleted Work, to Contract Price.

1.8. CHANGES IN THE WORK DUE TO A SUPPLEMENTAL INSTRUCTION

- 1.8.1. Supplemental Instruction does not include any change in Contract Price nor in Contract Time. Formally notify Consultant in writing within 10 Days that a Supplemental Instruction requires an amendment in Contract Price and/or Contract Time. Consultant may issue a PC for processing, or if notification has not been received within 10 Days, it is understood there are no anticipated changes in Contract Price and/or Contract Time.

1.9. CONTRACT MODIFICATION PROCEDURES

- 1.9.1. Further to GC 6.1 of the General Conditions of the Contract, promptly and not later than 10 Working Days after becoming aware of circumstances which may require a change in Work or other directions, give written notice to Consultant outlining such circumstances and requesting proposed change. Do no work in affected area, or that would prevent Consultant from properly evaluating circumstances and proposed change, without obtaining written direction. Consultant will act promptly to give Contractor direction so the Work is not unreasonably delayed.
- 1.9.2. Advise Consultant in writing of any contradictions, discrepancies, omissions or errors discovered or revealed. Do not proceed before obtaining clarifications and directions from Consultant in writing. Failure to follow this results in Contractor assuming full responsibility for resulting circumstances and costs.

1.10. CHANGE ORDER AND CHANGE DIRECTIVE

- 1.10.1. Any variation in the Contract involving a change in total amount of Contract Price or in Contract Time shall be initiated through Consultant in form of a PC describing work proposed under variation and requesting a quotation from Contractor.
- 1.10.2. PCs or CDs will be issued electronically as PDF. Additional copies of these documents, including referenced Drawings and Schedules, are provided by Contractor. Issuance of electronic Drawing files (Revit, AutoCAD, etc.) with a PC, CD and CO are at Contractor's cost.
- 1.10.3. Immediately inform relevant Subcontractors and Suppliers of proposed change.
- 1.10.4. Upon receipt of a PC or CD and where specifically directed by Consultant, suspend work affected by proposed change until a CO is issued, or until PC or CD is cancelled.
- 1.10.5. Upon receipt of a CD, begin work described therein as soon as possible and prepare a quotation for the Work.
- 1.10.6. Return 1 copy of PC or CD with a quotation for the Work.
- 1.10.7. Include work described in PC or CD and other work caused, however incidental it may be, by proposed change. Once CO is issued by Owner, no further claims for extra costs or time extensions will be accepted.
- 1.10.8. If quotation received is unreasonable, Consultant will reject quotation and request revised quotation from Contractor.

- 1.10.9. When Consultant deems quotation reasonable, it will prepare a CO.
- 1.10.10. Value of changes in the Work are determined and processed in accordance with General Conditions of the Contract.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. PROJECT COORDINATION

1.2.1. Study Contract Documents to determine extent of work required by each Section and upon which work of other Sections depend and coordinate scope and extent of work to be performed by each trade. Neither organization of Specifications into Divisions and 3-part Section format nor arrangements of Drawings, Schedules and Standard Drawings shall affect in any way Contractor's control in, or diminish its responsibility for, dividing Work or establishing each trade's scope of work. Claims for additional compensation arising from disputes between trades due to lack of coordination by Contractor will not be considered.

1.2.2. Coordinate work of each Section as required for satisfactory and expeditious completion of Work. Take field dimensions required. Take into account existing installations to assure best arrangements of components in available space. Consult before commencing Work in critical locations. Fabricate and erect Work to suit field dimensions and field conditions.

1.2.3. Provide forms, templates, anchors, sleeves, inserts and accessories or other components required to be fixed to or inserted in Work. As applicable set them in place or instruct related Sections as to their location.

1.2.4. Pay cost of extra work caused by and make up time lost as result of failure to comply with these requirements at proper time.

1.2.5. Coordinate work of all trades including construction sequence, schedule and interfacing of all work. Coordinate work as required to incorporate metric modular components. Coordinate work of each trade as required for satisfactory and expeditious completion of Work. Ensure components to be built in are supplied in time with setting drawings and other related information. Fabricate and erect Work to suit field dimensions and field conditions.

1.2.6. Ensure Contract Documents are fully coordinated with respect to architectural, structural, mechanical, electrical and other specialty requirements.

1.2.7. Cooperate and coordinate with Consultant for moving Owner's equipment into building when Work or substantial part thereof is ready for use for purpose intended.

1.3. DOCUMENTS AT THE SITE

1.3.1. Maintain in good condition and order on site 1 copy of Addenda, proposed changes in Work, Change Orders, approved set of Permit and Contract Drawings (if they are not the same set), test reports, manufacturer's installation and application instructions, progress photographs, as-built drawings, reviewed progress schedules, minutes of site meetings and other modifications to Contract Documents. Ensure Building Permit is posted on site.

1.4. START-UP MEETING

1.4.1. Presided over by Consultant, after award of Contract.

1.4.2. Attendees:

1.4.2.1. Consultant(s).

1.4.2.2. Contractor.

1.4.2.3. Contractor's Superintendent.

1.4.2.4. Subcontractors (Mechanical, Electrical).

- 1.4.2.5. Major Equipment Suppliers.
- 1.4.2.6. Others as appropriate.
- 1.4.3. Contractor shall prepare minutes. Contractor will distribute minutes to each participant within 5 Working Days.
- 1.4.4. Minimum Agenda:
 - 1.4.4.1. List of major Subcontractors and Suppliers.
 - 1.4.4.2. Tentative construction progress schedules.
 - 1.4.4.3. Start date; submission of schedules; long term delivery items.
 - 1.4.4.4. Insurance Certificates, Cash Flow Schedule, Construction Schedule, Shop Drawing submission schedule, bonds including Value Added Taxes, Trade Breakdown including value for Close Out, Workplace and Safety & Insurance Board Clearance Certificate, Project Sign.
 - 1.4.4.5. Critical work sequencing.
 - 1.4.4.6. Major equipment and Product deliveries and priorities.
 - 1.4.4.7. Designation of responsible personnel.
 - 1.4.4.8. Building Permit status.
 - 1.4.4.9. Procedures for maintaining record documents.
 - 1.4.4.10. Use of Premises: Office, keys, work and storage areas; Owner's requirements (storage delivery, path of construction activities, vehicle, by foot, carts, exterior and interior, elevator use, washrooms, bin location).
 - 1.4.4.11. Construction facilities, controls, temporary hoarding, dust partitions, parking, hours, noisy work, interruption of services, smoking, cell phone usage and construction aids.
 - 1.4.4.12. Construction scheduling (particularly drying time for concrete slabs).
 - 1.4.4.13. Temporary utilities.
 - 1.4.4.14. Safety and first-aid procedures.
 - 1.4.4.15. Security procedures.
 - 1.4.4.16. Housekeeping procedures.

1.5. SITE COORDINATION AND PROGRESS MEETINGS

- 1.5.1. Conduct site meetings at regular intervals (every 2 weeks), to identify and resolve construction coordination items, record minutes including significant proceedings and decisions and identify "action by" parties; and reproduce and distribute to meeting participants, copies of minutes within 3 Working Days after each meeting. Consultant also reserves right to call additional special emergency site meetings on short notice without any cost to Owner.
- 1.5.2. Attendees:
 - 1.5.2.1. Contractor's project manager and site superintendent.
 - 1.5.2.2. Mechanical and Electrical Subcontractors.
 - 1.5.2.3. Subcontractors invited by Contractor.
 - 1.5.2.4. Owner and/or Consultant(s).
- 1.5.3. Chair: Contractor.
- 1.5.4. Include following:
 - 1.5.4.1. Prepare agenda for meetings.

- 1.5.4.2. Distribute written notice of each meeting minimum 7 Days in advance of meeting date, stating time and place, to persons whose presence is required.
- 1.5.4.3. Make physical arrangements for meetings.
- 1.5.4.4. Record minutes and attendees; include significant proceedings and decisions.
- 1.5.4.5. Reproduce and distribute copies of minutes after each meeting to parties attending meeting, to parties affected by decisions made at meeting and to Consultant.
- 1.5.4.6. Ensure representatives of Contractor, Contractor's consultants, Subcontractors and Suppliers attending meetings are qualified and authorized to act on behalf of entity each represents.
- 1.5.4.7. Ensure relative information is available to allow meetings to be conducted efficiently.
- 1.5.4.8. Consultant may attend meetings to ascertain Work is consistent with Contract.
- 1.5.4.9. Documents and Construction Progress Schedule.
- 1.5.4.10. Construction Progress Schedule may be reviewed to ensure rapid and efficient completion of Work in accordance with Contract requirements. Keep Consultant informed of progress, of delays and of potential delays during all stages of Work.
- 1.5.4.11. Review, approval or correction of minutes of previous meeting.
- 1.5.4.12. Review of work progress since previous meeting.
- 1.5.4.13. Field observations, problems, conflicts.
- 1.5.4.14. Problems which impede Construction Progress Schedule.
- 1.5.4.15. Review of off-site fabrication, delivery schedules.
- 1.5.4.16. Review of submittals schedules including Shop Drawings logs.
- 1.5.4.17. Review of mock-up and sample installation requirements and schedules.
- 1.5.4.18. Corrective measures and procedures to regain projected schedules.
- 1.5.4.19. Quality standards.
- 1.5.4.20. Pending changes and substitutions.
- 1.5.4.21. Safety and manforce issues.
- 1.5.4.22. Other business.

1.6. PREINSTALLATION TRADE MEETINGS

- 1.6.1. If a trade requires a meeting prior to starting work, arrange for such meeting of all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, include Subcontractor performing work of trade involved, Testing Company's Representative and Contractor's consultants of applicable discipline. Review Contract Documents for work included under trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of concrete placement and other matters affecting construction, to permit compliance with intent of trade under consideration.

1.7. SCHEDULE OF THE WORK

- 1.7.1. Submit a detailed "Gantt Chart" or "Critical Path Method" construction schedule with activities itemized to enable Contractor and Consultant to monitor progress of the Work.
- 1.7.2. Schedule shall indicate without limitations dates for:
 - 1.7.2.1. erection and dismantling of temporary facilities.
 - 1.7.2.2. submission of Shop Drawings for various divisions of Work.

- 1.7.2.3. submission of Mechanical and Electrical trades coordination and interference drawings.
- 1.7.2.4. submission of samples and installation dates for mock-ups and sample installations.
- 1.7.2.5. commencement and completion of each major division of Work, including work to be done by Subcontractors.
- 1.7.2.6. critical work sequencing.
- 1.7.2.7. drying time for concrete slabs to allow for placement of moisture sensitive floor coverings.
- 1.7.2.8. major equipment deliveries and priorities.
- 1.7.2.9. weather allowance.
- 1.7.2.10. final completion date.

- 1.7.3. Update and resubmit schedule on a monthly basis.

1.8. SHORT TERM SCHEDULE

- 1.8.1. On a bi-weekly basis, provide Owner with a 2 week short term schedule based on above schedule, indicating important construction activities as the Owner and Consultant may see suitable for Project requirements.

1.9. PERSONNEL APPOINTMENT

- 1.9.1. Appoint a senior member of staff, with full authority to commit Contractor to methods and schedules for construction, to participate actively in administration functions including by not limited to SD reviews, meeting minutes, administration and maintenance of detailed construction schedule. Provide necessary information on progress of the Work to enable a status report to be produced every 2 weeks.
- 1.9.2. Superintendent: In addition to above, provide a full time qualified, skillful and efficient site superintendent having minimum 5 years' experience on Projects of comparable type and complexity. Ensure he/she represents and has full charge of operation of Contractor in performance of the Work and is authorized to accept any notice, consent, order, decision or other communication on behalf of Contractor.

1.10. GENERAL REVIEW

- 1.10.1. Consultant shall conduct periodic field review to review the Work for general conformance with Contract Documents, Code(s) and authorities having jurisdiction.
- 1.10.2. Review includes review of Shop Drawings, review of field work and review of reports produced by various inspection and testing agencies.
- 1.10.3. Record each review in manner suitable for submission to Consultant at completion of Project along with inspection and testing reports at site meetings every second week.

1.11. PRODUCT SUBSTITUTION PROPOSALS

- 1.11.1. After award of Construction Contract, Product substitution proposals will not be reviewed except in cases where written proof from Product manufacturer/distributor has been submitted to verify specified Products:
 - 1.11.1.1. are unavailable (providing reasons why).
 - 1.11.1.2. were ordered in advance and in accordance with manufacturer's recommendations for lead time but timely delivery of specified Products is not possible in order to maintain construction schedule.
- 1.11.2. Submit following for each Product substitution proposal:
 - 1.11.2.1. fully detailed and clear description of Products, systems and assemblies proposed with a complete comparison made against original Products, systems and assemblies.
 - 1.11.2.2. Shop Drawings, including full details.

- 1.11.2.3. technical Product data indicating substituted Product is equal or exceeds specified Product's performance.
- 1.11.2.4. samples.
- 1.11.2.5. on site mock-up for review by Consultant prior to no objections being recorded against the substitution.
- 1.11.2.6. difference in price, if any, in form of certified quotations of both selected and proposed substitutions.
- 1.11.3. Submit Contractor's written review with no objections recorded for use of substituted Products and certification substituted Products:
 - 1.11.3.1. will not exceed space requirements allocated for originally specified Products or, if they do, Contractor is including with substitution submission, design drawings, to accommodate substituted Product.
 - 1.11.3.2. are compatible with and inert to adjacent materials.
 - 1.11.3.3. will not affect Project schedule due to delays in delivery and installation.
 - 1.11.3.4. have been priced to include design adjustments required to accommodate substituted Products.
- 1.11.4. Proposed substitutions require Consultant's review with no objections recorded and, if there is a difference in price, extra or credit requires Owner's acceptance.
- 1.11.5. Review with no objections recorded against proposed substitution by Consultant/Owner does not relieve Contractor of his responsibility and cost for any effect proposed substitution has on other Products, systems and/or assemblies.

1.12. CERTIFICATES AND TRANSCRIPTS

- 1.12.1. Immediately after receiving notification of award of Contract, submit Workplace Safety & Insurance Certificate status, transcription of insurances and other certificates and transcripts required by Contract Documents or Consultant.

1.13. CONTRACTOR'S PERSONNEL AND SUBCONTRACTORS

- 1.13.1. Submit complete list of Contractor's Subcontractors with addresses, phone numbers and personnel along with Contractor's list of personnel.

1.14. SUBMITTAL PROCEDURES

- 1.14.1. Submit to Consultant and authorities having jurisdiction as required, documents listed to be submitted for review. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time or extra costs and no claim for extension of Contract Time or increase to Contract Price by reason of such default will be allowed. Obtain final approval of authorities having jurisdiction, where required, prior to submitting Shop Drawing or other documentation to Consultant.
- 1.14.2. Prior to submission to Consultant, Contractor shall review submittals. Submittals not stamped, signed, dated and identified as to specific Project will be returned without being examined and considered rejected. Verify field measurements and ensure affected adjacent Work is coordinated. Confirm and correlate information pertaining to fabrication processes, quantities, techniques of construction and installation and similar information.

1.15. REQUEST FOR INFORMATION (RFI)

- 1.15.1. RFI is a formal process used to request an interpretation to information already provided in Contract Documents from Consultant during the Work.

- 1.15.2. RFI is not used to expand Contract between Owner and Contractor or to add any additional work resulting in an increase in Contract Price or Contract Time. It is only for routine interpretation of Contract Documents.
- 1.15.3. Where RFI form does not provide sufficient space for complete information to be provided thereon, attach additional sheets as required.
- 1.15.4. Submit necessary supporting information with RFI form.
- 1.15.5. RFI Log: Maintain tracking log of RFIs sent to and responses received from Consultant complete with corresponding dates.
- 1.15.6. Submit RFIs sufficiently in advance of affected parts of the Work so not to cause a delay in the Work. Any costs resulting from failure to do this will not be paid by Owner.
- 1.15.7. Submit RFIs to Consultant only.
- 1.15.8. Number RFIs consecutively in 1 sequence in order submitted.
- 1.15.9. Consultant requires 7 Working Days for review of RFI from time of Consultant's receipt to time of Consultant's return to Contractor. Contractor will establish a steady flow of RFIs for review and avoid accumulation of an excessive quantity of RFIs in a single submission.
- 1.15.10. A graphic response (ie, sketch, etc.) may be issued and Consultant will deem whether this information is required in the Record Documents.
- 1.15.11. Consultant's response (graphic or written) is not considered a Change Order or Change Directive, nor does it authorize changes in the Contract Price or Contract Time or changes in the Work.
- 1.15.12. Undertake a thorough review of Contract Documents to satisfy a claim, dispute or other matters in question relating to performance of the Work or interpretation of Contract Documents cannot be resolved by direct reference to Contract Documents. Describe in detail this review on RFI form as part of RFI submission. RFIs lacking such detailed review description or where detail provided is in opinion of Consultant insufficient, Consultant will not review RFI and reject it.
- 1.15.13. Consultant may determine certain RFIs issued by Contractor are unnecessary and in responding to such unnecessary RFIs, give reasons for the determination in each case.
- 1.15.14. Any request for information from a Contractor will be deemed to be a Request for Information and is subject to the provisions of this Article.

1.16. SHOP DRAWINGS

- 1.16.1. Shop Drawing Schedule: Submit a Shop Drawing schedule in accordance with GC 3.8.
- 1.16.2. Fabrication: Do not fabricate until Shop Drawings are indicated as "REVIEWED" or "REVIEWED AS NOTED".
- 1.16.3. Consultant's Shop Drawing Review:
 - 1.16.3.1. Consultant's review of Shop Drawings is for sole purpose of ascertaining conformance with general design concept.
 - 1.16.3.2. Consultant's review does not provide approval of items which remain Contractor's responsibility.
 - 1.16.3.3. Without limitation, among other things, Contractor remains responsible for:
 - 1.16.3.3.1. detail design inherent in Shop Drawings.
 - 1.16.3.3.2. errors and omissions in Shop Drawings.
 - 1.16.3.3.3. meeting requirements of Contract Documents.
 - 1.16.3.3.4. confirmed and correlated site dimensions.
 - 1.16.3.3.5. information that pertains solely to fabrication processes, techniques of construction and installation.

- 1.16.3.3.6. co-ordination of work of all trades.
- 1.16.4. Shop Drawing Requirements:
 - 1.16.4.1. Indicate following minimum requirements as applicable:
 - 1.16.4.1.1. metric system only.
 - 1.16.4.1.2. plans, sections and details.
 - 1.16.4.1.3. verified site dimensions.
 - 1.16.4.1.4. materials thicknesses and finishes.
 - 1.16.4.1.5. methods of setting and sealing.
 - 1.16.4.1.6. methods of securing, fastening and anchoring including field connections.
 - 1.16.4.1.7. signed and sealed Shop Drawings and calculations where specifically required herein.
 - 1.16.4.2. Do not make Product substitutions on Shop Drawings without Consultant's written permission in accordance with Product substitution proposal process or they will be rejected. Replace rejected Product substitutions and complete Work in accordance with Contract Documents.
 - 1.16.4.3. Determine which Shop Drawings the local Building Department will require for its approval and submit 2 final copies of each Shop Drawing to local Building Department. Obtain approval and pay associated charges and fees.
- 1.16.5. Shop Drawing Procedures:
 - 1.16.5.1. Execute following prior to submitting Shop Drawings to Consultant:
 - 1.16.5.1.1. review, check and mark-up Shop Drawings with comments and revisions and re-direct back to Subcontractor ("REVISE AND RESUBMIT", etc.) in the first instance if required prior to forwarding to Consultant.
 - 1.16.5.1.2. stamp each Shop Drawing with Shop Drawing stamp.
 - 1.16.5.1.3. insert applicable Specification Section reference, e.g. "10 28 00" for Section 10 28 00, Washroom Accessories.
 - 1.16.5.1.4. insert next consecutive Shop Drawing number within that Section, e.g. "002" for second Drawing within Section 10 28 00.
 - 1.16.5.1.5. insert Contractor's review date and signature of Contractor's reviewer.
 - 1.16.5.2. Submit following for Consultant's review:
 - 1.16.5.2.1. 1 digital copy of each stamped Shop Drawing (legible PDF under 10 mB per transfer).
 - 1.16.5.2.2. If catalogue cuts are permitted by Consultant, submit a digital copy of catalogue cuts for review as agreed to.
 - 1.16.5.3. Reproductions of Consultant's Contract Documents are not permitted as Shop Drawings.
 - 1.16.5.4. Shop Drawings not conforming to above criteria will be automatically returned without review. Any resulting delays will be Contractor's responsibility.
 - 1.16.5.5. Shop Drawings submitted without specified licensed engineer's design and stamp will be automatically returned without review. Any resulting delays will be Contractor's responsibility.
 - 1.16.5.6. Do not resubmit Shop Drawings indicated as "REVIEWED" and "REVIEWED AS NOTED".
 - 1.16.5.7. Resubmit Shop Drawings indicated as "REVISE AND RESUBMIT" with required changes and comments addressed. Insert letter "R" after Shop Drawing number on resubmitted Shop Drawings, re-date and re-sign. Identify revisions from earlier submissions graphically on revised Shop Drawings.

1.16.5.8. Consultant requires 14 Days for review of Shop Drawings from time of Consultant's receipt to time of Consultant's return to Contractor. Contractor will establish a steady flow of Shop Drawings for review and avoid accumulation of an excessive quantity of Shop Drawings in a single submission.

1.16.5.9. Provide Shop Drawings required by Contract Documents.

1.17. INTERFERENCE DRAWINGS

1.17.1. Prepare drawings indicating relationship of new and existing and/or unforeseen conditions at congested areas prior to commencement of work in area.

1.17.2. For congested locations, before commencing installation, prepare drawings showing relationship of ductwork, conduit, piping, sprinklers, ceiling supports and framing, communication and specialized equipment located within ceiling and shaft spaces.

1.17.3. Indicate locations of visible items such as air handling outlets, light fixtures, smoke detectors, sprinkler heads, communication grilles and access panels occurring at these locations.

1.17.4. Ensure interference drawings are initialed by a responsible person of each Subcontractor involved along with Contractor's signature and submitted to Consultant for review and record purposes.

1.18. SAMPLES

1.18.1. Prior to fabrication or supply of Products, submit samples for Consultant's review. Remove and discard Products whose samples have not been reviewed by Consultant.

1.18.2. Deliver samples to Consultant as directed with charges prepaid and allow for 1 of samples to be kept by Consultant.

1.18.3. Unless otherwise specified, submit samples in duplicate.

1.18.4. Identify each sample with:

1.18.4.1. Project name and Project number.

1.18.4.2. date of sample submission.

1.18.4.3. component name using the Specification's terminology.

1.18.4.4. material (including alloy).

1.18.4.5. finish including colour, sheen, texture, grain and if needed, a Drawing showing proposed grain direction.

1.18.4.6. dimensions including thickness.

1.18.5. Exhibit each of following for each sample:

1.18.5.1. materials.

1.18.5.2. finishes:

1.18.5.2.1. material.

1.18.5.2.2. colour including maximum colour range within each specified colour.

1.18.5.2.3. sheen, tone.

1.18.5.2.4. texture.

1.18.5.2.5. range of blemishes and other markings.

1.18.6. Alter, refinish or provide additional samples until they are reviewed with no objections recorded by Consultant.

1.18.7. Fabricate samples using same tools and techniques to be employed in actual installation of the Work.

- 1.18.8. Provide Products in the Work which are identical to reviewed samples.
- 1.18.9. Provide samples required by Contract Documents.

1.19. ACCESS PANELS AND ACCESS DOORS

- 1.19.1. Before commencing installation of mechanical and electrical work, prepare, together with mechanical and electrical Subcontractors, on a set of Drawings provided for that purpose, a complete lay-out of all access panels and access doors which will be required. Submit these layouts for review as specified for Shop Drawings and show exact sizes and locations of access panels and doors. Revisions may be required to lay-out before final review. Allow Consultant to revise layout or quantity of access doors and panels, by relocating related building services a maximum of 2000 mm (6' - 7") at no extra cost to Owner. Should relocation exceed this measurement then Contract Price will be adjusted in accordance with provisions for changes in Contract Documents.
- 1.19.2. Finish access panels and doors to match adjacent wall and/or ceiling finish unless otherwise specified or indicated.

1.20. COLOURS

- 1.20.1. Colour and gloss value selection by Consultant. Obtain direction on colour and gloss value in advance of need. If requested, submit samples for colour and gloss selection. Follow colour schedule provided by Consultant and use colours and gloss designated.

1.21. RECORD DRAWINGS AND SPECIFICATIONS

- 1.21.1. Keep 1 set of Drawing prints and Specifications on site for use in maintaining record information. Ensure these Drawings and Specifications are kept on site at all times available for review by authorities having jurisdiction, Owner and/or Consultant at any given time.
- 1.21.2. Accurately and neatly record deviations from Contract Documents, concealed work caused by site conditions.
- 1.21.3. Record information concurrently with construction progress. Do not conceal actual work until required information is recorded.
- 1.21.4. Legibly indicate each item to record actual construction including:
 - 1.21.4.1. Field changes of dimension and details.
 - 1.21.4.2. Details or information not on original Contract Drawings.
- 1.21.5. Catalogue field review reports and cross reference to relevant trade, building area and component. Submit inspection and testing reports in accordance with requirements of Specifications. Highlight unsatisfactory inspection and testing results with supplementary instructions issued by Consultant.
- 1.21.6. Identify Drawings as "Project Record Copy", maintained and available for inspection on site by Consultant.
- 1.21.7. Prior to applying for Certificate of Substantial Performance submit as-built Drawings and O & M manuals (less warranties).

1.22. MISCELLANEOUS SUBMITTALS

- 1.22.1. Supply submittals required by Contract Documents (e.g. plans, reports, certifications, results, records, etc.) for Consultant's review.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. REGULATORY REQUIREMENTS

1.2.1. Comply with The Building Code Act, as amended, OBC as amended and Regulations and by-laws of other authorities having jurisdiction, including latest amendments thereto; all hereafter referred to as Code. Where Code or Contract Documents do not cover particular requirement which is covered by NBCC, as amended, conform to requirements of NBCC including its related supplements. Where Contract Documents exceed Code requirements, satisfy such additional requirements.

1.2.2. Conform to OFC enacted under The Fire Marshall's Act, including latest amendments.

1.2.3. Building permit will be obtained and paid for by Owner.

1.2.4. Unless otherwise indicated, obtain and pay for all other permits, licenses and certificates of inspection. Ensure permits, licenses and certificates included under specific Sections are provided as specified. Forward copies of all permits to Consultant before commencing work.

1.3. REFERENCE DOCUMENTS

1.3.1. Where reference is made to codes, specification standards, manuals, contract forms, installation, application and maintenance instructions, produced by various organizations, conform to edition of standards specified or, if not specified, to latest edition as amended and revised to date of Contract.

1.3.2. Amendments to reference documents after award of Contract affecting Contract Price shall be dealt with in accordance with Part 6, Changes in the Work of General Conditions.

1.3.3. If requested provide copy on site of such standard(s).

1.4. ACRONYMS

1.4.1. Following acronyms are used in Contract Documents:

AA	The Aluminum Association; www.aluminum.org
ACI	American Concrete Institute; www.concrete.org
AISC	American Institute of Steel Construction; www.aisc.org
ANSI	American National Standards Institute; www.ansi.org
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc.; www.ashrae.org
ASME	The American Society of Mechanical Engineers; www.asme.org
ASTM	ASTM International; www.astm.org
AWI	American Woodwork Institute; www.awinet.org
AWMAC	Architectural Woodwork Manufacturer's Association of Canada; www.awmac.com
AWWA	American Water Works Association; www.awwa.org
BCA	Building Commissioning Association
BHMA	Building Hardware Manufacturer's Association
BMEC	Building Materials Evaluation Commission
CCA	Canadian Construction Association; www.cca-acc.com
CCDC	Canadian Construction Documents Committee; www.ccdc.org
CEC	Canadian Electrical Code (published by CSA)

CGA	Canadian Gas Association; www.cga.ca
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction; www.cisc-icca.ca
CMHC	Canadian Mortgage and Housing Corporation; www.cmhc-schl.gc.ca
COFI	Council of Forest Industries of British Columbia; www.cofi.org
CPCI	Canadian Prestressed Concrete Institute; www.cpci.ca
CRCA	Canadian Roofing Contractors' Association; www.roofingcanada.com
CSA	CSA Group; www.csagroup.org
CSDMA	Canadian Sheet Door Manufacturers Association; www.csdma.org
CSPI	Corrugated Steel Pipe Institute; www.cspi.ca
CSSBI	Canadian Sheet Steel Building Institute; www.cssbi.ca
CWC	Canadian Wood Council; www.cwc.ca
DND	Department of National Defence, Construction Material Board
EEMAC	Electrical and Electronic Manufacturers Association of Canada
ECP	Environmental Choice Program
ESA	Electrical Safety Authority
FGIA	Fenestration & Glazing Industry Alliance; www.fgiaonline.org
FM	FM Global; www.fmglobal.com
GANA	National Glass Association with Glass Association of North America; www.glass.org
IEEE	Institute of Electrical and Electronic Engineers; www.ieee.org
MTO	Ministry of Transportation, Province of Ontario
NAAMM	National Association of Architectural Metal Manufacturers; www.naamm.org
NBCC	National Building Code of Canada
NEMA	National Electrical Manufacturer's Association (USA)
NFPA	National Fire Protection Association; www.nfpa.org
NHLA	National Hardwood Lumber Association (USA); www.nhla.com
NLGA	National Lumber Grades Authority
NRCC	National Research Council Canada; www.nrc.canada.ca
OBC	Ontario Building Code, "Building Code", Ontario Regulation 332/12, including amendments thereto
OFC	Ontario Fire Code, "The Fire Code", Ontario Regulation 388/97, including amendments thereto
OIRCA	Ontario Industrial Roofing Contractors' Association; www.ontarioroofing.com
OMCA	Ontario Masonry Contractors' Association; www.canadamasonrycentre.com
OPCA	Ontario Painting Contractors Association; www.ontariopainting.contractors
OPSS	Ontario Provincial Standards Section
SJI	Steel Joist Institute; www.steeljoist.org
SSPC	The Society for Protective Coatings (formerly known as Steel Structures Painting Council); www.sspc.org
TSSA	Technical Standards & Safety Authority; www.tssa.org
TTMAC	Terrazzo Tile & Marble Association of Canada; www.ttmac.com
ULC	Underwriters Laboratories of Canada; www.canada.ul.com
UL	UL LLC; www.ul.com
WHI	Warnock Hersey (Intertek); www.intertek.com

1.5. ABBREVIATIONS

- 1.5.1. Abbreviations used in Contract Documents are listed on Drawings.

1.6. DESIGN INTEGRITY AND ARCHITECTURAL REQUIREMENTS

- 1.6.1. Continuity of Fire Separations:
- 1.6.1.1. Conform to following requirements to maintain continuity of fire separations:
- 1.6.1.1.1. Fire separations may be pierced by openings for electrical and similar service outlets provided such boxes are noncombustible and are tightly fitted.
- 1.6.1.1.2. Where a fire separation required to be of noncombustible construction terminates at exterior wall, underside of floor, ceiling or roof structures and at floors, fire stop opening with an approved Listed material referenced in Section 01 60 00.
- 1.6.1.2. Do not use combustible members, fastenings and like to anchor fixtures to fire separations.

1.7. TOLERANCES

- 1.7.1. Unless more stringent tolerances are required by a Section of the Specifications or a referenced standard, meet following tolerances for installed work:
- 1.7.1.1. "plumb" means plumb within 6 mm in 3 m (1/4" in 10' - 0").
- 1.7.1.2. "level" means level within 6 mm in 3 m (1/4" in 10' - 0").
- 1.7.1.3. "square" means not in excess of 10 seconds, less or more than 90°.
- 1.7.1.4. "straight" means within 8 mm in 3 m (5/16" in 10' - 0"), under a 3 m (10' - 0") straightedge.

1.8. QUALIFICATIONS

- 1.8.1. For manufacturer's, fabricator's and installer's qualifications, conform to requirements specified under respective trade Section as applicable. Where applicable, manufacturer's field services shall be obtained as specified under respective trade Section.
- 1.8.2. Quality Control System Protocol:
- 1.8.2.1. Prior to commencement of Work, establish quality control system protocols, rules, related chain of commands and commitment to provide quality work as intended in Contract Documents for Work.
- 1.8.2.2. Retain services of quality control staff, shop and field supervisors complete with their skills, knowledge, duties and responsibilities. Upon request provide full resume of supervisors showing their qualifications.

1.9. ENGINEER'S QUALIFICATIONS

- 1.9.1. Employ a licensed engineer registered to practice in Province of Ontario carrying a minimum \$2,000,000.00 professional liability insurance to:
- 1.9.1.1. design components of work of this Project specific to their license to practice.
- 1.9.1.2. be responsible for determining sizes or other specific requirements within their license to practice in accordance with applicable codes and regulations.
- 1.9.1.3. be responsible for production and review of Shop Drawings.
- 1.9.1.4. inspect work of this Section during fabrication and erection/installation.
- 1.9.1.5. be responsible for sealing and signing each Shop Drawing and associated calculations performed.
- 1.9.1.6. provide site administration and inspection of this part of the Work.
- 1.9.2. Certification: Submit certification stating performance of engineered work will perform as required.

1.10. PAYMENT FOR QUALITY CONTROL SERVICES

- 1.10.1. Owner may appoint separate inspection and testing companies for certain work where specifically stated or where it may later require. Wherever documents state that inspection and testing companies may be appointed by Owner, give adequate notice to Consultant to determine if such inspection and testing companies will be appointed.
- 1.10.2. Services performed by inspection and testing companies and other consultants are a function to assist Consultant and do not to replace Contractor's responsibility for conforming to requirements of Contract Documents. Contractor is responsible for continuous checking and inspections to ensure Contract performance is in accordance with Contract Documents as the Work proceeds. In such cases, following will apply:
 - 1.10.2.1. If tests or inspections reveal work not in accordance with Contract Documents then Contractor shall bear cost of such tests and further tests as required, to verify acceptability of corrected work.
 - 1.10.2.2. Consultant will advise Contractor of work to be inspected and companies appointed therefor and will supply them with necessary Drawings and Specifications.
 - 1.10.2.3. Advise Consultant and applicable inspection and testing companies not less than 5 Working Days prior to commencement of work to be inspected or tested and ensure proper facilities and coordination are provided. Do no work without required inspection and testing.
- 1.10.3. Establish schedule of testing, number of testing reports, submission and distribution of testing reports. Inspection and testing reports shall provide all pertinent data regarding site conditions, dates, test references, Product identification, procedures and description, instructions and recommendations and other relevant information. Identify clearly Products not meeting requirements of Contract Documents and provide measures and recommendations for correcting situation. Advise Consultant promptly when Product or system fails to meet applicable Standards.
- 1.10.4. Materials and work not in accordance with requirements of Contract Documents will be rejected at any time during progress of the Work. Defective material and work, whenever found prior to final completion of the Work, may be rejected regardless of previous inspection or testing.

1.11. COOPERATION WITH TESTING AND INSPECTION COMPANIES

- 1.11.1. Representatives of the testing laboratories shall have access to work at all times; provide facilities for such access in order that the laboratories may properly perform its function.
- 1.11.2. Cooperate with testing and inspection companies and give adequate notification of any changes in source of supply, additional work shifts and any other proposed changes.
- 1.11.3. Prior to commencing significant segments of work, give Consultant and independent testing and inspection agencies appropriate notification so as to afford them reasonable opportunity to review work previously completed. Failure to meet this requirement may be cause for the Consultant to classify the work as defective.
- 1.11.4. Ensure no Product is installed before it is tested when a test is specified, nor work executed where a test or inspection is required and the inspectors cannot attend.
- 1.11.5. Cooperate in permitting access for inspection to all places where work is being done or material is stored prior to shipping.
- 1.11.6. Allow free access to testing agencies and supply necessary sampling materials for tests. Supply additional labour required to assist the testing and inspection companies in making tests.
- 1.11.7. Cost of above labour and material shall be borne by individual Subcontractors concerned.
- 1.11.8. Testing and inspection service does not relieve Contractor and Subcontractor of their responsibility for normal shop inspection, quality control of production and for errors made by them.

1.12. SCHEDULES FOR TESTING

- 1.12.1. Establishing Schedule:
 - 1.12.1.1. By advance discussion with selected testing laboratories, determine the time required for laboratories to perform their tests and to issue each of their findings.
 - 1.12.1.2. Provide required time within construction schedule.
- 1.12.2. Adherence to Schedule:
 - 1.12.2.1. Advise testing laboratories in advance when testing of work is required.
 - 1.12.2.2. When testing laboratories are ready to test according to predetermined schedule, but are prevented from testing or taking specimens due to incompleteness of Work, extra costs for testing attributable to the delay may be back-charged to Contractor and not borne by Owner.

1.13. SOURCE QUALITY CONTROL

- 1.13.1. Refer to respective trade Sections for source quality control requirements.

1.14. SITE QUALITY CONTROL

- 1.14.1. Refer to respective trade Sections for field quality control requirements.

1.15. TESTING AND INSPECTION OF MECHANICAL AND ELECTRICAL SYSTEMS

- 1.15.1. Provide testing and inspection of Mechanical and Electrical Systems as defined in Contract Documents under trade Sections of Divisions 20, 21, 22, 23, 25, 26, 27 and 28 respectively.

1.16. PROJECT MOCK-UPS

- 1.16.1. Arrange with Consultant to assist in preparing a schedule fixing dates for mock-up review.
- 1.16.2. Prior to manufacture and delivery of Products, arrange for Consultant's and Owner's review of mock-ups. Allow time for modifications and subsequent reviews.
- 1.16.3. Failure to review mock-ups in ample time will not be considered sufficient reason for extensions to Contract Time or for extra costs.
- 1.16.4. Provide following types of mock-ups:
 - 1.16.4.1. Transportable Mock-Ups. Refer to Sections for size requirements. Arrange and pay for delivery and pick-up.
 - 1.16.4.2. Site Mock-Ups: Refer to Sections to determine if mock-ups will form part of Work or are built separately. Demolish mock-ups built separately after work of applicable Section is completed and Consultant has reviewed that part of Work. Review with Consultant location of site mock-ups.
- 1.16.5. Modify mock-ups in accordance with Consultant's review at no additional cost to Owner.
- 1.16.6. Mock-ups are used to refine design of components. Changes to mock-ups will be made. Allow time in schedule for revisions to be made to mock-ups and Shop Drawings. Mock-up review and revisions will not be permitted as basis of claim for delay or additional cost.
- 1.16.7. Provide mock-ups using personnel assigned to the Work and Products and techniques to be used on the Work.
- 1.16.8. Mock-ups shall serve as standard for remaining parts of the Work.
- 1.16.9. Refer to each Section of the Work for additional mock-up requirements.
- 1.16.10. Provide mock-ups required by Contract Documents.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

- 1.1.1. Read and conform to:
 - 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
 - 1.1.1.2. Division 1 requirements and documents referred to therein.
- 1.1.2. Be responsible for arranging, obtaining and paying for any permit necessary for temporary facilities and controls. Provide and maintain all temporary facilities and controls. Remove them when directed and/or when no longer required. Payment for temporary facilities and controls shall be made by Contractor unless specified otherwise.
- 1.1.3. Provide and maintain adequate temporary supports, structures, light, power and water in accordance with GC 3.3, as required by all trades and to produce environment for Work to proceed without delay at all times of year. Cost of temporary light, power and water shall be included in Contract Price. Pay for installation, light, power and water used, maintenance and removal.

1.2. REFERENCES

- 1.2.1. Abbreviations and Acronyms:
 - 1.2.1.1. ULC: Underwriters Laboratories of Canada; www.canada.ul.com.
 - 1.2.1.2. VOC: Volatile Organic Compound.

1.3. TEMPORARY UTILITIES

- 1.3.1. Temporary Water Supply:
 - 1.3.1.1. Arrange with Owner for use of existing water service for construction purposes at the Place of the Work. Coordinate with Owner and pay for water used at cost.
 - 1.3.1.2. Provide connections, piping and fittings for distribution of water and, upon completion of the Work, remove such temporary distribution.
- 1.3.2. Temporary Power:
 - 1.3.2.1. Level of illumination on all floors and stairs shall be not less than 161 lux (15 lumens/sq ft or 15 foot candles). When finishing trades are performing work, provide illumination comparable to final illumination. Extension cords, lamps and hoses shall be provided by those using them in accordance with governing regulations and ordinances.
 - 1.3.2.2. Owner will arrange for use of existing electrical power service for temporary power required during construction for temporary lighting and the operating of hand power tools. Coordinate with Owner and pay for power used at cost. Provide electrical connection and distribution.
- 1.3.3. Temporary Protection: Provide and maintain following temporary protection at all times:
 - 1.3.3.1. Window Openings: Translucent, weatherproof protection until windows and glazing are installed.
 - 1.3.3.2. Door Openings: Minimum wood doors, frames, hinges, locks and bolts to exterior and interior to existing areas.
 - 1.3.3.3. Air Intakes: Provide protection against infiltration of dirt, dust and other deleterious matter.
 - 1.3.3.4. Temporary Dust Tight Partitions: Separate areas of work from occupied portions of building with temporary dust tight partitions constructed from floor to underside of structure. Construct temporary dust tight using plastic film attached to studs. Seal edges and joints to achieve positive protection. Remove temporary dust tight partitions promptly when no longer required and Make Good adjacent surfaces.

1.4. CONSTRUCTION FACILITIES

- 1.4.1. Contractor's Field Offices and Sheds:
 - 1.4.1.1. Provide Contractor's field offices within the Place of the Work only.
 - 1.4.1.2. Provide following field office facilities:
 - 1.4.1.2.1. Telephone services for Contractor's own use.
 - 1.4.1.2.2. "No Smoking" signs.
 - 1.4.1.2.3. Provide proper flammable and explosive materials storage.
- 1.4.2. Existing Elevator:
 - 1.4.2.1. Contractor may be permitted to use 1 existing elevator designated by Owner during construction, at times acceptable to Owner. Coordinate delivery and removal times of materials in advance with Owner. Use only designated elevator for transportation of materials and rubbish.
 - 1.4.2.2. Provide approved protection to elevator cab and hoistway finishes, keep it reasonably clean and remove protection promptly when no longer required. Repair damage to finishes.
 - 1.4.2.3. Arrange and pay for complete servicing of elevators used in the Work.
- 1.4.3. Sanitary Facilities:
 - 1.4.3.1. Existing washroom facilities on 5th floor may be used as directed provided they are kept clean and serviced. Existing washrooms are not permitted to be used for cleaning Construction Equipment or disposal of debris on site. Repair damage to existing washroom facilities and clean before handing over the Project.
 - 1.4.3.2. Misuse of water closets and washing facilities or fouling of building by workers shall constitute grounds for instant dismissal from site.
- 1.4.4. Garbage Removal: Do not use institutional garbage bin facilities for removal of construction rubbish and debris. Contractor will be allowed to provide a 20 cu yd sized bin in a defined located at Owner's loading dock (location to be reviewed with Owner). If demand for a larger bin is required, Contractor may be permitted to use the Owner's 40 cu yd sized bin already located on site as overflow. Costs related to overflow bin will be borne by Contractor. Repair damage to site surface upon removal of garbage. Garbage can be transported through tunnels to shipping area.
- 1.4.5. Safety Program:
 - 1.4.5.1. Conform to GC 3.5, undertake role of "Constructor" as defined under The Occupational Health and Safety Act, as amended. Be responsible to provide full safety program for anyone who gets paid for services on site including management, labour, delivery drivers, service personnel and others involved for services on site. Arrange for pre-project meeting related to safety, joint safety inspections with Contractor's consultant where required, site safety training and safety committees complete with accident investigation procedures.
 - 1.4.5.2. Prior to commencement of construction, design fire safety plan in conjunction with local Fire Chief. Post fire plan throughout construction as recommended. Do not allow accumulation of waste that may constitute fire hazard.
 - 1.4.5.3. Prior to commencement of Work, carry out preconstruction safety audit to identify hazards and establish protocols, commitment to safety, safety rules and safety related chain of commands for selective demolition work, sequential contract work, removal of designated hazardous materials, replacements of components and glazing items. For sequential contracts, preconstruction safety audit shall include reviewing work carried out under previous contract which is to be taken over to form part of this Contract. Design, implement, monitor and maintain a safe work environment throughout Contract in accordance with procedures established during preconstruction safety audit. Consultant will have authority to correct deficiencies and disregard for good safety practice at Contractor's expense. Attendance to pre-construction safety audit shall be mandatory for Contractor, Subcontractors and major Suppliers.

- 1.4.5.4. Conform to Construction Safety Association of Ontario's Manual on Propane in construction. Watch work area for minimum of 30 minutes after hot work is completed. Provide site fire security when required by local building department and/or municipal fire department. Ensure water supply is adequate for fire-fighting.
- 1.4.5.5. Provide on site such equipment and medical facilities as are necessary to furnish first aid to anyone who may be injured in connection with Work in accordance with regulations of *Occupational Health and Safety Act (Ontario)*.
- 1.4.5.6. Promptly report in writing to Consultant all accidents arising out of or in connection with performance of Work, whether on or adjacent to site, which caused death, personal injury or property damage, giving full details and statements of witnesses. In addition, in case of death, serious injuries or damages, report accident immediately by telephone or messenger to Consultant.
- 1.4.5.7. If any claim is made by anyone against Contractor or any Subcontractor on account of any accident or damage, promptly report facts in writing to Consultant, giving full details of claim.

1.5. CONSTRUCTION AIDS

- 1.5.1. Construction Hoists: Provide, install, maintain, locate where directed and pay costs for hoisting equipment if required. Position equipment so not to interfere with Work. Operate equipment by qualified hoist operator along with well trained flag and signal persons. Trade Sections shall make their own financial and schedule arrangements with Contractor for use thereof. Provide concrete pads for hoisting equipment.
- 1.5.2. Scaffolding: Erect fixed or mobile scaffolding as applicable independent of walls. Use it in manner as to interfere as little as possible with other Sections. When not in use, move it as necessary to permit installation of other work. Construct and maintain scaffolding in rigid, secure and safe manner. Remove it promptly when no longer required or remove it at end of each Day and store in secure place as directed.

1.6. VEHICULAR ACCESS AND PARKING

- 1.6.1. Existing Parking Facilities: Confine parking to Founders 2 lot. Owner will provide parking passes for a maximum 6 vehicles per Day. Arrange and pay for associated costs. Do not block any streets, walkways or allow their use for parking by any construction crew or visitors except with approved specific permission from appropriate authorities and in accordance with stipulated standing regulations and restrictions. Minimize traffic movement and temporary closing of access streets.

1.7. TEMPORARY BARRIERS AND ENCLOSURES

- 1.7.1. Hoarding and Boardwalk:
 - 1.7.1.1. Provide hoarding and gates in accordance with the requirements of the Municipality, the Occupational Health and Safety Act, Regulations for Construction Projects and other authorities having jurisdiction to:
 - 1.7.1.1.1. Protect public, Owner's occupants, personnel and property from injury and damage.
 - 1.7.1.1.2. Exclude non-construction personnel and public from parts of the Place of the Work under construction.
 - 1.7.1.2. Maintain Access to Exits and Exits, for emergency escape through or around hoarding to a safe area of refuge acceptable to authorities having jurisdiction.
 - 1.7.1.3. Relocate and reconstruct hoarding to accommodate phasing of the Work.
 - 1.7.1.4. Remove and dispose of hoarding upon completion of the parts of the Work.
- 1.7.2. Temporary Heated Enclosures:
 - 1.7.2.1. Conform to requirements of Occupational Health and Safety Act.

- 1.7.2.2. Take precautions and provide temporary protection to prevent damage to Work affected by temperature, water, weather and other environmental conditions.
- 1.7.2.3. Provide temporary heated enclosures in advance of cold weather to continue full scope of operations through cold climatic temperature and weather from commencement to completion without delay.
- 1.7.2.4. Take precautions to protect openings made in existing building(s) from entry of elements and of persons during construction and to protect existing structure and finishes from damage. Protection of exterior enclosure shall be air tight and have minimum thermal resistance value of $R = 5$ ($RSI = 1$).
- 1.7.2.5. Provide heating to maintain the recommended Product storage, mixing, substrate, ambient air, placement, Product installation and curing temperatures recommended by respective Product manufacturers.
- 1.7.2.6. Provide temporary enclosures and heating required by Contract Documents.

1.8. TEMPORARY CONTROLS

- 1.8.1. Pollution Control: Take appropriate dust control measures to avoid contamination of adjacent areas near site from dust. Respond immediately to complaints of dust received from public, authorities, or Consultant. Keep public and private roads free of dust, mud and construction debris resulting from trucks employed on this Project.
- 1.8.2. Noise and Vibration Control: Control noise and vibration generated by Work. Respond immediately to complaints of noise and vibration received from public, authorities or Consultant. Prior to commencing any noisy work, submit plan to Owner for review and approval.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

- 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
- 1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. REFERENCES

1.2.1. Reference Standards:

- 1.2.1.1. ANSI/ASME B18.6.3-13 - Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series)
- 1.2.1.2. CSA W47.1:19 - Certification of companies for fusion welding of steel
- 1.2.1.3. CSA W47.2-11(20) - Certification of companies for fusion welding of aluminum
- 1.2.1.4. CSA W59:18(23) - Welded steel construction
- 1.2.1.5. CSA W59.2:18 - Welded aluminum construction
- 1.2.1.6. CAN/ULC-S101-14 - Standard Methods of Fire Endurance Tests of Building Construction and Materials

1.3. BASIC PRODUCT REQUIREMENTS

- 1.3.1. Material, Machinery, Equipment and Fixtures: Product employed in the Work shall be those which affect indoor air quality as little as possible. Provide adequate ventilation during installation of finishing materials to avoid effect on indoor air quality.
- 1.3.2. Material, plant, equipment and fixtures specified shall form basis of Contract. Where more than 1 brand or manufacturer is named in Specifications, or on Drawings, Contractor shall have choice to use 1 of specified manufacturer or brand provided requirements of Drawings and Specifications including requirements pertaining to carbon reduction design and material ingredient disclosure are met. Generally, when selecting Products among a list of available options, Contractor shall give preference to Products which have compliant environmental disclosure and material ingredient disclosure documentation.
- 1.3.3. Ensure materials, plant, equipment and fixtures are not damaged or defective and of quality specified and compatible for purpose intended. If requested provide evidence as to type, source and quality. Remove and replace defective Products, at own expense, regardless of previous reviews and be responsible for delays and expenses caused thereby. Replace factory finished equipment, or parts thereof, whose paint finish is damaged and cannot be reasonably remedied by paint touch-up.
- 1.3.4. In general Owner retains right to select all choices available within specified Products colours, finishes and other options unless specified otherwise.
- 1.3.5. Toxic or Hazardous Substances and Materials:
 - 1.3.5.1. Definitions:
 - 1.3.5.1.1. Normal Mould Concentrations: Indoor concentrations of spores, hyphae and mycelia fragment (both airborne and on surfaces) that are similar in concentration and species population distribution that would be found outdoors in natural environment.
 - 1.3.5.1.2. Mould Amplification: Growth or elevated population of mould (both airborne and on surfaces) including visible growth or staining on any building material. This amplification is most often caused by water damage to building materials.

- 1.3.5.2. Products and materials incorporated in the Work shall be as free as possible of noxious or toxic volatile emissions or emissions of irritating or toxic particles, so interior air of completed building is as pollution-free as possible. (For example, Products emitting benzene, mercury, lead or other known toxic compounds are not permitted.)
- 1.3.5.3. Prior to commencement of the Work, as part of the Contract, investigate and inspect existing building for potential mould amplification that may affect the Work. Appoint and pay for independent inspection and testing company having qualified and experienced bio-contamination investigator to carry out sampling and laboratory analysis to document type of mould and its removal procedures and its removal procedure. Arrangement and removal of mould thereafter if any shall become part of the Contract.
- 1.3.5.4. Products, materials and substances employed in the Work shall be free of mould amplification. In addition to requirements specified herein, take special care while handling, storing and installing materials, without limitation, such as particleboard, plywood, cellulose materials, wallpaper, ceiling panels, gypsum boards and insulation with kraft paper back up.
- 1.3.5.5. Product with visible or invisible signs of mould amplification whether installed or not, shall be considered defective and removed at Contractor's expense. Contractor is responsible to retain a qualified and experienced bio-contamination investigator to conduct at its expense sampling and laboratory analysis and other required assessment steps to determine whether or not materials are impacted by mould amplification and follow up recommended contamination management method. As a minimum requirement conform to New York City Department of Health and Mental Hygiene November 2008, "Guidelines on Assessment and Remediation of Fungi in Indoor Environments" and appropriate Levels of requirements for mould removal.
- 1.3.5.6. Ensure construction workers are not exposed to amplified moulds. Take every reasonable precaution in circumstances for protection of workers, as air movement and handling of contaminated material can release spores into atmosphere which can cause adverse health effects. Mould metabolites including mycotoxins, when in contact with skin or inhaled, may irritate skin, eyes, nose and throat resulting in allergy-like symptoms such as difficulty in breathing, runny nose, watery eyes, fatigue, headache, asthmatic attacks and general 'flu' like symptoms.
- 1.3.5.7. Where odourless Products are not available, Products shall be chosen where possible so odours are minimized within a 1 month gas-off period following installation at normal occupancy ventilation levels. Ventilation levels during the construction period shall be set sufficiently high to encourage the gassing off of materials to their minimum levels prior to occupancy of the building, where possible.
- 1.3.5.8. Products for installation within the air-handling and distribution systems shall be especially chosen to minimize the introduction of pollutants into the fresh air supply to the building.
- 1.3.6. Availability:
- 1.3.6.1. Immediately upon signing the Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of Products are likely or possible, or Products are no longer available, or a specified manufacturer is no longer in business, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of the Work.
- 1.3.6.2. Products which are specified by their proprietary names, by part, or catalogue number form basis of the Contract. No substitutes for these are permitted.
- 1.3.6.3. In the event of failure to notify Consultant at commencement of the Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available Products of similar character, at no increase in Contract Price.
- 1.3.6.4. No substitution of materials will be allowed on basis of long deliveries, unless such long delivery problems are identified at time of signing of Contract.

- 1.3.7. Mechanical & Electrical Location Drawings:
 - 1.3.7.1. Mechanical and electrical drawings indicate approximate locations diagrammatically. Prior to installation, request and obtain final locations and arrangement drawings for mechanical and electrical items. Allow Consultant to adjust final locations within a 1500 mm (5') radius from diagrammatic position indicated, without change to Contract Price.
 - 1.3.7.2. Align and cluster devices and fitments neatly in accordance with specified mounting heights, properly aligned horizontally and vertically.
- 1.3.8. Gauges:
 - 1.3.8.1. Interpret gauges of uncoated steel sheet based on manufacturer's standard gauge (msg), stainless steel sheet based on "United States Standard Gauge (Revised)" and non-ferrous sheet metals based on "Brown & Sharpe Gauge". For galvanized steel sheet based on galvanized sheet gauge (ga).
 - 1.3.8.2. Interpret gauges specified for wire as "Steel Standard" and for non-ferrous wire, as "American".
- 1.3.9. Fire Rating:
 - 1.3.9.1. Where material, component or assembly is required to be fire rated, fire rating shall be determined on basis of results of tests conducted in conformance with CAN/ULC-S101 by 1 of following testing authorities acceptable to authorities having jurisdiction:
 - 1.3.9.1.1. Underwriters Laboratories of Canada (ULC); www.canada.ul.com
 - 1.3.9.1.2. Underwriters Laboratories Inc. (UL); www.ul.com
 - 1.3.9.1.3. FM Global; www.allendale.com
 - 1.3.9.1.4. National Research Council of Canada; www.nrc.ca
 - 1.3.9.1.5. National Board of Fire Underwriters.
 - 1.3.9.1.6. Warnock Hersey - Intertek; www.intertek.com
 - 1.3.9.2. Where reference is made to only 1 testing authority, an equivalent fire rating as determined or listed by another of aforementioned testing authorities is acceptable if approved by authorities having jurisdiction. Obtain and submit such approval of authorities, in writing, when requesting acceptance of a proposed equivalent rating or test design.
 - 1.3.9.3. Ensure engineering judgements are sealed by a licensed engineer.
- 1.3.10. Manufacturers' Written Instructions:
 - 1.3.10.1. Unless specified otherwise, use each Product in accordance with manufacturer's published written instructions regarding handling, storage, preparation, methods of installation, protection and cleaning. Take into account site conditions and provide ancillary Products or accessories.
 - 1.3.10.2. Conform to manufacturer's recommended installation temperatures. If finishes are installed at temperatures different from operation or service temperatures, make provisions for expansion and contraction in service as acceptable to manufacturer. Repair resulting damage should expansion provisions prove inadequate.
 - 1.3.10.3. Notify Consultant, in writing, of conflicts between Contract Documents and manufacturer's instructions, so Consultant may establish course of action to be taken. If requested, make a copy of those instructions available at site.
 - 1.3.10.4. Improper installation or erection of Products, due to failure to comply with these requirements, shall require removal and re-installation at no increase in Contract Price.
 - 1.3.10.5. Whenever specific reference to following manufacturer's directions or instructions is made in Specifications, upon request submit copies thereof for review before commencing such work.

- 1.3.11. Anchors and Fasteners:
- 1.3.11.1. Supply appropriate anchors, fasteners, accessories and adhesives required for fabrication and erection of Work.
- 1.3.11.2. Unless specified otherwise use exposed metal fastenings and accessories of same texture, colour and finish as Product being fastened.
- 1.3.11.3. Use metal fastenings of same material as metal component being fastened, or of metal which will not generate electrolytic action and cause damage to fastening or metal component under moist conditions. In general use non-corrosive or hot dip galvanized steel anchors occurring on or in exterior wall, slab or other exterior locations, unless higher standard is indicated or specified.
- 1.3.11.4. Fastening devices or adhesives shall be of appropriate type, used in sufficient quantity and in such manner to provide positive, permanent fastening which will not shift, work loose or fail during occupancy of building due to vibration or other causes resulting from normal use of building. Install anchors at spacing to provide required load/stress carrying capacity. Do not use wood plugs.
- 1.3.11.5. Lay out fastenings neatly, evenly spaced and aligned. Keep exposed fastenings to minimum.
- 1.3.11.6. Supply adequate instructions and templates and, if necessary supervise installation, where fastenings or accessories for your Section are required to be built into work of other Sections.
- 1.3.11.7. Do not use fastenings which will cause spalling, cracking, or deformation or deterioration of material being fastened by or to.
- 1.3.11.8. Do not use powder actuated fastening devices, which are used in tension, without approval. Take stringent safety precautions when using powder actuated fastenings. Use only low velocity plunger-type devices.
- 1.3.11.9. Use adhesives specified, or if not specified, those recommended by manufacturer of materials involved, compatible with materials to be joined, and effective in forming permanent joint of adequate strength.
- 1.3.11.10. Use screws, nails, staples and other similar, driven fasteners suitable to materials to be joined and to conditions under which they are installed and used. Ensure in finished work, fasteners are sized to take durable hold under stress to be encountered without damage to, or weakening of, elements secured together and fastenings will not corrode or cause staining of exposed surfaces.
- 1.3.11.11. Security Screws: Complying with ANSI/ASME B18.6.3; provide only tamper-resistant Torx-Plus® or break off type screws as specified and noted on Drawings. Provide flathead security screws where Torx-Plus® or breakoff is indicated to be counter sunk otherwise provide only trusshead or buttonhead for Torx-Plus® and only roundhead for breakoff type. Torx-Plus® Tamper resistant screws with heads having a deep hex-lobular recess with a solid post formed in the centre requiring a special metal driver to install or remove screw. Ensure fasteners and tools are of type produced by licensed manufacturer. Break-Off head security screws with drive heads having an additional hexagonal shaped head designed to break off after installation at a predetermined torque level. Grind remaining portion of neck smooth after hex-head is broken off. Permitted Manufacturers: Tamperproof Screw Co., Inc.; www.tamperproof.com or Sentry Security Fasteners Inc.; www.sentrysf.com.
- 1.3.11.12. Do brazing or soldering to form durable connections of strength adequate to resist stresses to be encountered without deformation of elements joined. Prepare base metals and use methods and materials to ensure clean joint, and to prevent staining, corrosion, discolouration, deformation or other damage to finished Work.
- 1.3.11.13. Do welding to CSA W59 for steel and to CSA W59.2 for aluminum, unless specified otherwise. Have welding performed by companies certified operatives to CSA W47.1 or CSA W47.2.
- 1.3.11.14. Provide accessory items or materials required, such as brackets, cleats, connectors, sealants, lubricants, cleaners, protection and similar items, whether specified or not, so Work is complete and performs as required.

- 1.3.12. Built in Items: Provide and coordinate location of chases, slots and reglets including frames, sleeves, inserts, anchors, fasteners and bolts, forms and templates.
- 1.3.13. Patents: Verify existence or exclusivity of patent licenses for Products prior to installation.
- 1.3.14. Trademarks and Labels: Do not expose trademarks and labels, including applied labels, in finished Work. Remove visible trademarks and labels except those which are essential to obtain identification of mechanical and electrical equipment for maintenance and replacement purposes and for mandatory fire ratings.

1.4. PRODUCT DELIVERY, HANDLING AND STORAGE

- 1.4.1. Package, crate and brace Products to prevent damage during delivery, storage and handling.
- 1.4.2. Provide protection to finished surfaces to prevent damage during delivery, storage and handling.
- 1.4.3. Store packaged materials in original, undamaged condition with manufacturers' labels and seals intact.
- 1.4.4. Handle and store materials in accordance with manufacturers' and Suppliers' recommendations, in protected locations.
- 1.4.5. Store materials susceptible to environmental damage in weather-tight enclosures, raised clear of the ground and protected from weather, dampness and deterioration.
- 1.4.6. Replace Products damaged during delivery to Place of the Work, storage, handling and installation.
- 1.4.7. Conform to written procedures for safe handling, storage and use of noxious and hazardous materials including special precaution, safe clean-up and disposal procedures. Conform to the environmental protection requirements under Code.
- 1.4.8. Mould Control During Product Storage and Handling:
 - 1.4.8.1. Do not bring building Products onto site containing toxic moulds.
 - 1.4.8.2. Exercise continuous quality control and enforce mould control requirements upon Subcontractors and establish proper Product storage and delivery sequence to protect Products from weather and other exposures conducive to mould growth.
 - 1.4.8.3. Take special care while handling and storing materials, without limitation, such as particleboard, plywood, cellulose materials, wallpaper, ceiling panels, gypsum boards and insulation with kraft paper back up.
 - 1.4.8.4. Monitor humidity levels and provide adequate ventilation in storage areas. Be watchful of any moisture condition in storage areas. Do not use materials which have been damaged by exposure to moisture and/or showing signs of mould growth.
 - 1.4.8.5. Take measures during Product storage and handling to provide mould free finished construction.

1.5. CONCEALMENT OF SERVICES

- 1.5.1. Conceal pipes, service lines and ducts in chases, behind furring or above ceilings, except where they are indicated as being exposed to view. Where no ceiling is provided, such items may be exposed, but must be neatly and logically arranged. Coordinate layout of exposed services with Consultant prior to installation.

1.6. MANUFACTURED ITEMS

- 1.6.1. Where a conflict occurs between specified technical description and manufacturer's standard model numbers and/or manufacturer's printed description of given model number, technical description specified herein governs. Manufacturers shall make necessary modifications in their manufacturing methods to meet all aspects of these Specifications.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

- 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
- 1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. PROFESSIONAL ENGINEERS' SERVICE

1.2.1. Obtain full time engineering service from professional engineer licensed to practice in Province of Ontario in applicable discipline. Engineering service shall include without limitation, design of structural elements and full inspection services during fabrication, erection and administration during construction.

1.3. EXAMINATION

1.3.1. Acceptance of Conditions:

1.3.1.1. Examine site at no cost or risk to Owner for all matters relating to Work, extent of Work, means of access and egress, all obstacles, rights and interests of other parties which may be interfered with during execution of Work, all conditions and limitations Contractor to take into consideration in performing Work, including obstructions, existing structures or facilities, local conditions, actual levels, character and nature of project and any other consideration which may affect performance of Work.

1.3.1.2. Where available obtain existing drawings pertaining existing building layout, architectural, structural, mechanical, electrical details and assess impact in performing work of this Contract.

1.3.1.3. Examine existing conditions at no additional cost to Owner, surfaces and substrata upon which your work depends. Drawings are, in part, diagrammatic and are intended to convey scope of Work and indicate general and approximate location, arrangement and sizes of fixtures, equipment, ducts, piping, conduit and outlets and similar items. Obtain more accurate information about locations, arrangement and sizes from study and coordination of Drawings, including Shop Drawings and manufacturers' literature and become familiar with conditions and spaces affecting these matters before proceeding with Work.

1.3.1.4. Ensure each Subcontractor has full understanding of extent of its work. Report in writing defects in such work and notify Subcontractors responsible for unfavourable and unsatisfactory conditions. Do not commence Work until unsatisfactory conditions have been corrected. Verify corrected work prior to commencing work. Execution and application of your work is deemed accepted of work upon which your work depends.

1.3.2. Existing Activities, Facilities and Conditions:

1.3.2.1. Existing institution may be in operation throughout Work. Do not interrupt existing services, facilities and activities at complex, except for authorized and scheduled interruptions of services acceptable to Owner. Obtain written permission of Owner at least 3 Working Days in advance of any shutdown required for tie-in of new construction systems. Written requests for shutdown permission shall clearly identify exact extent of systems affected, time and duration.

1.3.2.2. Make necessary enquiries to determine locations of existing services such as hydro, telephone, water, natural gas, sewer and like. Make arrangements and pay all costs to temporarily relocate, shore, underpin or in any way accommodate existing services which affect Work of this Contract.

1.3.2.3. Protect and maintain in operation all existing services and systems. When removing or altering existing services, make safe, secure and maintain seals as applicable for all lines affected.

1.3.2.4. Perform required shutdowns outside of normal working hours at no increase in cost if requested by Owner.

1.4. MATERIALS

- 1.4.1. Where Specification requirements include design of a Product or system, and minimum material requirements are specified, design of such Product or system shall employ materials specified within applicable Section. Where materials or components are not specified, Contractor shall augment materials with those of its choice within applicable Code limitations while maintaining integrity of design and architectural requirements.
- 1.4.2. Defective Products, whenever identified prior to completion of Work, will be rejected, regardless of previous reviews. Review does not relieve responsibility but is a precaution against oversight or error. Remove and replace defective and/or damaged Products at own expense and be responsible for delays and expenses caused by rejection.
- 1.4.3. Ensure new materials used to repair damage are compatible with existing work.

1.5. PREPARATION

- 1.5.1. Planning, Scheduling & Coordination of Alterations:
 - 1.5.1.1. Plan and schedule alterations to accommodate anticipated difficulties, indicated on and inferrable from the Contract Documents.
 - 1.5.1.2. Plan, schedule and coordinate alterations to accommodate on-going operations of Owner with minimal disruption.
 - 1.5.1.3. Plan, schedule and coordinate alterations, required in Owner-occupied spaces or adjoining or below the Place of the Work, on a room-by-room basis and in accordance with a schedule mutually agreed upon with Owner. Requests for access to occupied areas shall be made to Owner a minimum of 1 week in advance of requested access time.
 - 1.5.1.4. Co-ordinate alterations with other contractors and proceed with the Work expeditiously.
- 1.5.2. Existing Services:
 - 1.5.2.1. Before commencing Work, establish location and extent of existing services in area of Work and notify Consultant of findings.
 - 1.5.2.2. Where job conditions require reasonable changes in indicated locations and arrangements, make such changes with as directed by Consultant at no additional cost to Owner. Similarly, where existing conditions interfere with new installation and require relocation, such relocation is included in Work.
 - 1.5.2.3. Whenever it is necessary to cut, interfere with, or connect to existing services or facility do so at hours and times recommended by governing authorities and reviewed by Consultant and with minimum disturbance to occupants, pedestrian and vehicular traffic and public and private property.
 - 1.5.2.4. Submit schedule of interruption to services for review by Consultant for each proposed shut-down of active service or facility. Adhere to revised schedule and provide notice to affected parties.
 - 1.5.2.5. If unknown services are encountered, immediately notify Consultant and confirm findings in writing. Obtain Consultant's written direction if such services require cutting, capping or relocation to do Work.
- 1.5.3. Access for Large Equipment:
 - 1.5.3.1. Where new mechanical and electrical equipment is located in existing areas of building, do necessary cutting, dismantling and reassembling of equipment, modifications to equipment, hoisting, shoring and patching required for installation of such equipment in space provided.
 - 1.5.3.2. Where Drawings show specific locations of walls, ceilings, slabs and like being broken out for access for equipment, this is merely to indicate an architectural preference for route, and it is not intended that Drawings necessarily show all such breaking out required.

1.6. EXECUTION

- 1.6.1. Existing Conditions: Make Good surfaces and finishes damaged or disturbed due to Work of this Contract to match existing. Ensure materials used to repair damage are compatible with existing work.
- 1.6.2. Installation:
 - 1.6.2.1. Except where specified otherwise, use each Product in accordance with manufacturer's published or written instructions, Specifications or recommendations regarding handling, storage, preparation, site conditions, ancillary Products or accessories, methods of installation, protection and cleaning. Submit copy of such instructions and indicate if and where there is discrepancy between them and requirements of Specifications and obtain direction.
 - 1.6.2.2. Whenever specific reference to following manufacturer's directions or instructions is made in Specifications, submit copies as requested thereof for review before commencing such work.
 - 1.6.2.3. Do Work in accordance with industry practice for type of work unless Contract Documents stipulate more precise requirements. Do not let unskilled workers perform work.
 - 1.6.2.4. Do Work in neat and careful manner to retain Work plumb, square and straight.
 - 1.6.2.5. Ensure Work is properly related to form close joints and appropriately aligned junctions, edges and surfaces and is free of warp, twist, wind, wave or other irregularities.
 - 1.6.2.6. When required by Specifications or by manufacturer's recommendations, have manufacturer, supplier or accredited agent, inspect work which incorporates their Products.
 - 1.6.2.7. Do not permit materials to come in contact with other materials whether in presence of moisture or otherwise if conditions will result in corrosion, stain or discolouration or deterioration of completed Work. Provide compatible, durable separators where such contact is unavoidable.
 - 1.6.2.8. Load no part of structure during construction with load greater than it is calculated to bear safely when completed. Make every temporary support as strong as permanent support. Place no load on concrete structure until it has sufficient strength to safely carry such load.
 - 1.6.2.9. Conceal pipes, ducts, conduits, tubing, wiring and other items requiring concealment in floor, wall and ceiling construction of finished areas except where indicated or specified otherwise. If in doubt as to method of concealment, or intention of Contract Documents in this connection, request clarification from Consultant before proceeding with work in question.
 - 1.6.2.10. Install and arrange fixtures, equipment, ducts, piping and conduit to conserve as much headroom and space as possible and avoid interference and obstruction of access. Observe good installation practice for safety, access, maintenance and follow manufacturer's recommendations. Location of fixtures, access panels, outlets and mechanical and electrical components indicated are approximate. Make changes requested to comply with these requirements at no additional cost to Owner.
 - 1.6.2.11. If requested by Consultant, and before their installation, relocate equipment, services, doors, openings, furring and other work at no additional cost to Owner; provided such relocation involves only reasonable minor adjustments and reasonable advance notice is given in writing. Ensure identification of electrical and mechanical system installations and other automated systems or equipment shall be provided in accordance with Contract Documents.
- 1.6.3. Lay out mechanical and electrical work in advance of concrete placement and furring installation to allow for its proper concealment.
- 1.6.4. Test and inspect work before applying pipe covering and before Work is concealed.

1.7. ALTERATIONS AND REPAIRS

- 1.7.1. Refer to Section 02 41 00. Conform to Owner's Policies and Procedures for Contractors and shut down protocol where applicable.

- 1.7.2. Perform work in a manner such as to cause a minimum of noise and interference to use of existing premises and services. Provide maximum safety for occupants during work.
- 1.7.3. Throughout entire construction period provide proper and safe means of fire exit from all zones of existing building at all times to approval of authorities having jurisdiction.
- 1.7.4. Wherever it becomes necessary to cut or interfere in any manner with existing apparatus for short periods of time, do work at such times as agreed upon with Owner and Consultant.
- 1.7.5. If unscheduled disturbance to use of existing premises and services is required to complete work, inform Owner with advance notice of 1 week minimum. Provide information of requirements and perform work at times directed by Owner.
- 1.7.6. Make provisions to join new work to existing and to install new supporting members, anchors and other items necessary for completion of work. Provide temporary bracing where required.
- 1.7.7. Proceed with demolition of or alterations to any portion of existing building only after review by Consultant has been performed and after weather tight and dustproof screens have been erected to provide thorough protection to adjoining areas and rooms.
- 1.7.8. When permission has been granted to proceed with alterations in existing building, carry out work expeditiously and continuously to completion.
- 1.7.9. Carry out work minimizing dust migration. Protect items sensitive to and which could be damaged by dust. Where practical, keep demolition areas wetted.
- 1.7.10. During performance of work, adequately protect work completed and in progress and existing work to remain, such as floors, finishes, trim and similar components, as completely as possible to minimize replacement of damaged work by each Subcontractor and trade. Repair or remove and replace Work damaged or defaced due to failure to provide adequate protection as directed by Consultant.
- 1.7.11. Properly coordinate work of various Sections and trades. Take into consideration existing installations to assure best arrangement of pipes, conduits, ducts and mechanical, electrical and other equipment and items, in available space. Under no circumstances will any extra payment be allowed due to failure by Contractor to coordinate work.
- 1.7.12. Remove, store and reinstall existing fixed equipment, fixtures and components which interfere with construction work.
- 1.7.13. Cutting, patching and Making Good of existing work to accommodate new work and requirements specified under other Sections shall be done in conjunction with work specified herein. Coordinate such work.
- 1.7.14. Employ tradesmen qualified in work being cut and patched to perform work correctly and skillfully.
- 1.7.15. Do not undermine, damage or endanger existing structure, footings, foundations, pipelines, electrical conduit and wiring by digging, cutting or any other operation in performance of Work of this Contract. Immediately repair and Make Good existing work so affected, including working after regular working hours, to Consultant's recommendation and satisfaction at no additional cost to Owner.
- 1.7.16. Cut off, cap, divert or remove existing services in areas being altered which are affected by changes as required or as directed by municipal authorities and utility company concerned and Consultant. Protect and maintain active services to existing building.
- 1.7.17. Where new work connects with existing and where existing work is altered, perform necessary cutting and fitting required to make satisfactory connections with existing work under this Contract, so as to leave entire work in a finished condition. Match new Work exactly with existing work in material, form, construction and finish unless otherwise noted or specified. Make joining work inconspicuous.
- 1.7.18. Make Good materials surfaces and finishes damaged or disturbed due to work of this Contract.

- 1.7.19. Except where structural requirements are indicated on Drawings, do not cut, drill or sleeve load bearing members without first obtaining Consultant's written authorization for each condition.
- 1.7.20. Perform drilling of existing work carefully, leaving a clean hole no larger than required.
- 1.7.21. Make cuts clean and true with smooth edges. Fit units to tolerances established by existing work and in conformance with best standard practice for applicable class of work.
- 1.7.22. Fill unused and unfilled sleeves and holes in non-fire rated floors and partitions not otherwise filled, by reviewed means. If unused sleeve is in fire or sound barrier, fill in manner to restore or maintain fire or sound barrier rating. Filling of openings in fire rated floors and partitions specified under Section 07 84 00.
- 1.7.23. If non-designated and unclassified sprayed fire resisting, sound absorbing, or insulation applications are encountered, inform Consultant for examination and instructions. Restore damaged non-asbestos type fireproofing to original condition before covering with finishes.
- 1.7.24. Work shown on Drawings, Schedules and Specifications may or may not be all work required to be done in existing building. Make Good and execute all necessary work including incidentals to make a complete job of alterations work.
- 1.7.25. Alterations (Changes/modifications):
 - 1.7.25.1. Provide alterations indicated on and inferrable from the Contract Documents.
 - 1.7.25.2. Demolish existing, obsolete construction as part of alterations, in accordance with Section 02 41 00 and prepare areas to receive new work.
 - 1.7.25.3. Refer to mechanical and electrical Specifications and Drawings for removal, capping, and alterations to work of Divisions 20, 21, 22, 23, 25, 26, 27 and 28, e.g., conduit, wiring, fixtures, ducts, piping and other service lines.
 - 1.7.25.4. Protect active services which are intended to remain and which pass through spaces involved in alterations and repairs.
 - 1.7.25.5. Conceal piping, duct, conduit and other service alterations in ceilings, walls and furred spaces if possible.
- 1.7.26. Repairs/Renovations (Restoration to Previous Condition):
 - 1.7.26.1. Repair adjacent construction and surfaces which are damaged or disturbed as a result of alterations.
 - 1.7.26.2. Provide Products, materials, construction, workmanship and finish to match existing unless indicated otherwise.
- 1.7.27. Cutting and Patching - General:
 - 1.7.27.1. Coordinate openings to avoid unnecessary cutting and patching.
 - 1.7.27.2. Coordinate cutting and patching with Subcontractors to avoid unscheduled cutting and patching work.
 - 1.7.27.3. Prior to cutting, sawing, breaking and core drilling provide integrated penetrating system to detect conduits, cables, pipes and similar items in suspended floor slabs and in walls where applicable. Carry out scanning to detect location of live power or energy transmitted from power source such as feeds for electric motors, compressors, heating and cooling systems prior to core drilling and sawing of typical slab on grade.
 - 1.7.27.4. Prior to cutting, sawing, breaking and core drilling through concrete, structural masonry and steel and load bearing members, including floors, ceilings, columns, beams and walls, obtain Consultant's review.
 - 1.7.27.5. Execute cutting neatly and carefully, no larger than necessary, employing workers skilled in erection of the part of the Work being cut.

- 1.7.27.6. Patch parts of the Work to match adjacent construction and finishes unless otherwise specified or indicated on Drawings.
- 1.7.27.7. Provide patching Products equal to existing finishes.
- 1.7.27.8. Join new work to existing in neat, accurate manner.
- 1.7.27.9. Provide soundproof interior junctions.
- 1.7.27.10. Design and provide permanent and temporary reinforcement and supports as directed by Consultant.
- 1.7.27.11. Maintain fire separations and provide fire and smoke penetration sealants in cut and patched parts of the Work.
- 1.7.27.12. Unless otherwise indicated, run piping, ducts and conduit in ceilings and furred spaces. Conceal conduit in walls.
- 1.7.27.13. Saw-cut floors, walls and ceilings accurately. Provide holes and openings no larger than necessary to minimize damage. Core drill circular holes in concrete. Accurately cut new openings for electrical outlets and other recessed items in walls.
- 1.7.27.14. After cutting and patching is completed, refinish surfaces to minimum 100 mm (4") outside patch perimeter, floor to ceiling and to nearest break in wall surfaces, such as inside and outside corners. Match patch finish to existing adjacent surfaces to completely conceal patch.
- 1.7.28. Cutting and Patching - Structural Alterations:
 - 1.7.28.1. Prior to cutting and drilling through structural and load bearing members, (e.g. slabs, columns, beams and shear walls), have Consultant review until no objections are recorded for cut location and layout.
 - 1.7.28.2. Locate existing reinforcement and conduit for Consultant's review before coring or cutting existing or new slabs, beams or walls. Retain an independent testing company to locate existing reinforcement and conduit in the areas of proposed openings and to mark locations of surfaces of slabs and walls on which cores and cuts are started. Scan concrete using non-destructive methods to accurately locate reinforcement and conduit. Remove toppings prior to locating reinforcement and conduit. Mark locations and sizes of cores and openings and locations of reinforcement and conduit using indelible markers with red for top bars, green for bottom bars and black for cores, openings and conduit. Consultant will review marked-up locations once a week. If locations are objected to, relocate proposed openings and repeat process at no extra cost to the Contract.
- 1.7.29. Cutting and Patching - Fire Separation Alterations:
 - 1.7.29.1. Maintain fire separations for duration of work of this Section.
 - 1.7.29.2. Provide fire and smoke penetration sealants at alterations and repairs in accordance with Section 07 84 00.
 - 1.7.29.3. Provide continuous and solid framing, blocking or masonry work around service penetrations through fire separations in accordance with the fire penetration sealant design to maintain the continuity of the fire separation.
- 1.7.30. Cutting and Patching - Mechanical and Electrical Alterations:
 - 1.7.30.1. Provide cutting and patching required for access to execute services' alterations. Conceal capped services unless specifically indicated to remain exposed. Patch to conceal altered and capped services.
 - 1.7.30.2. Provide cutting, e.g., core drilling of existing concrete and masonry walls and slabs, required to pass services through existing assemblies to accommodate alterations.
- 1.7.31. Removal of Flooring and Preparation of Substrate:
 - 1.7.31.1. Remove flooring and adhesive/setting bed materials completely, down to concrete substrate.

- 1.7.31.2. Remove ridges and trowel marks and scrape substrate to a smooth level surface.
- 1.7.31.3. Fill new and existing depressions, dished areas, low spots, voids, gaps, cracks, joints, holes and other substrate defects with skim coat and self-leveling topping to achieve a flat substrate to within following tolerances:
 - 1.7.31.3.1. 3 mm (1/8") total maximum deviation +/- along a 3 m (10') straight edge applied omni-directionally over entire floor area.
- 1.7.31.4. Provide skim coats, primers and bonding agent slurries to neutralize residue adhesives and setting beds and to provide a suitable substrate to receive scheduled floorings.

1.8. CLEANING

- 1.8.1. Progress Cleaning:
 - 1.8.1.1. Keep access areas to Work in tidy condition, free from accumulation of waste products and debris during construction and on completion, other than caused by Owner's crew or other contractors. Do not dispose of volatile fluid wastes (such as mineral spirits, oil or paint thinner) in storm or sanitary sewer systems or into streams or waterways.
 - 1.8.1.2. Keep site and building, including concealed spaces, free from accumulation of dirt, debris, garbage and excess material. Remove oily rags and waste from premises at close of each Day work is performed, or more often if required.
 - 1.8.1.3. Remove waste material and debris from site at end of each Working Day. Remove from finished surfaces deposits which could stain, harden, set or become difficult to remove.
 - 1.8.1.4. Remove rubbish and surplus materials promptly and dispose of in a legal manner. Do not allow scrap piles to accumulate. Do not permit fires.
 - 1.8.1.5. Lower waste materials in a controlled manner with minimum handling; do not drop or throw materials from heights. Schedule cleaning operations so dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces. Sprinkle dusty debris with water.
 - 1.8.1.6. A demolition bin will be allowed on site where directed and as coordinated with Owner.
 - 1.8.1.7. Vacuum-clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.
- 1.8.2. Final Cleaning:
 - 1.8.2.1. Prior to occupancy, clean the Place of the Work thoroughly, free of rubbish and surplus material. Dispose of rubbish and debris. Vacate the Place of the Work in a clean and tidy condition satisfactory to Consultant.
 - 1.8.2.2. Dismantle and remove work of Section 01 50 00 from the Place of the Work.
 - 1.8.2.3. Prior to cleaning, submit to Consultant a complete list of manufacturers' cleaning/maintenance instructions for all components of the Work.
 - 1.8.2.4. Final finishing is in addition to and compatible with cleaning and finishing specified in trade Sections.
 - 1.8.2.5. Clean new and existing components in accordance with manufacturers' recommendations including, but not limited to:
 - 1.8.2.5.1. floors:
 - 1.8.2.5.1.1. Tile Flooring: Sweep floor free of debris; clean corners and base boards free of marks and dirt. Scrub new flooring using appropriate solutions to remove factory installed protective coatings. Strip existing flooring using appropriate chemical solution to remove any existing floor finish coating and base seal coatings. Apply to new and existing flooring 2 coats of sealer recommended by manufacturer of flooring materials. Let floor completely dry between coats. Use prime quality top line Products. Do not apply finish to baseboards.

- 1.8.2.5.1.2. Vacuum carpet flooring using power brush equipped vacuum cleaner. Remove stains using approved stain removal methodology. Where carpet is exposed to extensive dry wall dust and other fine dust particles, carpet shall be pile lifted using rotary pile lifting machine. In addition, carpet shall be cleaned using extraction method approved by manufacturer.
- 1.8.2.5.2. completely dust and remove marks on walls. Where necessary wash wall if painting is not an option.
- 1.8.2.5.3. ceilings.
- 1.8.2.5.4. window coverings.
- 1.8.2.5.5. doors, windows and frames.
- 1.8.2.5.6. exposed interior glazed surfaces.
- 1.8.2.5.7. hardware.
- 1.8.2.5.8. mechanical and electrical fixtures and equipment.
- 1.8.2.5.9. stainless steel, anodized aluminum, brass, bronze and other metals.
- 1.8.2.6. Use experienced cleaners or professional cleaners for final cleaning. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- 1.8.2.7. Final cleaning includes, without limitations, requirements specified herein, removal of surplus materials, tools, construction machinery and equipment from site. Carry out final cleaning in accordance with manufacturer's instructions for each material. Clean Work in accordance with applicable Sections and/or manufacturer's directions.
- 1.8.2.8. Remove stains, spots, marks, dust, smudges caused by Work within work areas of this Contract. Remove from decorative work, electrical and mechanical fixtures, furniture fitments, walls, ceiling and floors.
- 1.8.2.9. Clean and polish interior glass, windows, hardware, stainless steel, chrome, porcelain, baked enamel, plastic laminate, mechanical and electrical fixtures.
- 1.8.2.10. Vacuum clean and dust building interiors, behind grilles, louvres and screens. Vacuum clean ducts, fans, blowers and coils if units were operated without filters during construction.
- 1.8.2.11. Replace broken, damaged, disfigured or scratched glass, which are part of Work.
- 1.8.2.12. Make Good any damage caused outside work area. Include doing necessary cleaning required due to Work.
- 1.8.2.13. Use appropriate apparatus and cleaning materials.
- 1.8.2.14. Close rooms and areas finished by cleaners, painters and decorators to all but authorized persons.
- 1.8.2.15. Upon completion of final cleaning, remove cleaning equipment, excess materials and debris from building and site.

1.9. STARTING AND ADJUSTING

- 1.9.1. Trial Usage and Instructions - Mechanical:
 - 1.9.1.1. Thoroughly instruct Owner's authorized representative(s) in safe operation of systems and equipment after installation and prior to Substantial Performance of the Work. Coordinate with Consultant and arrange schedule for instruction times. Ensure operating, maintenance and or documents have been submitted to Consultant prior to demonstration. Submit a commissioning schedule to Consultant 1 week prior to commissioning of each system.
 - 1.9.1.2. Arrange and pay for services of qualified service engineers and manufacturers' representatives to instruct Consultant on specialized portions of installation, such as refrigeration machines, boilers, automatic controls and water treatment.

- 1.9.1.3. Submit a complete record of instructions as part of maintenance instructions and data book given to Consultant. For each instructional period, supply following data:
 - 1.9.1.3.1. date.
 - 1.9.1.3.2. system or equipment involved.
 - 1.9.1.3.3. names of persons giving instructions.
 - 1.9.1.3.4. names of persons being instructed.
 - 1.9.1.3.5. other persons present.
 - 1.9.1.3.6. carry out instructional period during a continuous period of 30 Days unless otherwise agreed with Consultant.
- 1.9.1.4. Permit Consultant trial usage of systems or parts of systems for purpose of testing and learning operational procedures. Trial usage shall not affect warranties nor be construed as reviewed with no objections recorded and no claim for damage shall be made against Consultant for any injury or breakage to any part or parts of above due to aforementioned tests, where such injuries or breakage are caused by a weakness or inadequacy of parts, or by defective materials or quality of performance of any kind.
- 1.9.1.5. Obtain and submit to Consultant, signature of Owner's representatives stating they understand system and equipment installation, operation and maintenance requirements.
- 1.9.1.6. Obtain and submit to Consultant, letters from manufacturers of equipment and systems indicating their technical representatives have inspected and tested systems and have approved methods of installation, connections and operation.
- 1.9.1.7. Only exception to foregoing requirements for acceptance of equipment and systems, will be 'fine tuning' which may be performed after Substantial Performance of Work and prior to Completion of Contract.
- 1.9.1.8. In conjunction with foregoing requirements, arrange necessary inspections and obtain written approval and acceptance of equipment and systems requiring approval by authorities and correction of unacceptable items to satisfaction of authorities.
- 1.9.2. Trial Usage and Instructions - Electrical:
 - 1.9.2.1. Provide services of manufacturers' specialized representatives to instruct Owner's representatives in operation of systems and equipment after installation and prior to Substantial Performance of Work. Coordinate with Consultant and arrange schedule for instruction times. Ensure operating, maintenance and documents have been submitted to Consultant prior to demonstration. Submit a commissioning schedule to Consultant, 1 week prior to commissioning of each system.
 - 1.9.2.2. Permit Owner's representatives, in order to familiarize themselves with equipment, to operate systems for a reasonable period of time as arranged.
 - 1.9.2.3. Trial usage of equipment by Owner's representatives shall not affect warranties, nor be construed as reviewed with no objections recorded of equipment or system and no claim for damage shall be made against Owner for injury or breakage to any part or parts of above due to aforementioned tests, where such injuries or breakage are caused by a weakness or inadequacy of parts, or by defective materials or quality of performance of any kind.
 - 1.9.2.4. Review information provided in maintenance instructions and data book with Consultant to ensure Owner's representatives have a complete understanding of electrical equipment and systems and their operation.

1.10. PROTECTING INSTALLED CONSTRUCTION

- 1.10.1. Protection of Work During Construction:
 - 1.10.1.1. Provide continuous protection to public, Work, Owner's property and adjacent property during construction. Protect work of other trades from damage while performing subsequent work.

- 1.10.1.2. Protect finished flooring from damage. Make special efforts and take measures when moving heavy loads or equipment over them. Keep floors free of oils, grime, grease or other materials likely to discolour them or affect bond of applied surfaces.
- 1.10.1.3. Protect, relocate and maintain existing, active services wherever they are encountered. Wherever inactive services are encountered, cap them off and remove unwanted portion, with approval of authorities having jurisdiction or public utility concerned in manner approved by them.
- 1.10.1.4. Adequately protect floors and roofs from damage. Take special measures when moving heavy loads or equipment on them.
- 1.10.1.5. Keep floors free of oils, grease or other materials likely to discolour them or affect bond of applied surfaces including fumes generated by temporary heating devices. Take care not to spill or allow oil, grease, gasoline, diesel and fuel oil, chemicals and other substances to contaminate soil or water on or adjacent to site. Should such contamination accidentally occur report it immediately and clean up to satisfaction of Consultant.
- 1.10.1.6. Protect work of other Sections from damage resulting from your work.
- 1.10.1.7. Make Good damaged work wherever possible by Section whose work is damaged but at expense of those causing damage.
- 1.10.1.8. Protect glass and other finishes against heat, slag and weld splatter using suitable protective shields or covers.
- 1.10.1.9. Provide and maintain in working order, suitable Underwriters' labelled fire extinguishers and locate in suitable positions, to approval of authorities having jurisdiction.
- 1.10.1.10. If an authorized visitor wants to access site, they must have their own Person Protection Equipment in possession, if not, they will be denied access immediately.
- 1.10.1.11. Protect public and those employed on Work from injury. Equipment (mobile) when not in use shall have keys removed and locked up in secure location.
- 1.10.2. Correction after Completion: In conformance with General Conditions of the Contract, Make Good any defects and deficiencies due to faulty materials or quality of performance that become apparent in Work within 12 months from date of Certificate of Substantial Performance or for such longer period as specified for certain Products in Contract Documents. Conform to requirements of General Conditions of the Contract and provide Warranty for 12 month period and for extended period where applicable, in writing in an approved form reviewed by Consultant, signed by authorized official of Contractor.

1.11. CLOSEOUT PROCEDURES

- 1.11.1. Final Site Review: Consultant will perform final review in accordance with provisions under final Certificate for Payment. Conform to Construction Act for commencement, procedure and release of hold back fund. Lien Period commencement, procedure and release of hold back monies will be in accordance with Construction Act.
- 1.11.2. Takeover Procedure:
 - 1.11.2.1. Conform to requirements of following General Conditions of Contract for take-over procedure:
 - 1.11.2.1.1. Comply also with recommended takeover procedures contained in OAA/OGCA Document No. 100-2018, except as modified by Contract Documents. In case of conflict with Contract Documents conform to more stringent requirements. Procedure described in document consists of following stages:
 - 1.11.2.1.1.1. Stage 1 Contract Submissions
 - 1.11.2.1.1.2. Stage 2 Contractor's Inspection for Substantial Performance
 - 1.11.2.1.1.3. Stage 3 Contractor's Application for Certificate of Substantial Performance
 - 1.11.2.1.1.4. Stage 4 Certificate of Substantial Performance & Contractor publishes Form 9

- 1.11.2.1.1.5. Stage 5 Certificate for Payment of Basic Statutory Holdback Monies
- 1.11.2.1.1.6. Stage 6 Contractor's Completion of the Contract
- 1.11.2.1.1.7. Stage 7 Certificate for Payment of Monies for Finishing Holdback
- 1.11.2.1.1.8. Stage 8 Final Payment Certificate
- 1.11.2.1.1.9. Stage 9 Warranty-Guarantee Period(s)
- 1.11.2.2. All stages will be reviewed at first Coordination Site Meeting to ensure all parties understand their responsibilities.
- 1.11.3. Substantial Performance Review: Provide a written request to Consultant for Substantial Performance review of Work. Such request shall include a reconciliation of compliance with money test given in Clause 2 (1) (b) of Construction Act in addition to all documentation specified in Contract Documents.
- 1.11.4. Certification of Substantial Performance: Prepare Certificate of Substantial Performance in a form required by Construction Act. When issued attach a normal progress Certificate showing statement of account to date and sub-titled "SUBSTANTIAL PERFORMANCE". Wherever practicable, accompany it with Final Change Order, sub-titled "FINAL". Consolidate all expenditures from cash allowances.
- 1.11.5. Defect and Deficiency:
- 1.11.5.1. A defect is an item of Work required by Contract which has been installed but requires repair and/or replacement at a specific time.
- 1.11.5.2. A deficiency is an item of Work required by Contract which has not been installed or put into operating condition.
- 1.11.5.3. A warranty item is an item of Work, installed under Contract which manufacturer or installer agrees to maintain in, or restore to perfect condition for a specific period of time, after Owner's acceptance of Work as being substantially performed. If a warranty item requires total replacement, new warranty will commence at time of replacement for same warranty period as existing replaced Product.
- 1.11.5.4. When, in Consultant's opinion, Work under Contract is substantially performed and prior to final review by Owner, a preliminary review shall be made at which time defects and deficiencies are listed, taking care to distinguish between preliminary and final reviews.
- 1.11.6. Deficiency Review:
- 1.11.6.1. Provide a written request to Consultant for deficiency review of Work. Ensure such request includes a statement by Contractor that Work to be reviewed by Consultant for deficiencies is, to best of his knowledge, in compliance with Contract Documents, reviewed Shop Drawings, samples and previously instructed corrections by Consultant have been corrected.
- 1.11.6.2. Provide a schedule of planned deficiency reviews having regard to foregoing.
- 1.11.7. Deficiency Lists:
- 1.11.7.1. Neither Owner's representatives, nor Consultant will be responsible for issue of extensive lists of deficiencies. Contractor assumes prime responsibility for ensuring items shown on Drawings and described in Specifications are completely his. Any reviews to approve Certificates of Substantial Performance will be immediately canceled if it becomes obvious that extensive deficiencies are outstanding.
- 1.11.7.2. Promptly correct deficiencies noted by Consultant. Do not proceed with installation of subsequent parts of Work until deficiencies have been corrected. Make every effort to ensure both defects and deficiencies are Made Good prior to final review.
- 1.11.7.3. During review, a decision will be made as to which elements must be completed at a later date due to uncontrollable circumstances such as weather, which defects must be rectified before building can be accepted and which defects are to be treated as warranty items.

- 1.11.7.4. Make Good deficiencies before Contract is considered complete.
- 1.11.7.5. Contractor will provide Consultant an electronic punch list prior to conducting their review. Ensure punch list includes a complete list of items identified in Contract that Contractor and his Subcontractors feel still incomplete or deficient in any way. Effectively identify each room or area so Consultant can reference that room or area in punch list during their review of Work. Deficiency list is made up of items identified in punch list plus any other items found by Consultant deemed to be incomplete or deficient.
- 1.11.8. Notification of Correction of Deficiencies: Advise Consultant in writing, upon completion of rectification of deficiencies noted by Consultant. Failure to provide such notification may be cause to withhold final payment.
- 1.11.9. Documents:
 - 1.11.9.1. Within 21 Days of commencement of Work, Contractor shall make first submittal required by OAA/OGCA Document No. 100-2018.
 - 1.11.9.2. Submit documents in accordance with requirements of Contract Documents.
 - 1.11.9.3. Submit required documents along with request for Certificate of Substantial Performance. Consultant's review for Substantial Performance is not required until such submittal is received.
- 1.11.10. Final Review for Final Payment:
 - 1.11.10.1. Further to requirements of GC 5.4, final review of Work shall constitute review precedent to issuance of final certificate of payment.
 - 1.11.10.2. If there are any further deficiencies determined by this review, they shall be listed by Consultant and provided to Contractor. This list is recognized as final deficiency list for purposes of acceptance of Work under Contract.
 - 1.11.10.3. Such deficiencies shall be corrected by a date mutually agreed upon between Consultant and Contractor, unless a specific date is required by Contract and a re-review by Consultant shall be called for by Contractor following his own review to take place within 7 Days from date of request.
 - 1.11.10.4. Contractor shall thereafter submit his invoice for final payment.
- 1.11.11. End of Warranty Period Review:
 - 1.11.11.1. At beginning of 11th month after Substantial Performance of Contract in accordance with GC12.3, Owner, Contractor and Consultant, along with key Subcontractors as designated by Consultant, carry out a complete review of building and its systems to determine which deficiencies are to be rectified under warranty.
 - 1.11.11.2. Prior to completion of warranty period, arrange with Consultant to carry out complete review of defects and deficiencies which have been observed during warranty period to determine which are to be corrected.

1.12. CLOSEOUT SUBMITTALS

- 1.12.1. Certificate of Substantial Performance:
 - 1.12.1.1. Conform to Construction Act and publish copy of Certificate of Substantial Performance once in a construction trade newspaper.
 - 1.12.1.2. Submit promptly copies of construction trade newspaper containing publication of copy of Certificate of Substantial Performance.
- 1.12.2. As-Built Drawings:
 - 1.12.2.1. Prior to applying for Certification of Substantial Performance, Contractor will provide Consultant a set of As-Built drawings.
 - 1.12.2.2. Add "AS-BUILT" at each Drawing title block.

- 1.12.2.3. Contractor is responsible for:
 - 1.12.2.3.1. maintaining As-Built drawings during progress of work, in complete sets, at the Place of the Work.
 - 1.12.2.3.2. including additional changes over and above those included in any Addenda, Request for Interpretations, Supplemental Instructions, Change Directives and Change Orders.
 - 1.12.2.3.3. including accurate locations, depths, sizes and types of underground utilities and concealed services in the As-Built Drawings.
 - 1.12.2.3.4. incorporating any review comments made by Consultant.
 - 1.12.2.3.5. resubmitting final reviewed set in following format:
 - 1.12.2.3.5.1. 1 electronic set in CAD and PDF formats.
 - 1.12.2.3.5.2. 1 set of white prints.
 - 1.12.2.4. Refer to Divisions 20, 21, 22, 23, 25, 26, 27 and 28 for supplementary requirements.
- 1.12.3. Operation and Maintenance Instructions and Data Book:
 - 1.12.3.1. Provide Consultant with a digital copy of operating and maintenance instructions and data books, 10 Days prior to advising Consultant that Work is substantially performed which include:
 - 1.12.3.1.1. Complete listing of Subcontractors' names, addresses and telephone numbers with notation as to which portions of Contract have been provided by them.
 - 1.12.3.1.2. Complete listing of materials, Products and equipment including serial numbers, manufacturer's names and sources of supply.
 - 1.12.3.1.3. Description of each system, with description of each major component of systems.
 - 1.12.3.1.4. Operation and installation instructions for each assembly, component and system.
 - 1.12.3.1.5. Complete cleaning and maintenance instructions for each finish, assembly, component and system, including warnings of harmful practices.
 - 1.12.3.1.6. Lists of spare parts for each assembly, component and system complete with names, addresses and telephone numbers of Suppliers.
 - 1.12.3.1.7. Operating curves of mechanical and electrical equipment.
 - 1.12.3.1.8. A lubrication schedule of all equipment.
 - 1.12.3.1.9. Page-size Valve Tag Schedule and Flow Diagrams.
 - 1.12.3.1.10. Water treatment procedures and tests.
 - 1.12.3.1.11. Final balancing reports for mechanical systems.
 - 1.12.3.1.12. Installation manual or installation instructions for each mechanical, electrical or architectural item, stamped and signed by Subcontractors submitting them.
 - 1.12.3.1.13. Record drawings of mechanical, electrical and special installations.
 - 1.12.3.1.14. Final reviewed Shop Drawings.
 - 1.12.3.1.15. Copies of all warranties, properly executed.
 - 1.12.3.1.16. Organize and label contents into applicable categories of work, parallel to Specification Sections and provide a Table of Contents.
 - 1.12.3.1.17. Use consistent terminology.
 - 1.12.3.1.18. Submit maintenance and operation instructions which are manufacturer's latest published editions at date of submission.
 - 1.12.3.1.19. Should any finish, Product or assembly be injured or damaged by faulty maintenance materials, practices not warned against in maintenance manual or by failure to provide proper maintenance manuals in time, rectify such damage or injury at no additional cost to Owner.

- 1.12.4. Distribution System Diagrams: Prior to date of Substantial Performance, submit framed single line diagrams of electrical distribution systems.

1.13. DEMONSTRATIONS FOR OWNER'S PERSONNEL

- 1.13.1. Provide qualified technicians to demonstrate operation and/or maintenance of systems to Owner's staff.

1.14. MISCELLANEOUS CLOSEOUT SUBMITTALS

- 1.14.1. Submit following to Owner:
- 1.14.1.1. keys with copy of transmittal submitted to Consultant.
- 1.14.1.2. electrical panel directories, inside panels.
- 1.14.1.3. fire plan graphics.

1.15. PRODUCT WARRANTIES

- 1.15.1. Examine Sections of the Specifications to ensure inclusion of Warranties specified.
- 1.15.2. In addition to requirements of the General Conditions, Article "GC 12.3 WARRANTY", Contractor shall note extended warranty periods required by Contract Documents for certain Products, systems and assemblies as specified under their respective Sections.
- 1.15.3. Typical clause: Similar clause applies to trades listed herein as applicable:
- "WARRANTY:** Warrant Work of aluminum windows against defects and deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner. Defects include but are not limited to failure of system to remain completely weather tight, leaking in excess of specified tolerances and limits, deformation of members, failure of insulated glass units, glass breakage, condensation in excess of specified tolerances and limits, mechanical failure and discolouration of finishes."
- 1.15.4. Spare Parts:
- 1.15.4.1. Supply extra maintenance materials and/or spare parts as required by Contract Documents.
- 1.15.4.2. Suitably package maintenance materials in accordance with manufacturer's instructions and label to identify Product type, manufacturer, Product name, colour number, dye lot and quantity.
- 1.15.4.3. Store maintenance materials, e.g., positioning, proper side up, etc., in accordance with manufacturer's recommendations.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

- 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
- 1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide demolition and salvage including but not limited to following:

1.2.1.1. selective demolition to accommodate alterations.

1.2.1.2. new openings.

1.2.1.3. Items for Salvage:

1.2.1.3.1. 4th floor lockers.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Alteration and repair requirements: Section 01 70 00, Execution and Closeout Requirements.

1.2.2.2. Firestopping and smoke seals: Section 07 84 00, Firestopping and Smoke Seals.

1.2.2.3. Demolition and removal of mechanical equipment services designated for removal on Drawings and as required by Work. Disconnecting and capping prior to authorizing removal: Division 21, Fire Suppression, Division 22, Plumbing and Division 23 Heating, Ventilating and Air Conditioning.

1.2.2.4. Demolition and removal of electrical equipment services designated for removal on Drawings and as required by Work. Disconnecting and capping prior to authorizing removal: Division 26, Electrical, Division 27, Communications and Division 28, Electronic Safety and Security.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. OBC: Ontario Building Code.

1.3.1.2. PCB: Polychlorinated Biphenyls.

1.3.2. Definitions:

1.3.2.1. Hand Demolition: Systematic demolition of structures by workers using hand-held tools.

1.3.2.2. Mechanical Demolition: Systematic demolition of structures using powered equipment.

1.3.2.3. Systematic Demolition: Methodical dismantling of structure piece by piece, usually carried out in reverse order of construction.

1.4. ADMINISTRATIVE REQUIREMENTS

1.4.1. Pre-Demolition Meeting:

1.4.1.1. Prior to start of work, arrange for site meeting of all parties associated with work of this Section. Presided over by Consultant, meeting shall include Contractor, demolition Subcontractor, testing company's representative and structural engineer.

- 1.4.1.2. Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, inspection of construction to be demolished, methods to be used, sequence and quality control, Project staffing, restrictions due to environmental protection requirements and other matters affecting demolition, to permit compliance with intent of this Section. Review structural load limitations of existing structures. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays. Review and finalize protection requirements.

- 1.4.2. Scheduling: Phase selective demolition as indicated on Drawings to accommodate new construction.

1.5. SUBMITTALS

- 1.5.1. Plan of Action:
- 1.5.1.1. Submit in accordance with Section 01 30 00.
- 1.5.1.2. Submit "Plan of Action" immediately after award of Contract for review by Consultant.
- 1.5.1.3. Coordinate demolition times, security requirements and access with Owner.

1.6. QUALITY ASSURANCE

- 1.6.1. Qualifications:
- 1.6.1.1. De-Installers: Employ for this work, a demolition company having 5 years Canadian experience in this type of work satisfactory to Consultant. If requested, submit proof of experience.
- 1.6.1.2. Licensed Professionals: Employ a licensed engineer carrying professional liability insurance and is registered in the Province of Ontario to undertake general review of Project during demolition, prepare plan of action, identify pre tensioned and post tensioned members and engineer temporary shoring, bracing. Inspect and review this work during demolition, fabrication and erection of shoring and bracing. In particular inspect where demolition extends below level of footing of any adjacent building and occurs within angle of repose of soil, drawing from bottom of such footing. Provide site administration and inspection of work of this Section.

1.7. SITE CONDITIONS

- 1.7.1. Ambient Conditions: Demolition performed on this Project in areas which may be partially occupied. Take care and provisions for protection of workers on site and occupants during progress of work.

PART 2 - PRODUCTS

2.1. MATERIALS

- 2.1.1. Description:
- 2.1.1.1. Regulatory Requirements:
- 2.1.1.1.1. Conform to The Occupational Health and Safety Act and Regulation for Construction Projects.
- 2.1.1.1.2. Conform to OBC, especially Division C, Part 1, Article 1.2.2.3 as applicable.
- 2.1.1.1.3. Conform to Fire Code, Regulation under Fire Marshal Act, especially Part 8.
- 2.1.1.1.4. Conform to requirements of Section 01 50 00 in particular, Article on engineering requirements for Temporary Construction.
- 2.1.2. Provide materials necessary for temporary bracing. On completion, remove temporary materials from site.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Preliminary Survey:
 - 3.1.1.1. Before commencing demolition operations, examine site and when requested, provide engineering survey to determine type of construction, condition of structure and site conditions. Assess strength and stability of damaged or deteriorated structures.
 - 3.1.1.2. Assess potential effect of removal of any part or parts on remainder of structure before such part(s) are removed.
 - 3.1.1.3. Investigate for following conditions:
 - 3.1.1.3.1. load-bearing walls and floors.
 - 3.1.1.3.2. structure suspended from another.
 - 3.1.1.3.3. cantilevered construction.
 - 3.1.1.3.4. presence of prestressed or post-tensioned elements.
 - 3.1.1.3.5. presence of hazardous materials.
 - 3.1.1.4. After determining demolition methods, determine area of possible vibration. Carefully inspect beyond those adjacent areas. List potential damage areas and photograph each for record purposes before starting work.
- 3.1.2. Existing Services:
 - 3.1.2.1. Notify Municipality to cut-off, remove and cap Municipal services. Verify services are cut off and properly capped before commencing associated or effected demolition. Cap and cover catch basins outside the building during the work of this Section. Do not allow demolition debris into the drains.
 - 3.1.2.2. Provide and maintain temporary services required during demolition to satisfaction of authorities having jurisdiction, fire departments and utility companies.
 - 3.1.2.3. Verify prior to commencement work of this Section that disconnection and capping of mechanical services have been carried out under Divisions 20, 21, 22 and 23 in accordance with requirements of local authority having jurisdiction. Make sure Natural gas supply lines are removed by Gas Company or by qualified tradesmen in accordance with Gas Company instructions. Removal and disposal of other existing underground services and mechanical equipment shall be by Divisions 20, 21, 22 and 23.
 - 3.1.2.4. Before commencing demolition, contact Electrical Department of local authority and tour site with them. Disconnect and seal electrical power lines and communications cables entering buildings to be demolished. Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.

3.2. PREPARATION

- 3.2.1. Protection of In-Place Conditions:
 - 3.2.1.1. Post danger signs conspicuously around property. If requested, provide a watchman for patrolling site when work is not in progress to prevent public entering danger zone and to maintain barricades.
 - 3.2.1.2. Provide fire extinguishers acceptable to fire prevention authorities in locations and of type suitable to enable personnel to deal with fire occurring during progress of work.

3.3. APPLICATION

3.3.1. Restrictions:

3.3.1.1. Restrict demolition activities between hours of 7:30 a.m. and 5:00 p.m., Monday through Friday.

3.3.1.2. Following methods of demolition will not be permitted in work of this Contract:

3.3.1.2.1. Mechanical method of demolition whereby wrecking is accomplished by smashing walls or floors with heavy weight suspended by cable from boom or hoist or where masonry walls are collapsed using power shovel, tractor or other mechanical contrivance.

3.3.2. Demolition action plans may indicate only general scope of work to be demolished and removed. It is Contractor's sole responsibility to determine exact extent of demolition required. Contractor may not rely solely on Drawings to limit scope of selective demolition work required. Review site conditions and assess exact scope of demolition and removal.

3.3.3. Examine and review existing conditions prior to starting demolition. Initially perform demolition only in selected and designated test areas prior to proceeding full scale demolition work. Review technique for demolition in test areas from Consultant. Only after review has occurred, proceed in other areas.

3.3.4. Do not stack materials and debris in building to extent that overloading of any part of structure will occur.

3.3.5. At end of each Day's work leave work in safe condition ensuring no parts of structure are in danger of collapsing.

3.3.6. Demolition:

3.3.6.1. Ensure demolition work is supervised by structural engineer licensed to practice in Province of Ontario at all times.

3.3.6.2. Demolish structure and remove materials from site. Use hand tools or pneumatic or hydraulic equipment. Adhere to manufacturer's recommendations in use of handheld tools while conforming to the Occupational Health and Safety Act requirements. Lower demolition materials and debris through chutes. Do not create falling materials hazard.

3.3.6.3. Investigate nature and condition of suspended concrete slabs, condition and position of reinforcement. Consult professional engineer qualified to practice in Ontario and qualified with this type of construction for method and sequence of demolition if structure is of post-tensioned construction to avoid uncontrollable failure.

3.3.6.4. Do not demolish spray or trowel-applied friable materials, materials suspected of containing PCBs or other hazardous materials. Where such materials are encountered notify Consultant immediately. Do not proceed until written instructions have been received from Consultant.

3.3.6.5. Remove mechanical and electrical items indicated to be removed.

3.3.6.6. Demolition shall proceed safely in systematic manner from roof to grade, as specified herein, and as necessary to accommodate remedial work indicated. Ensure work on each floor level is complete before commencing work on supporting structure and safety of its supports are impaired. Parts of building which would otherwise collapse prematurely shall be securely shored. Walls and piers shall not be undermined.

3.3.6.7. Neatly cut openings and holes plumb, square and true to dimensions required. Use cutting methods least likely to damage remaining or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3.3.6.8. Separate attached structures by hand demolition prior to general demolition. Separation may be carried out floor by floor in advance of demolition at each level. Demolish masonry and concrete walls in small sections. Remove and lower structural members and other heavy objects with safe and suitable equipment.

- 3.3.6.9. Demolish and remove interior partitions, walls, ceilings, flooring down to concrete substrate, except those specified and/or indicated to remain.
- 3.3.6.10. Keep work wetted down to minimize dust.
- 3.3.6.11. Minimize noise. Avoid use of noisy machinery where possible. Carry out noise work to outside working hours. Submit noisy work plan for Owner's Project Manager's review and approval.
- 3.3.6.12. Remove debris through building. Route will be pre-arranged with Owner. Loading dock access is available but require scheduling in advance with Owner's Project Manager.
- 3.3.6.13. Provide protection around floor and/or roof openings.
- 3.3.6.14. Protect from weather parts of adjoining structures not previously exposed.
- 3.3.6.15. Firestopping and Smoke Seal: In event work of this Section impacts on integrity of fire separations, ensure trade performing firestopping is notified.
- 3.3.7. Building Services:
 - 3.3.7.1. Arrange with Owner to disconnect existing building services. Cut-off and cap existing building services under Owner's supervision. Provide caps to abandoned services.
 - 3.3.7.2. Prevent demolition debris from entering building drains.
- 3.3.8. Salvaged Items: Carefully remove and hand over to Owner 4th floor lockers.
- 3.3.9. Except as indicated on Drawings or designated on site by Consultant, materials forming permanent part of structure being demolished shall become property of this Section. Remove from site.
- 3.3.10. Coordinate with Divisions 20, 21, 22, 23, 26, 27 and 28 respectively for removal, relocation and reinstallation of mechanical and electrical items.
- 3.3.11. Remove electrical equipment scheduled for removal on Drawings and as required by Work.
- 3.3.12. Remove sewer and water lines to extent indicated on Drawing and cap to prevent leakage.
- 3.4. SITE QUALITY CONTROL**
 - 3.4.1. Site Tests and Inspections:
 - 3.4.1.1. Structural Inspection: Ensure a licensed engineer specified herein inspects work of this Section during erection/installation and submits sealed and signed Field Review Report within 5 Days of site visit.
- 3.5. CLEANING**
 - 3.5.1. Waste Management:
 - 3.5.1.1. Clear away dirt, rubbish and loose litter resulting from work of this Section, minimum daily. Keep dust to a minimum. When necessary and practical demolition works shall be sprayed periodically with water to reduce dust. Wet down debris from time to time to control dust. Maintain roadways, lanes and street sidewalks in the vicinity of the premises safe and clear.
 - 3.5.1.2. Selling or burning of materials on site is not permitted.
 - 3.5.1.3. Conform to requirements of authorities having jurisdiction regarding disposal of waste materials.
 - 3.5.1.4. Materials prohibited from municipality waste management facilities shall be removed from site and dispose of at recycling companies specializing in recyclable materials.
 - 3.5.1.5. Any additional materials prohibited from waste management facilities shall be removed from site and dispose of to requirements of authorities having jurisdiction without any additional cost to Owner.

3.6. PROTECTION

- 3.6.1. Do not interfere with use and activities of occupants where applicable and adjacent buildings. Maintain free and safe passage to and from buildings. Maintain integrity of existing fire exits.
- 3.6.2. Protect existing adjacent work against damages which might occur from falling debris or other causes due to work of this Section.
- 3.6.3. Ensure scaffolds, ladders, equipment and other such equipment are not accessible to public. Protect with adequate fencing or remove and dismantle at end of each Day or when no longer required.
- 3.6.4. Where necessary to seal fire exits of adjoining or adjacent buildings, provide other exits in compliance with applicable fire safety and building regulations.
- 3.6.5. Where demolition operations prevent normal access to adjacent properties, provide and maintain suitable alternative access.
- 3.6.6. Erect and maintain partitions as required to prevent spread of dust, fumes and smoke to other parts of building. Maintain fire exits from site. On completion, remove partitions and Make Good surfaces to match adjacent surfaces of building.
- 3.6.7. Before starting demolition, ensure required dust-tight partitions have been installed where necessary.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

- 1.1.1. Read and conform to:
 - 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
 - 1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

- 1.2.1. Section Includes: Provide polished concrete floor finishing including but not limited to following:
 - 1.2.1.1. polished concrete floor finishing system consisting of:
 - 1.2.1.1.1. surface preparation.
 - 1.2.1.1.2. application of clear, colourless, liquid concrete hardener and densifier.
 - 1.2.1.1.3. grinding and polishing floor to desired finish.
 - 1.2.1.1.4. application of water-based concrete enhancer.

1.3. REFERENCES

- 1.3.1. Abbreviations and Acronyms:
 - 1.3.1.1. AODA: Accessibility for Ontarians with Disabilities Act; www.aoda.ca.

1.4. ADMINISTRATIVE REQUIREMENTS

- 1.4.1. Preinstallation Meetings: Arrange preinstallation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, Subcontractor performing concrete finishing, concrete supplier, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.5. SUBMITTALS

- 1.5.1. Product Data:
 - 1.5.1.1. Submit manufacturer's literature, data sheets for typical material provided under this Section for Project. Submit 3 copies of detailed instructions for maintaining, preserving and keeping materials clean and safe. Provide adequate notice of maintenance practices or materials detrimental to specified materials.
 - 1.5.1.2. Submit manufacturer's recommended installation instructions which when reviewed by Consultant will become basis for permitting or rejecting completed Work.

1.6. QUALITY ASSURANCE

- 1.6.1. Qualifications:
 - 1.6.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
- 1.6.2. Mock-Ups: Construct minimum 10 m² (100 sq ft) mock-up sample at Project location designated by Consultant for review. Once reviewed with no objections recorded, sample remains part of finished work and used as a quality reference standard for balance of Project.

1.7. DELIVERY, STORAGE AND HANDLING

- 1.7.1. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying Product name and manufacturer.
- 1.7.2. Storage and Handling Requirements:
- 1.7.2.1. Store materials in a clean dry area in accordance with manufacturer's instructions.
- 1.7.2.2. Keep Products from freezing.
- 1.7.2.3. Avoid direct contact with this Product as it may cause mild to moderate irritation of eyes and/or skin.
- 1.7.2.4. Protect materials during handling and application to prevent damage or contamination.

1.8. SITE CONDITIONS

- 1.8.1. Ambient Conditions:
- 1.8.1.1. Do not apply Product when air, surface, or material temperatures are expected to fall below 4 deg C (40 deg F) within 4 hours of expected application.
- 1.8.1.2. Do not apply to frozen concrete.
- 1.8.1.3. Do not use on highly dense or non-porous surfaces.
- 1.8.1.4. Limit and control damage from excessive dust caused by grinding/polishing procedure.
- 1.8.1.5. Properly dispose of collected dry dust from polishing.

1.9. WARRANTY

- 1.9.1. Manufacturer Warranty: Warrant work of this Section for period of 10 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner. Defects include but are not limited to; bond failure and extensive sheen fading.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
- 2.1.1.1. Euclid Chemical Canada Ltd.; www.euclidchemical.com
- 2.1.1.2. W.R. Meadows of Canada Ltd.; www.wrmeadows.com
- 2.1.2. Substitution Limitations: Comparable Products and systems from other manufacturers not listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

- 2.2.1. Performance/Design Criteria:
- 2.2.1.1. Gloss Levels:

	Level	Grit	Sheen	Min No. of Passes	Appearance	Gloss Reading
2.2.1.1.1.	1	<100	None to very low	4	Flat, Floor has little if any reflectivity	n/a

2.2.1.1.2.	2	100 to 400	Low to medium	5	Satin or matte appearance with or without slight diffuse reflection	40 - 50
2.2.1.1.3.	3	800 & higher	Medium to high	6	Semi-polished. Objects being reflected are not quite sharp and crisp, but can be easily identified	50 - 60
2.2.1.2.	Aggregate Exposure Table:					
	Class	Name		Approx. Surface Cut Depth	Appearance	
2.2.1.2.1.	A	Cream		Very little	Little aggregate exposure	
2.2.1.2.2.	B	Fine Aggregate (Salt & Pepper finish)		1.6 mm (1/16")	Fine aggregate exposure with little or no medium aggregate at random locations	
2.2.1.2.3.	C	Medium Aggregate		3 mm (1/8")	Medium aggregate exposure with little or no large aggregate exposure at random locations	
2.2.1.2.4.	D	Large Aggregate		6 mm (1/4")	Large aggregate with little or no fine aggregate exposure	
2.2.2.	Concrete Densifier: Finish exceeding AODA recommendations for wet and dry surfaces, "Liqui-Hard® Concrete Densifier and Chemical Hardener" by W.R. Meadows of Canada Ltd. or "Euco Diamond Hard" by Euclid Chemical Canada Ltd.					
2.2.3.	Concrete Enhancer: Water-based, synthetic polymer concrete floor enhancer, "Bellatrix" by W.R. Meadows of Canada Ltd. or "UltraGuard" by Euclid Chemical Canada Ltd.					
2.2.4.	Water: Potable water.					
2.3.	EQUIPMENT					
2.3.1.	Use following grinding/polishing equipment:					
2.3.1.1.	Three-head counter rotating variable speed floor grinding machine.					
2.3.1.2.	Dust extraction system and pre-separator.					
2.3.1.3.	75 kw MQ power generator or equivalent.					
2.3.2.	Ensure grinding/polishing equipment possess at least 775 lb of head pressure.					
2.3.3.	Edge Grinding/Polishing: Use a hand grinder with dust extraction equipment					
2.3.4.	Diamond Grinding Segments: Metal bonds: 40, 60, 80 and 150 grit.					
2.3.5.	Diamond Polishing Pads: Resin bonds: 100, 200, 400, 800, 1500, and 3000 grit.					
2.3.6.	Grinding Pads for Edges: Resin bonds: 40, 60, 80, 100, 200, 400, 800, 1500, and 3000 grit.					
2.3.7.	Equipment used for densifying and cleaning floor after grinding/polishing procedure has been performed:					
2.3.7.1.	Tennant ride-on auto-scrubber or equivalent with a head pressure of 150 lb.					
2.3.7.2.	Follow auto-scrubber's manual for cleaning instructions after densifying and conditioning floor.					
2.3.7.3.	Do not allow densifier to remain inside auto-scrubber after densifying.					

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. PREPARATION

- 3.2.1. Protection of In-Place Conditions: Protect adjacent surfaces not designated to receive treatment.
- 3.2.2. Surface Preparation:
 - 3.2.2.1. Clean and prepare surfaces to receive treatment in accordance with manufacturer's instructions, ensuring stains, oil, grease, form release agents, dust and dirt are removed prior to application.
 - 3.2.2.2. Ensure concrete is a minimum of 28 Days old.

3.3. APPLICATION

- 3.3.1. Level 2 – Class B – Satin or Matte Finish: Provide “Induroshine” by W.R. Meadows of Canada Ltd. or “Double Diamond – Satin-Gloss Finish” by Euclid Chemical Company Ltd. ensuring applicator follows applicable procedures incorporating grinding plates in following order:
 - 3.3.1.1. Verify floor is clean and dry prior to polishing procedure.
 - 3.3.1.2. Inspects and verifies floor does not have curled joints, large cracks, spalling or lippage. If lippage or curled joints are present, refer to manufacturer for corrective procedures.
 - 3.3.1.3. Using 30 or 40 grit metal bond grinding segment, grind floor surface at a rate of 46.5 m²/hr (500 sq ft/hr). Vacuum surface to remove loose particulates.
 - 3.3.1.4. Using 80 grit metal bond grinding segment, grind floor surface at a rate of 46.5 m²/hr (500 sq ft/hr). Vacuum surface to remove loose particulates.
 - 3.3.1.5. Using 150 grit metal bond grinding segment, grind floor surface at a rate of 55.7 m²/hr (600 sq ft/hr). Vacuum surface to remove loose particulates.
 - 3.3.1.6. Flood surface with concrete densifier and scrub into floor for 45 minutes, ensuring no puddling of densifier occurs.
 - 3.3.1.7. Squeegee off excess material.
 - 3.3.1.8. Wait 24 hours.
 - 3.3.1.9. Verify floor is dry and clear of debris prior to continuation of polishing procedure.
 - 3.3.1.10. Using 200-grit resin bond polishing segment, grind floor surface at a rate of 65 m²/hr (700 sq ft/hr). If scratches from previous grit are still apparent, decrease rate of grinding by 9.3 m² (100 sq ft) until scratches are removed. Vacuum surface to remove loose particulates.
 - 3.3.1.11. Using 400 grit resin bond polishing segment, grind floor surface at a rate of 65 m²/hr (700 sq ft/hr). If scratches from previous grit are still apparent, decrease rate of grinding by 9.3 m² (100 sq ft) until scratches are removed. Vacuum surface to remove loose particulates.
 - 3.3.1.12. Using auto-scrubber, clean floor thoroughly per manufacturer's instructions with a white non-woven pad. Replace pads approximately every 2790 m² (30,000 sq ft).
- 3.3.2. Concrete Enhancer:
 - 3.3.2.1. Allow 24 hours before proceeding with concrete enhancer application.
 - 3.3.2.2. Apply concrete enhancer, undiluted, according to manufacturer's instructions.

- 3.3.2.3. Spray concrete enhancer using industrial sprayer delivering 0.76 l/s (1/10th gal/min).
- 3.3.2.4. Pre-wet micro-fiber applicator with concrete enhancer prior to use.
- 3.3.2.5. Uniformly spread concrete enhancer with a micro-fiber applicator. Do not allow Product to dry before spreading is complete, keep a wet edge and do not overlap dry areas to avoid lap marks.
- 3.3.2.6. Allow concrete enhancer to set up for 2 hours, then burnish with a 3000 grit diamond pad at 2000 RPM.
- 3.3.2.7. For optimum performance, apply a second coat at a 90° (right) angle to first coat, after first coat is thoroughly dry.

3.4. SITE QUALITY CONTROL

- 3.4.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.5. PROTECTION

- 3.5.1. Keep surface dry for a minimum of 48 hours after application.
- 3.5.2. Allow 72 hours before heavy traffic is allowed.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

- 1.1.1. Read and conform to:
 - 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
 - 1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

- 1.2.1. Section Includes: Provide cast cement underlayment including but not limited to following:
 - 1.2.1.1. gypsum cement underlayment.
 - 1.2.1.2. hydraulic cement underlayment.

1.3. REFERENCES

- 1.3.1. Abbreviations and Acronyms:
 - 1.3.1.1. SDS: Safety Data Sheets.
- 1.3.2. Reference Standards:
 - 1.3.2.1. ASTM C472-20 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete

1.4. ADMINISTRATIVE REQUIREMENTS

- 1.4.1. Preinstallation Meetings: Arrange preinstallation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.5. SUBMITTALS

- 1.5.1. Product Data: Submit manufacturer's Product data, performance criteria and other documentation for each material specified in this Section proposed for use.

1.6. QUALITY ASSURANCE

- 1.6.1. Qualifications:
 - 1.6.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
- 1.6.2. Mock-Ups: Construct minimum 10 m² (100 sq ft) mock-up sample at Project location designated by Consultant for review. Once reviewed and no objections recorded, sample remains part of finished work and used as a quality reference standard for balance of Project.

1.7. DELIVERY, STORAGE AND HANDLING

- 1.7.1. Storage and Handling Requirements:
 - 1.7.1.1. Store materials on site in manner to prevent damage thereto. Protect materials from inclement weather.
 - 1.7.1.2. Refer to Product SDS for precautionary measures during storage and handling.

1.8. SITE CONDITIONS

1.8.1. Ambient Conditions:

- 1.8.1.1. Temporary Lighting: Minimum 1-200 W light source, placed 2.5 m (8') above floor surface, for each 40 m² (430 sq ft) floor being finished.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:

- 2.1.1.1. ARDEX Group; www.ardex.ca
- 2.1.1.2. CGC Inc.; www.cgcinc.com
- 2.1.1.3. ChemRex; www.chemrex.com
- 2.1.1.4. CPD Construction Products; www.cpd.ca
- 2.1.1.5. Custom Building Products; www.customtechflooring.com
- 2.1.1.6. Euclid Chemical Canada Inc.; www.euclidchemical.com
- 2.1.1.7. MAPEI Inc.; www.mapei.ca
- 2.1.1.8. Maxxon Canada; www.maxxon.ca
- 2.1.1.9. Sika Canada Inc.; www.sika.ca

- 2.1.2. Substitution Limitations: Comparable Products from manufacturers listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

- 2.2.1. Self-Leveling Topping: Provide 1 of following:

- 2.2.1.1. ARDEX Cementitious Self-Leveling Floor Underlayment: "ARDEX V 1200™, ARDEX K 15®, ARDEX K 16™, ARDEX SD-T®" or commercial topping in accordance with manufacturer's recommendations for following:
- 2.2.1.1.1. Typical leveling without short downtime limitation requirements: "ARDEX V 1200™" by ARDEX Group normal setting polymer-modified self-leveling 0 mm - 25 mm (0" - 1") underlayment with a compressive strength greater than 31 MPa (4,500 psi).
- 2.2.1.1.2. Where fast track or thicker applications are required: "ARDEX K 15®" by ARDEX Group high-performance fast-setting self-leveling 0 mm - 38 mm (0" - 1-1/2") underlayment with a compressive strength greater than 38 MPa (5,500 psi).
- 2.2.1.1.3. Where extended flow and skim coat self-leveling properties are required: "ARDEX K 16™" by ARDEX Group fast setting, skim coat 0 mm - 25 mm (0" - 1") cement based concrete topping and underlayment with a compressive strength greater than 36 MPa (5,300 psi).
- 2.2.1.1.4. Self-leveling high strength concrete wear topping: "ARDEX SD-T®" by ARDEX Group premium fast setting self-leveling grey or white 0 mm - 50 mm (0" - 2") cement based concrete topping and underlayment with a compressive strength greater than 42 MPa (6,100 psi).
- 2.2.1.1.5. Use "ARDEX P 51™" porous substrate primer, "ARDEX P 82™" non-porous substrate primer: by ARDEX Group in accordance with manufacturer's recommendations for various substrates such as concrete, wood, cut back adhesives, epoxy, terrazzo, quarry and ceramic.
- 2.2.1.1.6. Use "ARDEX Feather Finish®", "ARDEX SD-P®" by ARDEX Group for isolated re-slope areas, isolated bug holes, isolated defect areas, non-moving cracks and seams, various repair or resurfacing areas.

- 2.2.1.2. Custom Building Products cementitious self-leveling floor underlayment: "CustomTech™ TechLevel™ 100", "CustomTech™ TechLevel™ 150", "CustomTech™ TechLevel™ XP-1™", "TechLevel-HPT" or commercial topping in accordance with manufacturer's recommendations for following:
 - 2.2.1.2.1. Without short downtime limitations requirements: "CustomTech™ TechLevel™ 100" by Custom Building Products normal setting polymer-modified self-leveling 0 mm - 38 mm (0" - 1-1/2") underlayment with a compressive strength greater than 27.5 MPa (4000 psi).
 - 2.2.1.2.2. Without short downtime limitations requirements: "CustomTech™ TechLevel™ 150" by Custom Building Products normal setting calcium aluminate-based self-leveling 0 mm - 38 mm (0" - 1-1/2") underlayment with a compressive strength greater than 29.6 MPa (4300 psi).
 - 2.2.1.2.3. Without short downtime limitations requirements: "CustomTech™ TechLevel™ XP-1™" by Custom Building Products normal setting calcium aluminate-based self-leveling 0 mm - 50 mm (0" - 2") underlayment with a compressive strength greater than 37.9 MPa (5500 psi).
 - 2.2.1.2.4. Without short downtime limitations requirements: "TechLevel-HPT" by Custom Building Products fast-setting self-leveling 6 mm - 25 mm (1/4" - 1") self-leveling high strength concrete wear topping with a compressive strength greater than 14.4 MPa (6000 psi).
 - 2.2.1.2.5. Use "TechPrime A Acrylic Primer" porous and non-porous substrate primer: by Custom Building Products in accordance with manufacturer's recommendations for various substrates such as concrete, wood, cut back adhesives, epoxy, terrazzo, quarry and ceramic.
 - 2.2.1.2.6. Use "Silk™ Patching & Finishing Compound" by Custom Building Products for isolated re-slope areas, isolated bug holes, isolated defect areas, non-moving cracks and seams, various repair or resurfacing areas.
- 2.2.1.3. MAPEI Inc. cementitious self-leveling floor underlayment: "Novoplan® 2 Plus, Ultraplan® 1 Plus, Ultraplan® M20 Plus" or commercial topping in accordance with manufacturer's recommendations for following:
 - 2.2.1.3.1. Without short downtime limitations requirements: "Novoplan® 2 Plus" by MAPEI Inc. normal setting polymer-modified self-leveling 0 mm - 25 mm (0" - 1") underlayment with a compressive strength greater than 29 MPa (4200 psi).
 - 2.2.1.3.2. Where short downtime limitations are required: "Ultraplan® 1 Plus" by MAPEI Inc. high-performance fast-setting self-leveling 0 mm - 38 mm (0" - 1-1/2") underlayment with a compressive strength greater than 31 MPa (4500 psi).
 - 2.2.1.3.3. Where extended flow characteristics are required: "Ultraplan® M20 Plus" by MAPEI Inc. fast setting self-leveling 0 mm - 50 mm (0" - 2") cement based concrete topping and underlayment with a compressive strength greater than 34.4 MPa (5000 psi).
 - 2.2.1.3.4. Self-Leveling Concrete Wear Topping: "Ultraplan® M20 Plus" by MAPEI Inc. fast setting self-leveling 13 mm - 50 mm (1/2" - 2") cement based concrete topping and underlayment with a compressive strength greater than 34.4 MPa (5000 psi).
- 2.2.1.4. Maxxon Canada Level Right-FS 10, Cementitious Self-Leveling Poured Floor Underlayment: Floor, Level Right-Plus, Level-Right or Commercial Topping in accordance with manufacturer's recommendations for following:
 - 2.2.1.4.1. Level-Right FS 10: 0 mm - 9 mm (0" - 3/8") thickness; up to 7000 psi, thin topping self levelling floor underlayment for topping concrete or precast. Proper surface preparation shall be provided such shot blasting or epoxy primers; remove tile glue and adhesive or other exterior foreign materials.
 - 2.2.1.4.2. Level-Right Plus: 0 mm - 38 mm (0" - 1-1/2"), up to 7000 psi, thick self levelling floor underlayment for unlevelled concrete or precast, pre-filling deep holes with aggregate and other similar materials.

- 2.2.1.4.3. Level-Right (non-polymer): 0 mm - 75 mm (0" - 3"), up to 5500 psi; surface preparation shall be subject to site conditions. Use over polystyrene foam, lightweight concrete, precast, terrazzo flooring, ceramic, quarry and marble tile, adhesive, tile and concrete. Over wood frames use metal lath for reinforcement.
- 2.2.1.4.4. Level-Right WearTop: Self-leveling cement-based topping for resurfacing interior concrete to provide level and smooth floors areas requiring a hard, smooth, flat concrete surface. Apply permitted sealer just 2 hours after installation except when an epoxy or other floor covering will be installed.
- 2.2.1.5. Sika cementitious self-leveling floor underlayment: "Sika Level 125, Sika Level 125 Rapid, Sikafloor Level 25" in accordance with manufacturer's recommendations for following:
 - 2.2.1.5.1. Without short downtime limitations requirements: "Sika Level 125" by Sika Canada Inc. polymer-modified self-leveling 0 mm - 25 mm (0" - 1") underlayment with a compressive strength greater than 29 MPa (4200 psi).
 - 2.2.1.5.2. Where short downtime limitations are required: "Sika Level 125 Rapid" by Sika Canada Inc. rapid strength gain, fast-setting self-leveler 0 mm - 25 mm (0" - 1") underlayment with a compressive strength greater than 38 MPa (5500 psi).
 - 2.2.1.5.3. Self-leveling concrete wear topping "Sikafloor Level 25" by Sika Canada Inc. rapid setting, polymer modified, self-leveling cementitious topping 5 mm - 25 mm (1/4" - 1") with a compressive strength greater than 38 MPa (5500 psi).
 - 2.2.1.5.4. Use "Sika Level 01 Primer, Sika Level 02 Primer, Sika Level 03 Primer" by Sika Canada Inc. in accordance with manufacturer's recommendations for various substrates such as concrete, wood, cut back adhesives, epoxy terrazzo, quarry tile and ceramic tile.
 - 2.2.1.5.5. Use "Sika Level Patch, Sika Level Skim Coat, Sika Level Screed" by Sika Canada Inc. for isolated re-slope areas, isolated bug holes, isolated defect areas, non-moving cracks and seams, various repair or resurfacing areas. Consult manufacturer's written instructions for specific uses.
- 2.2.2. Other Permitted Products and Manufacturers: "Super Flo-Top" by Euclid Chemical Canada Inc., "Levelrock 4500" by CGC Inc., Industrial Product Group, "Floor Leveller C26 UL" by Target Products Ltd., "Sonoflow" by ChemRex or "CPD® Topcrete SL" by CPD Construction Products.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Self-levelling Topping:
 - 3.2.1.1. Ensure sub-floor is structurally sound. Clean sub-floor and remove mud, oil, grease other contaminating materials.
 - 3.2.1.2. Grind and patch existing concrete slabs as required; level slabs, clean surfaces, remove adhesives and residues. Surfaces shall be smooth, clean, free of gouges, matter detrimental to bond of leveling coat and/or flooring and shall be ready to receive flooring.
 - 3.2.1.3. Make Good existing floor substrates suitable to receive thin, direct applied floor finishes including but not limited to scraping, grinding, patching and latex modified cementitious overlays as required.

- 3.2.1.4. Patch damaged sub-floor with patching compound compatible with leak proof sealants and leveling topping and its primer. Seal cracks and voids with approved leak proof sealants compatible with self-leveling topping and its primer.
- 3.2.1.5. Level all slabs to accommodate flooring with self-leveling underlayment. All floor areas shall be flush with adjacent areas. Prepare mix in accordance with manufacturer's instructions. Prepare for flush application of new flooring material. Provide aluminum retaining angles or other suitable means of containing leveling coat in areas required.
- 3.2.1.6. Apply primer at recommended rate. Ensure area is enclosed from exterior elements and proper ventilation and required temperature is maintained. Place topping at recommended thickness and spread and screed to smooth surface. Dry self-leveling topping to finished floor applicator's requirements. Apply sealers to seal cementitious underlayment prior to installation of glue down flooring application. Ensure sealers are compatible with finish floor adhesive and installation systems.
- 3.2.1.7. Provide slump test verifying conformance to manufacturer's requirements. Perform slump test at beginning of each installation to verify required slump. Test cubes in accordance with modified ASTM C472.
- 3.2.1.8. Provide protection from heavy loads during construction when floor is subject to wheeled or concentrated loads.

3.3. SITE QUALITY CONTROL

- 3.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide structural metal stud framing system including but not limited to following:

1.2.1.1. structural metal stud framing system in interior wall assemblies including:

1.2.1.1.1. wall studs subjected to lateral loads (no axial loads other than self weight and weight of applied finishes).

1.2.1.1.2. steel bridging.

1.2.1.1.3. top and bottom track.

1.2.1.1.4. head, sill and jamb members for wall openings.

1.2.1.1.5. studs, bridging and track connections.

1.2.1.1.6. top and bottom connections to structure complete details to accommodate structure deflections.

1.2.1.2. exterior sheathing.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of adhesive and insulation: Section 07 21 00, Building Insulation.

1.2.2.2. Provisions of flexible air vapour barriers to maintain integrity of air/vapour barrier: Section 07 25 00, Miscellaneous Air/Vapour Barriers.

1.2.2.3. Provision of sealants and caulking: Section 07 92 00, Joint Sealants.

1.2.2.4. Provision of non-structural interior metal stud framing: Section 09 21 16, Gypsum Board Assemblies.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. OBC: Ontario Building Code.

1.3.2. Reference Standards:

1.3.2.1. ASTM A653/A653M-25a - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.3.2.2. ASTM A792/A792M-25a - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process

1.3.2.3. ASTM C1177/C1177M-24 - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing

1.3.2.4. ASTM D3273-21 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

1.3.2.5. ASTM E84-25 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.3.2.6.	ASTM E136-26	- Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C
1.3.2.7.	CSA S136-16(21)	- North American specification for the design of cold-formed steel structural members
1.3.2.8.	CSA W47.1:19(24)	- Certification of companies for fusion welding of steel structures
1.3.2.9.	CSA W59:24	- Welded steel construction
1.3.2.10.	CAN/ULC-S101-14	- Standard Methods of Fire Endurance Tests of Building Construction and Materials
1.3.2.11.	CAN/ULC-S102:19(24)	- Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
1.3.2.12.	CAN/ULC-S114-18	- Standard Method of Test for Determination of Non-Combustibility in Building Materials

1.4. SUBMITTALS

- 1.4.1. Product Data: Submit Product data for mechanical fasteners indicating sizes, load capacities and type of corrosion protection.
- 1.4.2. Shop Drawings:
- 1.4.2.1. Submit Shop Drawings of work of this Section in accordance with Section 01 30 00.
- 1.4.2.2. Submit Shop Drawings showing, in as large a scale as possible, details and erection diagrams, indicate member sizes, locations, thicknesses exclusive of coating, coating materials, provision for expansion and contraction, details of other pertinent components of work and adjacent constructions to which this work shall be attached. Include connection details for attaching framing to itself and for attachments to structure. Show splice details where details permitted. Indicate profiles, dimensions, openings, requirements of related work and critical installation procedures. Show temporary bracing required for erection purposes.
- 1.4.2.3. Ensure a licensed engineer specified herein is responsible for:
- 1.4.2.3.1. production and review of Shop Drawings.
- 1.4.2.3.2. sealing and signing each Shop Drawing and any associated calculations performed.
- 1.4.3. Submit 1 representative piece of each framing component, including mechanical fasteners to be used. Length of pieces submitted shall be 300 mm (12") long.
- 1.4.4. If requested by Consultant, submit calculations certified by a licensed engineer to design structures and registered in Province of Ontario, substantiating sizes for members and connections based on the design loads before fabrication and erection. Indicate design loads on Shop Drawings.
- 1.4.5. Samples: Submit samples in accordance with Section 01 30 00. Submit following samples in sizes indicated:
- 1.4.5.1. One 300 mm x 300 mm (12" x 12") sample of exterior sheathing.

1.5. QUALITY ASSURANCE

- 1.5.1. Qualifications:
- 1.5.1.1. Installers: Provide work of this Section executed by competent installers with minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
- 1.5.1.2. Licensed Professionals: Employ a licensed engineer carrying professional liability insurance and is registered in the Province of Ontario.

- 1.5.2. Certifications: Ensure maximum deflections under specified loads conform to L/360. Limit deflection so integrity of air/vapour barrier will be maintained at design loading. Permanent deformation of members due to applied loads is not permitted. Notwithstanding limits specified herein, structural steel framing system shall not deflect under design loads sufficient to cause noise, breaking of sealants, or to break integrity of insulation thermal blanket or air/vapour barrier seal.
- 1.5.3. Mock-Ups: Conform to requirements of Section 01 40 00. Construct 1 typical site mock-up of structural metal stud framing assemblies. Provide mock-up approximately 2400 mm x 2400 mm (8' x 8'). Do not commence work of this Section until mock-up has been reviewed with no objections recorded by Consultant.

1.6. DELIVERY, STORAGE AND HANDLING

- 1.6.1. Delivery and Acceptance Requirements:
- 1.6.1.1. Deliver materials in original, unopened containers or bundles stored in a place providing protection from damage and exposure to exterior elements.
- 1.6.1.2. Transport materials in a manner to prevent damage.
- 1.6.2. Storage and Handling Requirements: Store and handle materials in a manner to prevent damage. Store units off ground and protected from mud and rain splashes.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
- 2.1.1.1. Bailey Metal Products Ltd.; www.bmp-group.com
- 2.1.1.2. CertainTeed Corporation; www.certainteed.com
- 2.1.1.3. CGC Inc.; www.cgcinc.com
- 2.1.1.4. Dass Metal Studs; www.dassmetal.com
- 2.1.1.5. Fusion Building Products; www.imperialgroup.ca
- 2.1.1.6. Georgia-Pacific Canada, Inc.; www.buildgp.com
- 2.1.1.7. Roll Formed Specialty; www.rollformed.com

2.2. MATERIALS

- 2.2.1. Description:
- 2.2.1.1. Regulatory Requirements: Work of this Section to conform to requirements of local jurisdictional authorities.
- 2.2.2. Performance/Design Criteria:
- 2.2.2.1. Exterior cladding for this Project is based on "Rain Screen" design principle as recommended by Division of Building Research of National Research Council of Canada. This principle requires that construction behind cladding act as an air and vapour barrier to prevent passage of moisture-laden air and diffusion of water vapour. Construction behind cladding shall accommodate installation of sealants, insulation, compartmentalization of air space, air/vapour barrier system and drainage slots as required and shown. To ensure provision for continuity of thermal blanket, vapour/air barrier within construction specified herein and with adjacent barrier construction is part of responsibility of this Section.
- 2.2.2.2. Base design on Limit States Design principles using factored loads and resistance. Determine resistance and resistance factors in accordance with OBC and CSA S136 requirements.

- 2.2.2.3. Determine loads and load factors in accordance with OBC requirements. For wind load calculations, base velocity pressure on 1 in 30 probability of being exceeded in any 1 year for design strength and 1 in 10 for deflection.
- 2.2.2.4. Conform to requirements of fire rated assemblies which have been tested in accordance with CAN/ULC-S101 and provide fire resistance rating noted on Drawings.
- 2.2.2.5. Design metal framing based on stud depth shown on Drawings. Adjust stud material thicknesses and spacings as required to meet design criteria. Use of greater or lesser depths only if reviewed with Consultant.
- 2.2.2.6. Design metal framing based on wall stud spacing at 300 mm (12") or 400 mm (16") maximum. Use lesser stud spacing if required to meet design criteria.
- 2.2.2.7. Design metal framing for wall studs system supporting brick veneer with minimum design thickness exclusive of coating of 1.12 mm (0.044").
- 2.2.2.8. Design metal framing with minimum design thickness for bridging channel of 1.22 mm (0.044"). Use greater bridging channel thickness to meet design criteria.
- 2.2.2.9. Design metal framing with minimum design thickness for clips shall be 1.52 mm (0.052"). Use greater clip thickness to meet design criteria.
- 2.2.2.10. Design metal framing exterior wall systems and their connections to withstand their own weight, weight of exterior sheathing, motion of operable elements, minimum design loads, pressure, suction of wind and internal pressure. Limit maximum flexural stud deflection under specified wind loads to L/360.
- 2.2.2.11. Design connections to accommodate vertical deflection movement of structure, frame shortening and vertical tolerances without imposing axial loads on to framing. Leave a minimum gap of 13 mm (1/2"). Larger gaps may be required to accommodate structural movement. Co-ordinate with design requirements.
- 2.2.2.12. Limit free play and movement in connections perpendicular to plane of framing to +/-0.51 mm (0.02") relative to building structure.
- 2.2.2.13. Design components and assemblies to accommodate specified erection tolerances of structure.
- 2.2.2.14. Design bridging to prevent member rotation and member translation perpendicular to minor axis. Provide for secondary stress effects due to torsion between lines of bridging. Do not rely on collateral sheathing to help restrain member rotation and translation perpendicular to minor axis. Provide bridging at 1500 mm (60") oc maximum. Space bridging at equal intervals over span length of member. Closer spacings may be required to satisfy structural design requirements.
- 2.2.2.15. Design anchorage and splice details for bridging.
- 2.2.2.16. Design for local loading due to anchorage of cladding and interior wall mounted fixtures where required to meet design requirements.
- 2.2.2.17. Use bolts, welding or sheet metal screws for connections between wind bearing steel stud members.
- 2.2.2.18. Provide head, sill and jamb members and connections to frame openings larger than 100 mm (4") in any dimension.
- 2.2.2.19. Anchor top and bottom track to structure at a maximum spacing of 800 mm (32") oc. Closer spacings may be required to satisfy structural design requirements.
- 2.2.2.20. Construct work to provide for expansion and contraction of components as will be caused by ambient temperature range without causing buckling, failure of joint seals, undue stress on fasteners or other effects detrimental to appearance or performance.
- 2.2.2.21. Compute section properties on basis of nominal core thickness.
- 2.2.2.22. Design bridging to prevent member rotation and member translation perpendicular to minor axis. Provide for secondary stress affects due to torsion between lines of bridging.

- 2.2.2.23. Structural Design: Employ a licensed engineer specified herein to:
 - 2.2.2.23.1. design components for work of this Section requiring structural performance.
 - 2.2.2.23.2. be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.
- 2.2.3. Structural Metal Stud Framing:
 - 2.2.3.1. Ensure steel conforms to requirements of CSA S136 and is identified as to specification, grade, mechanical properties and coating type and thickness.
 - 2.2.3.2. Ensure steel has metallic coatings conforming to 1 of following ASTM Standards:
 - 2.2.3.2.1. ASTM A653/A653M.
 - 2.2.3.2.2. ASTM A792/A792M.
 - 2.2.3.2.3. Ensure interior structural steel studs and tracks have a minimum coating of Z180 (G60) galvanizing in accordance with ASTM A653/A653M. Other coatings (e.g. aluminum-zinc alloy to ASTM A792/A792M) providing equal or better corrosion protection may be used.
 - 2.2.3.2.4. Ensure wind bearing steel studs and tracks have a minimum coating of Z275 (G90) galvanizing in accordance with ASTM A653/A653M. Other coatings (e.g. aluminum-zinc alloy to ASTM A792/A792M) providing equal or better corrosion protection may be used.
 - 2.2.3.3. Wind bearing steel studs and tracks minimum 150 mm (6") wide, minimum 33 mils designation thickness (0.836 mm (0.0329") base steel thickness) of following minimum grades conforming to requirements of CSA S136:
 - 2.2.3.3.1. Grade A (33 ksi yield) @ min 43 mils designation thickness (1.087 mm (0.0428") base steel thickness).
 - 2.2.3.3.2. Grade D (50 ksi yield) @ min 54 mils designation thickness (1.367 mm (0.0538") base steel thickness) and 68 mils designation thickness (1.720 mm (0.0677") base steel thickness).
 - 2.2.3.4. Design Deflection at Maximum Wind Load: Maximum L/360.
 - 2.2.3.5. Size: 150 mm (6") unless otherwise indicated.
 - 2.2.3.6. Design Wind Loading: As noted herein in accordance with OBC.
 - 2.2.3.7. Maximum Span: As noted herein.
 - 2.2.3.8. Top Track: Telescopic 2 piece slip track. Fill deflection cavity with batt insulation.
 - 2.2.3.9. Bottom Track: Provide 9 mm (3/8") diameter weep holes draining through exterior flange at 800 mm (32") oc.
 - 2.2.3.10. Colour code ends of individual gauges of studs as follows:
 - 2.2.3.10.1. 43 mils designation thickness (1.087 mm (0.0429") base steel thickness): yellow.
 - 2.2.3.10.2. 54 mils designation thickness (1.367 mm (0.0538") base steel thickness): green.
 - 2.2.3.10.3. 68 mils designation thickness (1.720 mm (0.0677") base steel thickness): orange.
 - 2.2.3.10.4. 97 mils designation thickness (2.454 mm (0.0966") base steel thickness): red.
 - 2.2.3.10.5. 118 mils designation thickness (2.997 mm (0.1180") base steel thickness): blue.
 - 2.2.3.11. Design structural metal stud framing system without relying on sheathing or metal airseal to resist torsion and weak axis buckling.
 - 2.2.3.12. Provide bridging at a maximum of 1200 mm (4') oc.

- 2.2.4. Zinc-Rich Paint: Repair damaged galvanized surfaces with "METALHIDE® ONE PAC | 97-676" by PPG Architectural Coatings; www.ppg.com, "Zinc Clad® 5 Organic Zinc-Rich Primer" by The Sherwin-Williams Company; www.sherwin-williams.com or "ZRC® Cold Galvanizing Repair Compound" by ZRC Worldwide; www.zrcworldwide.com.
- 2.2.5. Bituminous Paint: To provide dielectric separation and which will dry to be tack-free and able to withstand high temperatures.
- 2.2.6. Exterior Sheathing: Provide glass mat reinforced, treated core gypsum board conforming to ASTM C1177/C1177M, non-combustible according to ASTM E136/CAN/ULC-S114, flame spread 0, smoke developed 0 to ASTM E84/CAN/ULC-S102 and ASTM D3273 with a rating of 10, no mould growth after 4 weeks exposure, 13 mm (1/2") or 16 mm (5/8") thick gypsum board 1200 mm (4') wide by maximum practical length, tapered edge as required, "DensGlass® Sheathing" by Georgia-Pacific Canada, Inc., "GlasRoc Sheathing" by CertainTeed Corporation or "Securock Glass-Mat Sheathing" by CGC Inc.
- 2.2.7. Fabrication:
- 2.2.7.1. Do not commence fabrication until Shop Drawings and erection drawings have been reviewed and samples have been reviewed with no objections recorded.
- 2.2.7.2. Insofar as practical, execute fitting and assembly in shop with various parts or assemblies ready for erection at building site.
- 2.2.7.3. Provide cutouts centred in webs of members to accommodate services. Limit dimensions of unreinforced cutouts to suite design requirements and effects on strength and stiffness of members.
- 2.2.7.4. Take field measurements and levels required to verify or supplement those shown on Drawings for proper layout and installation of work. Coordinate dimensional tolerances in adjacent building elements and confirm prior to commencement of work.
- 2.2.7.5. Accurately machine file and fit frames rigidly together at joints, corners and mitres. Match components carefully to produce perfect continuity of line and design.
- 2.2.7.6. Fabrication Tolerances: Provide light-weight steel framing true and plumb within following tolerances:
- 2.2.7.6.1. Track and Framing:
- 2.2.7.6.1.1. Member Depth: ± 0.76 mm (± 0.03 ").
- 2.2.7.6.1.2. Flange Width: ± 0.76 mm (± 0.03 ") (where exterior board is attached directly to flange).
- 2.2.7.6.1.3. Minimum Flange Width: 32 mm (1-1/4").
- 2.2.7.6.1.4. Lip length: +3 mm (+1/8").
- 2.2.7.6.1.5. Thickness: -0 mm (-0").
- 2.2.7.6.1.6. Corner Angles: $\pm 3^\circ$.
- 2.2.7.6.1.7. Framing Length: ± 3 mm ($\pm 1/8$ ").

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. ERECTION

- 3.2.1. Ensure erection conforms to reviewed Shop Drawings. Methods of construction may be either piece by piece (stick-built) or by fabrication into panels (panelized) either on or off site.
- 3.2.2. Erect work plumb, true and in proper alignment and relationship to established lines and grades. Submit modifications required to accommodate as built conditions (other than minor dimensional changes) for review.
- 3.2.3. Employ temporary bracing whenever necessary to withstand all loads to which structure may be subjected during erection and subsequent construction. Leave temporary bracing in place as long as required for safety and integrity of structure. Ensure during erection a margin of safety consistent with requirements of OBC and CSA S136 is provided.
- 3.2.4. Wind Bearing Stud Erection:
 - 3.2.4.1. Install studs at 300 mm (12") or 400 mm (16") oc maximum. Ensure studs seat into top and bottom tracks. Ensure gap between end of stud and web of track does not exceed 4.8 mm (3/16"). Allow 19 mm (3/4") minimum at top of framing for anticipated floor slab deflection, unless otherwise noted on Structural Drawings.
 - 3.2.4.2. Align adjacent or abutting members in same plane to within 0.5 mm (0.02") maximum.
 - 3.2.4.3. Ensure spacing of studs is not more than +/-3 mm (+/-1/8") from design spacing. Ensure cumulative error in spacing does not exceed requirements of finishing materials.
 - 3.2.4.4. Align web cut-outs in studs as required for installation of through-the-knockout style bridging and services.
 - 3.2.4.5. Make field measurements necessary to insure proper fit of members.
 - 3.2.4.6. Reinforce cut-outs where distance from centreline of cut-out to end of member is less than 300 mm (6"). Submit reinforcing detail for review.
 - 3.2.4.7. Ensure holes field cut into lightweight steel framing members conform to requirements specified herein.
 - 3.2.4.8. Replace damaged members from site.
 - 3.2.4.9. Unless a closer spacing is shown on shop requirements of OBC and Drawings, anchor top and bottom tracks securely to structure at 800 mm (32") oc maximum. Place 1 additional anchor within 100 mm (4") of end of each piece of track and additionally as required by Shop Drawings.
 - 3.2.4.10. Install additional studs at abutting walls, openings, terminations against other materials and on each side at corners unless explicitly detailed otherwise on Shop Drawings.
 - 3.2.4.11. Place insulation in jamb and header assemblies that may be inaccessible after their installation into wall. Insure insulation is kept dry and not compressed.
 - 3.2.4.12. Handling and lifting of prefabricated panels shall not cause permanent distortion to any member or collateral material.
- 3.2.5. Fasteners and Welds:
 - 3.2.5.1. Ensure connected parts are in contact. Provide clamping before welding or installing screws.
 - 3.2.5.2. Ensure companies engaged in welding are certified by Canadian Welding Bureau to CSA W47.1. Ensure companies have welding procedures approved and welders qualified for base material types and thicknesses being welded.
 - 3.2.5.3. Ensure welds conform to CSA S136 or CSA W59, whichever is applicable.
 - 3.2.5.4. For material less than 1.6 mm (1/16") thick, Shop Drawings may show nominal weld leg sizes. For such material, ensure effective throats of welds are not less than thickness of thinnest connected part.

- 3.2.5.5. Touch-up welds and coatings damaged by welding with zinc rich paint. Prior to touching-up prepare surface in accordance with paint manufacturer's recommendations.
- 3.2.5.6. Sheet metal screw thread types, drilling capability and installation conform to manufacturer's recommendations. Ensure sheet metal screws are minimum diameter indicated on Shop Drawings but not less than a #8. Provide sheet metal screws covered by sheathing materials with low profile heads. Penetration beyond joined materials shall be not less than 3 exposed threads. Secure steel stud framing to bottom track with minimum #8 x 13 mm (1/2") long screws both sides of framing.
- 3.2.5.7. Base resistance for sheet metal screws on manufacturer's lower bond test values multiplied by appropriate resistance factor, diameter is given in CSA S136.
- 3.2.6. Mechanically fasten track and clip angles to concrete slab by drill-in fastenings. Bear cost of repair satisfactory to Consultant of concrete chipped by drilling or fixing operations.
- 3.2.7. Secure framing at top with sliding connection. Provide inner and outer track deflection head under steel beams and decks.
- 3.2.8. Field Cutting:
 - 3.2.8.1. Cut members using saw or shear. Torch cutting is not permitted.
 - 3.2.8.2. Limit field cut holes into light-weight steel framing to 64 mm (2-1/2") maximum across member web 110 mm (4-3/8") maximum along member length, 610 mm (24") oc minimum.
 - 3.2.8.3. Apply 1 coat of zinc-rich paint to galvanized surfaces which have been damaged or had coating removed.
 - 3.2.8.4. Co-ordinate with other Sections for installation of anchors and ties required for work specified under other Sections.
- 3.2.9. Exterior Sheathing:
 - 3.2.9.1. Provide exterior sheathing in accordance with manufacturer's instructions.
 - 3.2.9.2. Minimum Fastening Requirements:
 - 3.2.9.2.1. Perimeter Edge of Each Board: 200 mm (8") oc max.
 - 3.2.9.2.2. Intermediate Supports: 300 mm (12") oc max.
 - 3.2.9.3. Provide exterior sheathing neatly with tight butt joints and without gaps and holes.
 - 3.2.9.4. Bear edges of exterior sheathing fully onto structural framing.
 - 3.2.9.5. Do not crush exterior sheathing edges.
 - 3.2.9.6. Do not countersink fasteners below exterior paper skin of exterior sheathing boards.
 - 3.2.9.7. Secure exterior sheathing to exposed leg of inner track of telescopic 2-piece top track.
 - 3.2.9.8. Provide ready to receive air/vapour barrier membrane.
- 3.2.10. Tolerances: For purpose of this work, camber is defined as deviation from straightness of a member or any portion of a member with respect to its major axis and sweep is defined as deviation from straightness of a member or any portion of a member with respect to its minor axis:
 - 3.2.10.1. Ensure out of plumbness does not exceed L/500 of member length; out of straightness (camber or sweep) not to exceed L/1000 of member length.
 - 3.2.10.2. For track, camber not to exceed L/1000 of member length.
 - 3.2.10.3. Do not space framing more than 3 mm (1/8") from design spacing. Ensure cumulative error in spacing does not exceed requirements of finishing materials.

3.3. SITE QUALITY CONTROL

- 3.3.1. Site Tests and Inspections: Inspection includes:
- 3.3.1.1. Consultant may appoint an independent air seal system consultant for:
 - 3.3.1.1.1. checking mill test reports are properly correlated to materials; welded and screwed connections, connections to main structure member, sizes, location and material and coating thicknesses.
 - 3.3.1.1.2. sampling fabrication and erection procedures for general conformity to requirements of Contract Documents.
 - 3.3.1.1.3. checking fabricated members against specified member shapes.
 - 3.3.1.1.4. sample checking of screwed and bolted joints.
 - 3.3.1.1.5. sample checking that tolerances are not exceeded.
 - 3.3.1.1.6. general inspection of field cutting and alterations required by other trades.
 - 3.3.1.1.7. submission of reports to Consultant, Owner and local jurisdictional authorities covering work inspected with details of deficiencies discovered.
 - 3.3.1.2. Structural Inspection: Ensure a licensed engineer specified herein inspects work of this Section during erection/installation and submits sealed and signed Field Review Report within 5 Days of site visit.
- 3.3.2. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.4. CLEANING

- 3.4.1. Keep installed work clean as work progresses.
- 3.4.2. Clean and Make Good surfaces soiled or otherwise damaged in connection with this work. Pay cost of replacing finishes or materials that cannot be satisfactorily touched up, cleaned or have been damaged by improper cleaning materials and methods.
- 3.4.3. Upon completion of this work, remove debris, equipment and excess material resulting from this work from site.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide metal fabrications including but not limited to following:

1.2.1.1. metal supports associated with architectural woodwork.

1.2.1.2. steel brackets for oxygen tanks.

1.2.1.3. miscellaneous steel fabrications and/or framing required for structural support not specifically described on Structural Drawings, engineered to suit applications indicated on Drawings.

1.2.1.4. other miscellaneous sections and framing required to complete the Work and/or inferable in Contract Documents but not explicitly shown on Drawings.

1.2.1.5. other miscellaneous sections and framing as defined under "Appendix F" of CISC Code of Standard Practice for Structural Steel.

1.2.2. Products installed but not supplied under this Section:

1.2.2.1. ceiling mounting rails in Research Lab 524B.

1.2.3. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.3.1. Provision of architectural woodwork: Section 06 40 00, Architectural Woodwork.

1.2.3.2. Provision of finish paint system: Section 09 91 00, Painting.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. CISC: Canadian Institute of Steel Construction; www.cisc-icca.ca.

1.3.1.2. DFT: Dry Film Thickness.

1.3.1.3. SSPC: The Society for Protective Coatings (formerly known as Steel Structures Painting Council); www.sspc.org.

1.3.2. Reference Standards:

1.3.2.1. ASTM A307-21 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

1.3.2.2. CSA G40.20-13(23) - General requirements for rolled or welded structural quality steel

1.3.2.3. CSA G40.21-13(23) - Structural quality steel

1.3.2.4. CSA W48:23 - Filler metals and allied materials for metal arc welding

1.3.2.5. CSA W59:24 - Welded steel construction

1.3.2.6. CSA W117.2:25 - Safety in welding, cutting, and allied processes

1.3.2.7. SSPC-SP 6/NACE No. 3-06 - Commercial Blast Cleaning

1.3.2.8. CISC Code of Standard Practices for Structural Steel, Eight Edition

1.4. SUBMITTALS

- 1.4.1. Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00. In addition to minimum requirements indicate following:
 - 1.4.1.1. large scale details of members, materials and connections.
 - 1.4.1.2. jointing details.
 - 1.4.1.3. methods of setting, sealing, securing, anchorage.
 - 1.4.1.4. field connections.
 - 1.4.1.5. Ensure a licensed engineer specified herein is responsible for:
 - 1.4.1.5.1. production and review of Shop Drawings.
 - 1.4.1.5.2. sealing and signing each Shop Drawing and any associated calculations performed.
- 1.4.2. Samples: Submit samples of exposed metal fabrications in accordance with Section 01 30 00 representing final finish.

1.5. QUALITY ASSURANCE

- 1.5.1. Qualifications:
 - 1.5.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
 - 1.5.1.2. Welding: Provide welding in accordance with CSA W59 performed by a fabricator and mechanics fully approved by the Canadian Welding Bureau.
 - 1.5.1.3. Licensed Professionals: Employ a licensed engineer carrying professional liability insurance and is registered in the Province of Ontario.
- 1.5.2. Certifications:
 - 1.5.2.1. Submit certification from a licensed engineer registered in Province of Ontario, who shall affix his/her seal and signature to certificate, stating structure is capable of supporting its own weight and specified live loads.
 - 1.5.2.2. Welders employed on this Project may be asked by Consultant at any time for their welding certificate.

1.6. DELIVERY, STORAGE AND HANDLING

- 1.6.1. Delivery and Acceptance Requirements: Coordinate deliveries to comply with construction schedule and arrange ahead for strategic off-the-ground, undercover storage locations. Do not load areas beyond the designed limits.
- 1.6.2. Storage and Handling Requirements:
 - 1.6.2.1. Handle and store metal materials at job site in such a manner to prevent damage to other materials, (to existing buildings) or property.
 - 1.6.2.2. Handle components with care and provide protection for surfaces against marring or other damage. Ship and store members with cardboard or other resilient spacers between surfaces. Use lifting chokers of material that will not damage surface of steel members.

PART 2 - PRODUCTS

2.1. MATERIALS

- 2.1.1. Performance/Design Criteria:
 - 2.1.1.1. Structural Design: Employ a licensed engineer specified herein to:
 - 2.1.1.1.1. design components for work of this Section requiring structural performance.
 - 2.1.1.1.2. be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.
 - 2.1.2. Structural Shapes, Plates, Etc.: New material conforming to CSA G40.20 and CSA G40.21, Grade 300W.
 - 2.1.3. Hollow Structural Sections (HSS): New material conforming to CSA G40.20 and CSA G40.21, Grade 350W, Class H.
 - 2.1.4. Welding Materials: Conforming to CSA W48 and CSA W59.
 - 2.1.5. Common or Ordinary Bolts and Anchor Bolts: Unfinished bolts conforming to ASTM A307, Grade A, with hexagon heads and nuts where exposed in the finish work. Supply common bolts of lengths required to suit thickness of material being joined, but not projecting more than 6 mm (1/4") beyond nut, without the use of washers. Supply anchor bolts of lengths noted but projecting not less than 13 mm (1/2") beyond nut unless otherwise noted.
 - 2.1.6. Dielectric Separator: Provide best grade, quick drying non-staining alkali resistant bituminous paint or epoxy resin solution or membrane type.
 - 2.1.7. Galvanized Primer Paint: "METALHIDE® ONE PAC | 97-676" by PPG Architectural Coatings; www.ppg.com, "Zinc Clad® 5 Organic Zinc-Rich Primer" by The Sherwin-Williams Company; www.sherwin-williams.com or "ZRC® Cold Galvanizing Repair Compound" by ZRC Worldwide; www.zrcworldwide.com.
 - 2.1.8. Fabrication:
 - 2.1.8.1. Fabricate each item of work of this Section in accordance with following general requirements:
 - 2.1.8.1.1. members square and straight.
 - 2.1.8.1.2. members plumb and true.
 - 2.1.8.1.3. joints accurately and tightly fitted.
 - 2.1.8.1.4. intersecting members in true, flush planes.
 - 2.1.8.1.5. fasteners concealed.
 - 2.1.8.1.6. steel connections.
 - 2.1.8.2. Fabricate, fit and assemble work in shop where possible. Where shop fabrication is not possible, make trial assembly in shop.
 - 2.1.8.3. Provide hangers, rods, bars, bolts, anchors, brackets, rivets, bearing plates and bracing, fitting, drilling, stopping, soldering, as required for a complete assembly.
 - 2.1.8.4. Isolate dissimilar metals including stainless steel and galvanized steel using dielectric separator to prevent galvanic corrosion.
 - 2.1.8.5. Weld connections unless otherwise indicated.

- 2.1.8.6. Shop Welding:
 - 2.1.8.6.1. Execute welding to avoid damage or distortion to the Work. Should there be, in the opinion of Consultant or Inspection Company, doubt as to adequacy of welds, they shall be tested for efficiency and any work not meeting Standards be removed and replaced with new work satisfactory to Consultant. Carry out welding in accordance with following standards:
 - 2.1.8.6.1.1. CSA W48 - for Electrodes (If rods are used, only coated rods are allowed).
 - 2.1.8.6.1.2. CSA W59 - for design of connections and workmanship.
 - 2.1.8.6.1.3. CSA W117.2 - for safety.
 - 2.1.8.6.2. Thoroughly clean welded joints and steel exposed for a sufficient space to properly perform welding operation. Neatly finish welds. Ensure welds exposed to view and finish painted are continuous and ground smooth.
- 2.1.8.7. Provide exposed metal fastenings and accessories of same material, texture, colour and finish as base metal to which they are applied or fastened.
- 2.1.9. Finishes:
 - 2.1.9.1. Cleaning and Shop Painting:
 - 2.1.9.1.1. Clean steel to SSPC-SP 6/NACE No. 3 and remove loose mill scale, weld flux and splatter.
 - 2.1.9.1.2. Shop prime steel with 1 coat of primer paint to DFT of 0.025 mm (1 mil). Paint on dry surfaces, free from rust, scale and grease. Do not paint when temperature is lower than 7 deg C (45 deg F). Paint items under cover and leave under cover until primer is dry. Follow paint manufacturer's recommendations regarding application methods, equipment, temperature and humidity conditions.
 - 2.1.9.1.3. Shop prime galvanized steel with galvanized primer paint.
 - 2.1.9.1.4. Clean but do not paint surfaces being welded in the field and surfaces in contact after assembly.
 - 2.1.9.2. Colours:
 - 2.1.9.2.1. MET-1: Stainless steel, random orbital finish (countertops).
 - 2.1.9.2.2. MET-3: Cold rolled steel, painted, colour: to be chosen.
 - 2.1.9.2.3. MET-3a: Cold rolled steel, powder coated PT-1A.
 - 2.1.9.2.4. MET-3b: Cold rolled steel, powder coated PT-2.
 - 2.1.9.2.5. MET-3c: Cold rolled steel, powder coated PT-5.
 - 2.1.9.2.6. MET-3: Hot rolled steel, painted matte finish (intumescent paint on structural steel).

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Erect work of this Section plumb, square, true and level.
- 3.2.2. Securely anchor work of this Section and rivet, weld or bolt to structural framing of the building. Where secured to concrete, provide bolts for setting in concrete. Provide expansion bolt supports to masonry.

3.2.3. Provide necessary fitting, setting and cutting required in connection with the fitting of work of this Section to other parts of the Work.

3.2.4. Field Painting: Paint bolt heads, washers, nuts, field welds and previously unpainted items. Touch up with matching paint, shop primer damaged during transit and installation.

3.3. SITE QUALITY CONTROL

3.3.1. Site Tests and Inspections:

3.3.1.1. Structural Inspection: Ensure a licensed engineer specified herein inspects work of this Section during erection/installation and submits sealed and signed Field Review Report within 5 Days of site visit.

3.3.2. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.4. CLEANING

3.4.1. On completion of installation, carefully clean metal work.

3.5. SCHEDULES

3.5.1. ARCHITECTURAL WOODWORK

3.5.1.1. Provide miscellaneous steel items required as part of work of Section 06 40 00, e.g.: valance supports, vanity support brackets.

3.5.1.2. Finish: Prime painted.

3.5.2. MISCELLANEOUS SECTIONS AND FRAMING

3.5.2.1. Provide miscellaneous steel sections as defined under "Appendix F" of CISC Code of Standard Practice for Structural Steel which are not shown or identified on Structural Drawings or specified under another Section of Specifications.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide rough carpentry including but not limited to following:

1.2.1.1. miscellaneous interior carpentry.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of architectural woodwork: Section 06 40 00, Architectural Woodwork.

1.2.2.2. Provision of plywood associated with acoustic floor system: Section 13 48 00, Acoustic Isolated Floating Floors.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. NLGA: National Lumber Grades Authority; www.nlga.org

1.3.1.2. ULC: Underwriters Laboratories of Canada; www.canada.ul.com.

1.3.2. Definitions:

1.3.2.1. Exposed Framing: Framing not concealed by other construction.

1.3.2.2. Dimension Lumber: Lumber of 50 mm (2") nominal or greater but less than 5" nominal in least dimension.

1.3.2.3. Timber: Lumber of 125 mm (5") nominal or greater in least dimension.

1.3.3. Reference Standards:

1.3.3.1. CAN/ULC-S102-18 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.4. QUALITY ASSURANCE

1.4.1. Certifications:

1.4.1.1. Grading:

1.4.1.1.1. Provide lumber bearing the grading stamps of an agency certified by the Canadian Lumber Standards Administration Board for identification.

1.4.1.1.2. Provide "fire treated" wood and plywood bearing the stamp of the Canadian Wood Preservers Bureau.

1.5. DELIVERY, STORAGE AND HANDLING

1.5.1. Storage and Handling Requirements:

1.5.1.1. Store lumber in a dry place and protect from dampness and damage.

1.5.1.2. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1. MATERIALS

- 2.1.1. Softwood Lumber: Of grades conforming to NLGA's "Standard Grading Rules for Canadian Lumber", graded as follows:
 - 2.1.1.1. Light Framing: Species Group D, Standard Grade.
 - 2.1.1.2. Studding: Species Group D, Stud Grade.
 - 2.1.1.3. Structural Light Framing: Species Group D, No. 1 Grade.
 - 2.1.1.4. Appearance Lumber: Species Group B, Appearance Grade.
- 2.1.2. Hardwood Lumber: Of grades conforming to grading rules of U.S. National Hardwood Lumber Association, solid White Oak, select or better.
- 2.1.3. Concealed Framing Lumber: No. 2 White Pine, No. 2 Red Pine, or No. 1 Construction Eastern Spruce, Balsam Fir or Jack Pine, kiln dried, free from sap, shakes, splits, knots and other defects.
- 2.1.4. Grounds, Nailing Strips and Blocking: No. 2 White Pine, No. 2 Red Pine, or No. 1 Construction Eastern Spruce, kiln dried, free from sap, shakes, splits, knots and other defects.
- 2.1.5. Rough Hardware: Supply rough hardware to frame and fix rough carpentry. This includes bolts, anchors, nails, expansion shields and other fastenings required. Hot dip galvanize hardware for exterior work; elsewhere, provide cadmium plated hardware. Provide spiral thread nails except as indicated otherwise.
- 2.1.6. "Fire Treated" Wood and Plywood:
 - 2.1.6.1. Flame Spread: Max 25 in 30 minutes in accordance with CAN/ULC-S102.
 - 2.1.6.2. Provide fire treated wood kiln dried to max 19% moisture content.
 - 2.1.6.3. Do not resurface or rip fire treated wood if it affects the ULC Label.
 - 2.1.6.4. Provide fire treated material bearing stamp of Canadian Wood Preservers Bureau and ULC stamp.
 - 2.1.6.5. Permitted Products: "Dricon® FS" by Arxada; www.arxada.com or "FlamePro®" by Timber Specialties Co.; www.timberspecialties.com.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Properly frame together parts of the Work with members accurately cut to size, closely fitted, well spiked and erected in a substantial manner, plumb, level, square and true to dimension.
- 3.2.2. Locate joints over bearing or supporting surfaces.
- 3.2.3. Provide running members full length wherever possible.
- 3.2.4. Design for expansion and contraction of the materials.
- 3.2.5. Provide fasteners and rough hardware for a rigid and secure installation.

- 3.2.6. Miscellaneous Interior Carpentry: Provide "fire treated" plywood, blocking, furring, nailers, rough carpentry, grounds and nailing strips as indicated and/or as required for proper installation.

3.3. SITE QUALITY CONTROL

- 3.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.4. PROTECTION

- 3.4.1. Protect rough carpentry from weather.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

- 1.1.1. Read and conform to:
 - 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
 - 1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

- 1.2.1. Section Includes: Provide architectural woodwork including but not limited to following:
 - 1.2.1.1. laminated casework.
 - 1.2.1.2. casework drawers and doors.
 - 1.2.1.3. edgebanding for casework and casework doors.
 - 1.2.1.4. casework hardware.
 - 1.2.1.5. wood base (B1).
- 1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:
 - 1.2.2.1. Provision of solid surface countertops: Section 06 61 16, Solid Surfacing Fabrications.
 - 1.2.2.2. Supply of hollow metal doors and frames: Section 08 11 13, Hollow Metal Doors and Frames.
 - 1.2.2.3. Supply of plastic laminate wood doors: Section 08 15 00, Plastic Laminate Wood Doors.
 - 1.2.2.4. Supply of door hardware: Section 08 71 00, Door Hardware.
 - 1.2.2.5. Glass and glazing: Section 08 80 00, Glass and Glazing.
 - 1.2.2.6. Building in and anchoring of steel frames in gypsum board partitions: Section 09 21 16, Gypsum Board Assemblies.
 - 1.2.2.7. Provision of pre-engineered sound absorption ceiling panel system: Section 09 84 13, Fixed Sound-Absorptive Panels.
 - 1.2.2.8. Filling nail holes and provision of finish painting: Section 09 91 00, Painting.

1.3. REFERENCES

- 1.3.1. Abbreviations and Acronyms:
 - 1.3.1.1. AWMAC/WI: Architectural Woodwork Manufacturers Association of Canada/Woodwork Institute; www.awmac.com.
 - 1.3.1.2. MDF: Medium Density Fibreboard.
 - 1.3.1.3. NAAWS: North American Architectural Woodwork Standards – 4.0, 2021, as amended.
 - 1.3.1.4. NEMA: National Electrical Manufacturers Association; www.nema.org.
- 1.3.2. Reference Standards:
 - 1.3.2.1. ANSI/NPA A208.2-22 - Medium Density Fiberboard (MDF) for Interior Applications
 - 1.3.2.2. ANSI/NEMA LD 3-05 - High-Pressure Decorative Laminates
 - 1.3.2.3. ASTM E84-25 - Standard Test Method for Surface Burning Characteristics of Building Materials
 - 1.3.2.4. CSA O153:19(24) - Poplar plywood

1.4. SUBMITTALS

- 1.4.1. Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00 and Section 01 of NAAWS. Clearly indicate material being supplied and show connections, attachments, reinforcing, anchorage and location of exposed fastenings.
- 1.4.2. Samples: Submit samples in accordance with Section 01 30 00 in following sizes:
 - 1.4.2.1. minimum 300 mm (12") square x 25 mm (1") thick solid wood.
 - 1.4.2.2. each type of hardware.

1.5. QUALITY ASSURANCE

- 1.5.1. Qualifications:
 - 1.5.1.1. Provide work of this Section in accordance with NAAWS produced by AWMAC/WI, except as specified otherwise herein and by reference are hereby made a part of this Section. Ensure any reference to grades and terminology in this Section is as defined in NAAWS.
 - 1.5.1.2. Requirements of this Section govern and modify NAAWS.
 - 1.5.1.3. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified.

1.6. DELIVERY, STORAGE AND HANDLING

- 1.6.1. Delivery and Acceptance Requirements:
 - 1.6.1.1. Do not deliver finished Products during rainy or damp weather.
 - 1.6.1.2. Do not deliver work of this Section until building and storage areas are sufficiently dry so Products will not be damaged by excessive changes in moisture content.
 - 1.6.1.3. Deliver Products of this Section in accordance with Section 13, 13.5.1.2 of NAAWS.
 - 1.6.1.4. Do not deliver damaged Products.
- 1.6.2. Storage and Handling Requirements:
 - 1.6.2.1. Store and handle Products of this Section in accordance with Section 13, 13.5.1.3 and 13.5.1.4 of NAAWS.
 - 1.6.2.2. Cover finished plastic laminate surfaces and varnished surfaces with heavy kraft paper and put in cartons for protection. Protect installed plastic laminate surfaces by acceptable means. Do not remove protective covers until immediately prior to final cleaning.

1.7. WARRANTY

- 1.7.1. Manufacturer Warranty: Warrant work of this Section for a period of 2 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner. Defects include but are not limited to, delamination of plastic laminate, opening of seams, warpage and extensive colour fading.

PART 2 - PRODUCTS

2.1. MATERIALS

- 2.1.1. Performance/Design Requirements:
 - 2.1.1.1. Ensure millwork (e.g. countertops, wall cabinets, etc.) are capable of supporting structural loads without deflection in accordance with "Casework Integrity Testing" in "Appendix" of NAAWS.
- 2.1.2. Framing Lumber: Select Merchantable Western White Spruce, kiln dried, or sound material of any species may be used for concealed members, free from sap, shakes, knots, splits and other defects.

- 2.1.3. Architectural Lumber:
 - 2.1.3.1. Clear, straight, kiln dried, White Oak, rift cut. Provide kiln dried lumber to 7% moisture content, free from blemishes that would be apparent after finish is applied.
 - 2.1.3.2. Finishes:
 - 2.1.3.2.1. WD-1: Stained and sealed, matte finish.
 - 2.1.3.2.2. WD-2: Stained (to match P.LAM) and sealed (sheen to match P.LAM).
 - 2.1.4. WD-3: Solid Poplar with paint finish, colour to be selected later by Consultant.
- 2.1.5. Plywood (WD-1A): Architectural Grade Selected White Oak veneer, rift cut, stained and sealed, matte finish.
- 2.1.6. Solid Birch: Of uniform grain and colour, Premium Grade.
- 2.1.7. High Pressure, Paper Base, Decorative Laminates (P.LAM):
 - 2.1.7.1. Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
 - 2.1.7.1.1. Wilsonart Canada; www.wilsonart.com
 - 2.1.7.2. Provide types and thicknesses conforming to ANSI/NEMA LD 3 and Section 04, "Table: 04-009 – HPL TYPES and MINIMUM PERFORMANCE REQUIREMENTS" of NAAWS.
 - 2.1.7.3. Colour and Finish (P.LAM-1): "Landmark Wood 7981K-12".
- 2.1.8. Plastic Laminate Adhesive: Provide in accordance with Section 04, 04.5.5.2 and "Adhesive Usage Guide" in "Appendix" of NAAWS.
- 2.1.9. Wood Cores:
 - 2.1.9.1. MDF Core: Medium density panels, Grade 155 in accordance with ANSI/NPA A208.2, balanced design, manufactured from 100% recycled materials, without use of formaldehyde resins and density of 740-770 kg/m³ (46-48 lb/cu ft) and surface character to match sample in Consultant's possession. Ensure fire retardant Product contains fire-retardant chemicals injected with raw materials during manufacturing and achieve a maximum Flame Spread rating of 25 with a maximum Smoke Developed of 200 when tested to ASTM E84. Do not use MDF panels in moist areas. "MDF Excel+" by Uniboard Canada Inc.; www.uniboard.com or CanFibre Group Ltd.
 - 2.1.9.2. Plywood Core (Veneer): Poplar plywood conforming to CSA O153, Grades A and B.
- 2.1.10. Casework Hardware: Provide following hardware:
 - 2.1.10.1. Shallow Drawer Slides: "8357" by Knappe & Vogt Manufacturing Company; www.knappeandvogt.com or "3832EC" by Accuride; www accuride.com, full extension type with a capacity of 34 kg (75 lb).
 - 2.1.10.2. Deep Drawer Slides: "8500" by Knappe & Vogt Manufacturing Company or "4005" by Accuride, full extension type with a capacity of 68 kg (150 lb).
 - 2.1.10.3. Flipper Door Slides (Non-adjustable): "1432" by Accuride; www accuride.com or Knappe & Vogt Manufacturing Company; www.knappeandvogt.com.
 - 2.1.10.4. Shelf Pins: Nickel-plated metal, minimum 5 mm diameter pin, "Art. No. 282-04-711" by Hafele Canada; www.hafele.ca or "331 ANO" by Knappe & Vogt Manufacturing Company; www.knappeandvogt.com. Provide 4 pins per shelf.
 - 2.1.10.5. Recessed Shelf Pilasters, Standards and Clips: Provide "255 ZC, zinc finished" pilaster and "256 ZC, zinc finished" clip supports by Knappe & Vogt Manufacturing Company; www.knappeandvogt.com or "120-10 Series" pilasters and "1903-2G" clip supports by Richelieu Hardware Ltd.; www.richelieu.com.

- 2.1.10.6. Concealed Hinges: European style "CLIP top" by Blum Canada Ltd.; www.blum.com, "NEXIS IMPRESSO 65" by Grass Canada Inc.; www.grass.at or "Salice 200 Series, 165" by Hafele Canada; www.hafele.ca minimum 170 degree opening angle and is self closing. Supply manufacturer's recommended number of hinges to suit door size and thickness.
- 2.1.10.7. Piano Hinges: Nickel plated finish; "Product #3225180" by Richelieu Hardware Ltd.; www.richelieu.com. Provide piano hinges along full length of door.
- 2.1.10.8. Wire Pulls (Doors and Drawers): "Art. No. 115.61.601" by Hafele Canada, 106 mm (4-3/16") long x 10 mm (13/32") dia., matte stainless steel finish.
- 2.1.10.9. Magnetic Catches: Aluminum finished economy magnetic catch with a pull strength of 22.2 to 48.9 N (5 to 11 lbs); "Model 918 ALUM" by Knape & Vogt Manufacturing Company.
- 2.1.10.10. Door and Drawer Locks: Keyed cylinder cam lock type C4 (brushed chrome) finish by Hafele Canada. Ensure double doors received "Double Door Latch Kit" by Richelieu Hardware Ltd.
- 2.1.10.11. Pivot hinge: Norton Rixson 117 pivot set. Finish to be selected by Consultant.
- 2.1.11. Provide locks for 50% of doors and drawers to be installed where located later by Consultant prior to occupancy.
- 2.1.12. Finishing:
- 2.1.12.1. Prime unexposed surfaces including backs of fitments against walls and underside of fitments.
- 2.1.12.2. Before priming, treat knots and sap streaks, with a coat of shellac/sealer and then prime with a wood primer.
- 2.1.12.3. Shop finish natural finished wood surfaces.

2.2. COMPONENTS

- 2.2.1. Supply casework conforming to Section 10 of NAAWS as applicable.
- 2.2.2. Casework for Plastic Laminate Finish:
 - 2.2.2.1. AWMAC/WI Quality Grade: Custom.
 - 2.2.2.2. Construction: Ensure casework conforms to Section 10 of AWS.
 - 2.2.2.3. Exposed Parts Core: Composition board (MDF).
 - 2.2.2.4. Exposed Parts Finish: Plastic laminate; HGS for horizontal surfaces and VGS for vertical surfaces in accordance with Section 10, 10.2 SURFACE DEFINITIONS of NAAWS.
 - 2.2.2.5. Semi-Exposed Parts Core: Composition board (MDF).
 - 2.2.2.6. Semi-Exposed Parts Finish: Plastic laminate; HGS for horizontal surfaces and VGS for vertical surfaces in accordance with Section 10, 10.2 SURFACE DEFINITIONS of NAAWS.
 - 2.2.2.7. Concealed Parts Finish: Backing sheet as required for balance.
- 2.2.3. Edgebanding: As per Section 10, 10.5.6 of NAAWS.
- 2.2.4. Wood Base:
 - 2.2.4.1. Interior for Opaque Finish:
 - 2.2.4.1.1. AWMAC/WI Quality Grade: Custom.
- 2.2.5. Field Touch-Up: Field touch-up is responsibility of installing trade or architectural woodwork manufacturer providing it is responsible for factory finishing. Field touch-up includes filling and touch-up of exposed job-made nail and screw holes, refinishing of raw surface resulting from job fitting, repair of job-inflicted scratches and mars and final cleaning up of finished surfaces.
- 2.2.6. Fabrication:
 - 2.2.6.1. Fabricate joints accurately fitted, coped where possible and well glued up. Fabricate joints mitred to perfect fit and alignments carefully matched.

- 2.2.6.2. Fabricate finished woodwork in 1 piece where possible. Fabricate running members in the longest lengths obtainable.
- 2.2.6.3. Fabricate to conceal fastenings.
- 2.2.6.4. Provide plastic laminate work in shop where practical and/or possible.
- 2.2.6.5. Fabricate exposed gables to match the required exposed finishes.
- 2.2.6.6. Exposed wood construction:
 - 2.2.6.6.1. Fabricate joints carefully matched for grain and colour.
 - 2.2.6.6.2. Fabricate millwork with slow fed machines free from sticker and/or sander markings, with sections and moulding work cut accurately to profiles.
 - 2.2.6.6.3. Sandpaper woodwork, smooth removing burrs, feathers, sleeves, raised grain and sharp arises and leave exposed surfaces perfectly clean and smooth ready for finishing.
 - 2.2.6.6.4. Provide edges noted to be solid, as minimum 6 mm (1/4") thick wood to match exposed veneer, glued to core prior to the application of face veneers.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Install work of this Section in accordance with appropriate Section of NAAWS.
- 3.2.2. Provide work of this Section true and straight and securely fastened in place.
- 3.2.3. Mitre exposed corners and butt joints.
- 3.2.4. Provide plastic laminate countertops plumb and true, neatly scribed to adjoining surfaces.
- 3.2.5. Thoroughly fix and anchor work of this Section into position.
- 3.2.6. Mechanical and Electrical Fittings:
 - 3.2.6.1. Provide openings required to accommodate mechanical and electrical fittings as part of the work of this Section and provide a core sealant to protect counter cores which are exposed to accommodate:
 - 3.2.6.1.1. mechanical services and fittings.
 - 3.2.6.1.2. washroom accessories.
 - 3.2.6.2. Mechanical and electrical fittings and services will be provided as part of the work of Divisions 20, 21, 22, 23, 26, 27 and 28.
- 3.2.7. Installation of Hardware:
 - 3.2.7.1. Install architectural woodwork hardware in accordance with manufacturer's requirements and templates. Adjust architectural woodwork hardware to provide smooth operation and ensure clearances are maintained. Repair damage to adjacent surfaces resulting from failure to conform with this requirement.
 - 3.2.7.2. Provide lubricants required and use in manner to ensure smooth function of hardware consistent with manufacturer's recommendations.

3.2.7.3. Verify fastening components are tightened securely. Align screws, bolts and similar fastenings such that relationship of screw head indentations, similar surfaces and slots are perpendicular to matching vertical or horizontal position when on same surface. Do not burr or otherwise mar edges of surfaces of hardware components. Repair defects caused by work of this Section in an acceptable manner.

3.2.8. Do not install damaged Products.

3.3. SITE QUALITY CONTROL

3.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide solid surfacing fabrications including but not limited to following:

1.2.1.1. countertops.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of finish carpentry and architectural woodwork: Section 06 40 00, Architectural Woodwork.

1.2.2.2. Provision of elastomeric joint sealants: Section 07 92 00, Joint Sealants.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. MDF: Medium Density Fibreboard.

1.3.2. Definitions:

1.3.2.1. Solid Polymer Surface: Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.

1.3.3. Reference Standards:

1.3.3.1. ANSI/NEMA LD 3-05 - High-Pressure Decorative Laminates (HPDL)

1.3.3.2. ANSI/NPA A208.2-22 - Medium Density Fiberboard (MDF) for Interior Applications

1.3.3.3. ASTM C920-18(24) - Standard Specification for Elastomeric Joint Sealants

1.3.3.4. ASTM D638-22 - Standard Test Method for Tensile Properties of Plastics

1.3.3.5. ASTM D785-23 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials

1.3.3.6. ASTM D790-17 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

1.3.3.7. ASTM E84-25 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.3.3.8. ASTM E228-22 - Standard Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer

1.3.3.9. ASTM G21-15(21)e1 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

1.3.3.10. ASTM G155-21 - Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Materials

1.3.3.11. CSA O115-M82(21) - Hardwood and Decorative Plywood

1.3.3.12. NSF/ANSI 51-23 - Food Equipment Materials

1.3.3.13.	CAN/ULC-S102-18	- Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
1.3.3.14.	UL 723-18	- Standard for Test for Surface Burning Characteristics of Building Materials
1.3.3.15.	UL 2824-13	- GREENGUARD Certification Program, Method for Measuring Microbial Resistance from Various Sources Using Static Environmental Chambers

1.4. ADMINISTRATIVE REQUIREMENTS

- 1.4.1. Preinstallation Meetings: Arrange preinstallation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.5. SUBMITTALS

- 1.5.1. Product Data: Indicate Product description including solid surface sheets, sinks, bowls and illustrating full range of standard colours, fabrication information and compliance with specified performance requirements. Submit Product data with resistance to list of chemicals.
- 1.5.2. Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00. Indicate plans, sections, dimensions, component sizes, edge details, thermosetting requirements, fabrication details, attachment provisions, sizes of furring, blocking, including concealed blocking and coordination requirements with adjacent work. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacles and other items installed in solid surface.
- 1.5.3. Coordination Drawings: Submit coordination drawings indicating plumbing and miscellaneous steel work indicating locations of wall rated or non-rated, blocking requirements, locations and recessed wall items and similar items.
- 1.5.4. Samples: Submit samples in accordance with Section 01 30 00. Submit minimum 150 mm x 150 mm (6" x 6") samples. Cut sample and seam together for representation of inconspicuous seam. Indicate full range of colour and pattern variation. Reviewed samples with no objections recorded will be retained as standard for work.
- 1.5.5. Test and Evaluation Reports: Submit flammability test reports and food preparation zone test certifications confirming compliance with NSF/ANSI 51. Refer to www.nsf.org for the latest compliance to NSF/ANSI 51 for food zone - all food types.

1.6. CLOSEOUT SUBMITTALS

- 1.6.1. Operation and Maintenance Data:
- 1.6.1.1. Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in Project closeout documents.
- 1.6.1.2. Provide a commercial care and maintenance kit and video. Review maintenance procedures and warranty details with Owner upon completion.

1.7. QUALITY ASSURANCE

1.7.1. Qualifications:

1.7.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in application of Products, systems and assemblies specified and with approval and training of the Product manufacturers. Ensure fabricator and installer are approved by solid polymer manufacturer.

1.7.2. Mock-Ups:

1.7.2.1. Prior to final review of Shop Drawings, erect 1 full size mock-up of each component at Project site demonstrating quality of materials and execution for Consultant's review.

1.7.2.2. Should mock-up have objections recorded, rework or remake until no objection are recorded. Remove rejected units from Project site.

1.7.2.3. Mock-up will be used as standard for review of subsequent work.

1.7.2.4. Mock-ups may remain as part of finished work.

1.8. DELIVERY, STORAGE AND HANDLING

1.8.1. Delivery and Acceptance Requirements: Deliver no components to Project site until areas are ready for installation.

1.8.2. Storage and Handling Requirements:

1.8.2.1. Store components indoors prior to installation.

1.8.2.2. Handle materials to prevent damage to finished surfaces.

1.9. WARRANTY

1.9.1. Manufacturer Warranty: Provide manufacturer's standard warranty for material only for period of 10 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:

2.1.1.1. Corian® by DuPont; www.corian.com

2.1.1.2. Samsung Chemical USA; www.staron.com

2.1.1.3. Wilsonart Contract; www.wilsonartcontract.com

2.1.2. Substitution Limitations: This Specification is based on DuPont's Products. Comparable Products from manufacturers listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

2.2.1. Performance/Design Criteria:

2.2.1.1. Solid Polymer Based Products:

	Property	Requirement	Test Procedure min or max
2.2.1.1.1.	Tensile Strength	6000 psi min	ASTM D638

2.2.1.1.2.	Tensile Modulus	1.5 x 106 psi min	ASTM D638
2.2.1.1.3.	Tensile Elongation	0.4% min.	ASTM D638
2.2.1.1.4.	Flexural Strength	10000 psi min	ASTM D790
2.2.1.1.5.	Flexural Modulus	1.2 x 106 psi min	ASTM D790
2.2.1.1.6.	Hardness	>85-Rockwell "M" scale min.	ASTM D785
2.2.1.1.7.	Thermal Expansion	3.90 x 10-5 in./in./°C (2.2 x 10-5 in./in./°F)	ASTM E228
2.2.1.1.8.	Fungi and Bacteria	Does not support microbial growth	ASTM G21
2.2.1.1.9.	Microbial Resistance	Highly resistant to mould growth	UL 2824
2.2.1.1.10.	Ball Impact	No fracture - 1/2 lb. Ball: 1/4" slab - 36" drop 1/2"* slab - 144" drop * - approximate weight per sq ft	NEMA LD3, Method 3.8
2.2.1.1.11.	Weatherability	ΔE*94<5 in 1,000 hrs	ASTM G155
2.2.1.1.12.	Flammability		ASTM E84 & UL 723
		All Colours	
		1/4"	3/4"
2.2.1.1.12.1.	Flame Spread	<25	<25
2.2.1.1.12.2.	Smoke Developed	<25	<25
2.2.1.1.12.3.	Class	1 and A	1 and A
	* NEMA results based on the NEMA LD 3		
2.2.2.	Solid Surfacing Material (SSM):		
2.2.2.1.	Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment; not coated, laminated or of composite construction; meeting following criteria:		
2.2.2.1.1.	Flammability: Flame Spread Index: 0 and Smoke Development Index: 5 when tested to CAN/ULC-S102.		
2.2.2.1.2.	Food Equipment Material Compliance: Food zone to NSF/ANSI 51.		
2.2.2.2.	Ensure material has minimum physical and performance properties specified under "Performance/Design Criteria".		
2.2.2.3.	Ensure superficial damage to a depth of 0.25 mm (0.010") is repairable by sanding and polishing.		
2.2.3.	Adhesive for Bonding to Other Products: One component silicone to ASTM C920.		
2.2.4.	Sealant: A standard mildew-resistant, FDA/UL® and NSF/ANSI 51 compliant in food zone area, recognized silicone colour matched sealant or clear silicone sealant.		
2.3.	COMPONENTS		
2.3.1.	Countertops (SSM-1): 13 mm (1/2") thick solid surfacing material, adhesively joined with inconspicuous seams, edge details as indicated on Drawings. Colour: "Glacier White".		

- 2.3.2. Counter Perimeter Frame: Ensure 13 mm (1/2") thick, moisture resistant cores for countertops in wet areas having sinks or lavatories are 19 mm (3/4") thick exterior grade plywood with waterproof adhesive, CSA O115-M (G/SO) Fir or Poplar plywood, veneer core only. MDF core conforming to ANSI/NPA A208.2 balanced design, manufactured from recycled materials, meeting ANSI Standards for emissions, of minimum density of 770 kg/m³, (48 lb/cu ft) and surface character to match sample reviewed by Consultant. Ensure fire retardant Product contains fire-retardant chemicals injected with raw materials during manufacturing and achieves a maximum flame-spread rating of 25 with a maximum smoke development of 200 when tested to ASTM E84. Permitted Product by Uniboard Canada or The Canfibre Group Limited.
- 2.3.3. Fabrication:
 - 2.3.3.1. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with reviewed Shop Drawings and solid surfacing manufacturer requirements. Form joints between components to create inconspicuous seams using manufacturer's standard joint adhesive. Provide factory cutouts for plumbing fittings and bath accessories as indicated on Drawings.
 - 2.3.3.2. Where indicated, thermoform corners and edges or other objects to shapes and sizes indicated on Drawings, prior to seaming and joining. Cut components larger than finished dimensions and sand edges to remove nicks and scratches. Heat entire component uniformly prior to forming.
 - 2.3.3.3. Ensure no blistering, whitening and cracking of components during forming.
 - 2.3.3.4. Form joints between components using manufacturer's standard joint adhesive. Ensure joints are inconspicuous in appearance and without voids. Attach 50 mm (2") wide reinforcing strip of solid polymer material under each joint.
 - 2.3.3.5. Provide holes and cutouts for plumbing and bath accessories as indicated on Drawings.
 - 2.3.3.6. Rout and finish component edges to a smooth, uniform finish. Rout cutouts, then sand edges smooth. Repair or reject defective or inaccurate work.
 - 2.3.3.7. Finish: Ensure surfaces have uniform finish:
 - 2.3.3.7.1. Matte, with a 60° gloss rating of 5 - 20.
 - 2.3.3.8. Fabrication Tolerances:
 - 2.3.3.8.1. Variation in Component Size: +/-3 mm (+/-1/8").
 - 2.3.3.8.2. Location of Openings: +/-3 mm (+/-1/8") from indicated location.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions:
 - 3.1.1.1. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 3.1.1.2. Verify actual site dimensions and location of adjacent materials prior to commencing work.
 - 3.1.1.3. Examine cabinets upon which countertops are to be installed. Verify cabinets are level to within 3 mm in 3 m (1/8" in 10' - 0").
 - 3.1.1.4. Notify Consultant in writing of any conditions which would be detrimental to installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Install components plumb, level, rigid, scribed to adjacent finishes in accordance with reviewed Shop Drawings and Product installation details.
- 3.2.2. Fabricate field joints using manufacturer's recommended adhesive, with joints being inconspicuous in finished work. Exposed joints/seams are not permitted. Keep components and hands clean when making joints. Reinforce field joints as specified herein. Cut and finish component edges with clean, sharp returns.
- 3.2.3. Route radii and contours to template. Anchor securely to base component or other supports. Align adjacent components and form seams to comply with manufacturer's written recommendations using adhesive in colour to match work. Carefully dress joints smooth, remove surface scratches and clean entire surface.
- 3.2.4. Install countertops with no more than 3 mm (1/8") sag, bow or other variation from a straight line.
- 3.2.5. Seal between wall and components with joint sealant as specified herein and in Section 07 92 00, as applicable.
- 3.2.6. Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Ensure components are clean on date of Substantial Performance of the Work.
- 3.2.7. Coordinate connections of plumbing fixtures with [Division 22] [Mechanical]. Make plumbing connections to sinks in accordance with [Division 22] [Mechanical].

3.3. REPAIR

- 3.3.1. Repair minor imperfections and cracked seams and replace areas of severely damaged surfaces in accordance with manufacturer's "Fabrication and Installation Manual".

3.4. SITE QUALITY CONTROL

- 3.4.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.5. CLEANING

- 3.5.1. Remove excess adhesive and sealant from visible surfaces.
- 3.5.2. Clean surfaces in accordance with manufacturer's "Care and Maintenance Instructions".

3.6. PROTECTION

- 3.6.1. Provide protective coverings to prevent physical damage or staining following installation for duration of Project.
- 3.6.2. Protect surfaces from damage until date of Substantial Performance of the Work.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide general installations including but not limited to following:

1.2.1.1. installation of hollow metal doors and frames.

1.2.1.2. installation of wood doors.

1.2.1.3. installation of door hardware.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of architectural woodwork: Section 06 40 00, Architectural Woodwork.

1.2.2.2. Supply of hollow metal doors and frames: Section 08 11 13, Hollow Metal Doors and Frames.

1.2.2.3. Supply of wood doors: Section 08 14 00, Wood Doors.

1.2.2.4. Supply of door hardware: Section 08 71 00, Door Hardware.

1.2.2.5. Installation of gypsum wall board partition steel frames and wall boards: Section 09 21 16, Gypsum Board Assemblies.

1.2.2.6. Electrical fittings and services: Division 26, Electrical.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. DHI: Door and Hardware Institute Canada; www.dhicanada.ca.

1.3.2. Reference Standards:

1.3.2.1. NAAMM-HMMA 840-24 - Guide Specification for Receipt, Storage and Installation of Hollow Metal Doors and Frames

1.3.2.2. ANSI/WDMA I.S. 1A-21 - Industry Standard for Interior Architectural Flush Wood Doors

1.4. ADMINISTRATIVE REQUIREMENTS

1.4.1. Preinstallation Meeting:

1.4.1.1. Prior to start of work, arrange for site meeting of parties associated with work of this Section. Presided over by Contractor, include Consultant, Subcontractor and manufacturer's representative.

1.4.1.2. Review work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of hardware, hardware to be used, installation of methods and procedures related to electrified door hardware, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of this Section. Also discuss following items:

1.4.1.2.1. electrical roughing in and other preparatory work performed by other trades.

1.4.1.2.2. sequence of operation of each type of electrified door hardware.

- 1.4.1.2.3. construction schedule and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
- 1.4.1.2.4. required testing, inspecting and certifying procedures.

PART 2 - PRODUCTS

2.1. MATERIALS

- 2.1.1. Doors, Frames and Hardware: Refer to following Sections for Products to be installed as part of the work of this Section:
 - 2.1.1.1. Section 06 40 00, Architectural Woodwork.
 - 2.1.1.2. Section 08 11 13, Hollow Metal Doors and Frames.
 - 2.1.1.3. Section 08 14 00, Wood Doors.
 - 2.1.1.4. Section 08 71 00, Door Hardware.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Verify frames comply with indicated requirements for type, size, location, swing characteristics and have been installed with plumb jambs and level heads. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Hollow Metal Frames:
 - 3.2.1.1. Install hollow metal frames in accordance with manufacturer's instructions and NAAMM-HMMA 840.
 - 3.2.1.2. Set frames plumb, square, level and at correct elevation, maintaining uniform door width and height.
 - 3.2.1.3. Secure anchorages and connections to adjacent construction.
 - 3.2.1.4. Remove temporary steel shipping jamb spreaders prior to setting 1-piece welded frames. Brace frames rigidly in position while being built in. Use precisely-dimensioned installation spreaders at sill and third-points of door opening height to maintain door opening width during building-in. Follow manufacturer's instructions regarding proper use of floor and jamb anchors. Remove installation spreaders only after mortar has set, where applicable.
 - 3.2.1.5. Allow for deflection to prevent structural loads from being transmitted to frame.
- 3.2.2. Hollow Metal Doors:
 - 3.2.2.1. Install hollow metal doors in accordance with manufacturer's instructions and NAAMM-HMMA 840.
 - 3.2.2.2. Install in accordance with following edge clearances unless otherwise indicated:
 - 3.2.2.2.1. Between doors and frames at head and jambs: 3 mm (1/8").
 - 3.2.2.2.2. At door bottom: 19 mm (3/4") maximum to unfinished floor, 16 mm (5/8") maximum to finished floor unless indicated to be undercut.
 - 3.2.2.2.3. Between meeting edges of pairs of doors: 3 mm (1/8").

3.2.3. Wood Doors:

- 3.2.3.1. Install wood doors in accordance with manufacturer's instructions and recommendations of ANSI/WDMA I.S. 1A.
- 3.2.3.2. Condition doors to average temperature and humidity in area of installation for not less than 48 hours prior to installation.
- 3.2.3.3. Install doors in a neat and workmanlike manner free from hammer or tool marks, open joints or slivers.
- 3.2.3.4. Set plumb, level, square and true. Install doors after building humidity is at an allowable level.
- 3.2.3.5. Install in accordance with following edge clearances unless otherwise indicated:
 - 3.2.3.5.1. Between doors and frames: at head and jambs: 3 mm (1/8").
 - 3.2.3.5.2. At door bottom: 19 mm (3/4") maximum to unfinished floor unless doors are indicated to be undercut.
 - 3.2.3.5.3. Between meeting edges of pairs of doors: 3 mm (1/8").
- 3.2.3.6. Cut, drill and prepare doors to template to receive hardware.
- 3.2.3.7. Ensure smoke gaskets are in-place before pre-finished door installation.
- 3.2.4. Door Hardware:
 - 3.2.4.1. Install hardware to doors and frames in accordance with manufacturer's packaged installation, template and adjusting instructions.
 - 3.2.4.2. Adjust hardware to provide smooth operation of doors and ensure clearances are maintained. Provide lubricants to allow smooth function of hardware consistent with manufacturer's recommendations.
 - 3.2.4.3. Mount hardware at heights in accordance with "Recommended Locations for Builder's Hardware" by DHI Canada except as otherwise indicated on the Documents or required by authorities having jurisdiction.
 - 3.2.4.4. Install frame bumpers.
 - 3.2.4.5. Tighten fastening components snugly. Do not burr or otherwise mar the edges of surfaces of hardware components. Repair defects resulting from work of this Section in accordance with Consultant's review.
 - 3.2.4.6. Unless otherwise indicated, mounting heights for door hardware is as follows:
 - 3.2.4.6.1. Locksets - 1023 mm (40-5/16") from floor to centre line of knob.
 - 3.2.4.6.2. Deadlocks - 1100 mm (43-5/16") from floor to centre line of cylinder.
 - 3.2.4.6.3. Panic Bolts - 1023 mm (40-5/16") from floor to centre line of bar.
 - 3.2.4.6.4. Pulls - 1041 mm (41") from floor to centre line of pull.
 - 3.2.4.6.5. Push Plates - 1100 mm (43-5/16") from floor to centre line of plate.
 - 3.2.4.6.6. Guard Bars - 1066 mm (42") from floor to centre line of bar.

3.3. SITE QUALITY CONTROL

- 3.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.4. ADJUSTING

- 3.4.1. Adjust doors and hardware and other moving or operating parts to function smoothly and correctly.

3.5. CLEANING

- 3.5.1. Carefully wipe clean doors of dust created due to work of this Project.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.2. SUMMARY

1.2.1. Section Includes: Provide building insulation including but not limited to following:

1.2.1.1. board, batt and loose insulation throughout building, except as specified under other Sections. This Section establishes insulation and accessory Products and minimum performance criteria which apply to board, batt and loose insulation types used throughout this Project. Read and become familiar with insulation requirements of all Sections.

1.2.1.2. where combustible insulation or vapour barrier materials are specified herein, comply with applicable Code requirements including supply and installation of approved non-combustible backing and independently-supported, non-combustible insulation covering except where these provisions are expressly specified as work of other Sections.

1.2.1.3. ensure material types (trade names), compatibility, sealing and adhesive qualities for each combination of insulation, adhesive and substrate encountered in work are reviewed for compatibility and suitability prior to commencement of installation. Include manufacturer's laboratory reports on adhesive quality and compatibility of each of these conditions.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Acoustic sealant: Section 07 92 00, Joint Sealants.

1.2.2.2. Insulation for mechanical work: Division 20, Mechanical General Requirements, Division 21, Fire Suppression, Division 22, Plumbing and Division 23, Heating, Ventilating and Air Conditioning.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. LTTR: Long Term Thermal Resistance.

1.3.1.2. NRCC: National Research Council of Canada; www.nrc-cnrc.gc.ca.

1.3.1.3. OBC: Ontario Building Code.

1.3.1.4. ULC: Underwriters Laboratories of Canada; www.canada.ul.com.

1.3.2. Definitions:

1.3.2.1. Rain Screen Principle: A theory governing the design of a building enclosure in such a way as to prevent water penetration due to rain; in other words, a scientific approach to eliminating water leakage.

1.3.3. Reference Standards:

1.3.3.1. ASTM C518-21 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

1.3.3.2. ASTM C1338-19 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings

1.3.3.3. CAN/CGSB-51.34-M86 - Vapour Barrier, Polyethylene Sheet for Use in Building Construction

1.3.3.4. CAN/ULC-S102-18 - Test Method of Surface Burning Characteristics of Building Materials and Assemblies

- 1.3.3.5. CAN/ULC-S114-18 - Standard Method of Test for Determination of Non-Combustibility in Building Materials
- 1.3.3.6. CAN/ULC-S701-17 - Standard for Thermal Insulation, Polystyrene Boards
- 1.3.3.7. CAN/ULC-S702.1-21 - Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification
- 1.3.3.8. CAN/ULC-S770-15(20) - Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams

1.4. QUALITY ASSURANCE

- 1.4.1. Qualifications:
 - 1.4.1.1. Installers:
 - 1.4.1.1.1. Provide work of this Section executed by competent installers with minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
 - 1.4.1.1.2. Employ only skilled mechanics having experience in the work specified and having an understanding of the design principles of the thermal and air/vapour barriers which they are providing.

1.5. DELIVERY, STORAGE AND HANDLING

- 1.5.1. Delivery and Acceptance Requirements: Deliver materials to site in original wrappings with labels intact and store in areas directed by Consultant.
- 1.5.2. Storage and Handling Requirements:
 - 1.5.2.1. Store insulation on raised platforms and protect with waterproof covers. Prevent exposure of insulation to sun.
 - 1.5.2.2. Store materials inside buildings for 24 hours prior to installation.

1.6. SITE CONDITIONS

- 1.6.1. Ambient Conditions: Maintain surface and ambient temperatures during application and curing of adhesive at temperature recommended by manufacturer of type of adhesive used.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
 - 2.1.1.1. CertainTeed Corporation; www.certainteed.com
 - 2.1.1.2. DuPont de Nemours Inc.; www.dupont.com
 - 2.1.1.3. Johns Manville Canada Inc.; www.jm.com
 - 2.1.1.4. Owens Corning Canada LP; www.insulation.owenscorning.ca
 - 2.1.1.5. ROCKWOOL™ International A/S; www.rockwool.com
 - 2.1.1.6. Soprema Inc.; www.soprema.ca
 - 2.1.1.7. Thermafiber, Inc. (Owens Corning Canada LP); www.thermafiber.com
- 2.1.2. Substitution Limitations: Comparable Products from other manufacturers not listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

2.2.1. Performance/Design Criteria:

2.2.1.1. Exterior envelope is based on "Rain Screen Principle" by NRCC. This requires construction behind cladding act as an air/vapour barrier to prevent passage of moisture laden air and diffusion of water vapour. To ensure continuity of air/vapour barrier within construction specified herein and with adjacent barrier construction is part of responsibility of this Section.

2.2.1.2. Refer to Drawings for thicknesses of insulation required. Select appropriate products from list of materials on basis of their maintaining thermal value of envelope, total compatibility when incorporated into finished system while ensuring substrate conditions as well as their ability to adhere components permanently, where applicable in rigid manner and maintain flexibility where required in finished work.

2.2.1.3. Ensure insulation materials and their facings do not support fungal growth when tested in accordance with ASTM C1338.

2.2.2. Cavity Insulation: Semi-rigid stone wool board, CAN/ULC-S702.1, Type 1, minimum RSI=0.75 (R=4.3) per 25 mm (1") and having a minimum density of 69 kg/m³ (4.3 pcf), "ROCKWOOL™ CAVITYROCK®" by ROCKWOOL™ International A/S, "JM CladStone™ Water & Fire Block Insulation" by Johns Manville Canada Inc., thickness as indicated on Drawings.

2.2.3. Wall Insulation: CAN/ULC-S701, Type 3, extruded polystyrene insulation with LTTR of RSI (R) value of 0.88 (5) when determined in accordance with CAN/ULC-S770 and ASTM C518, minimum compressive strength 140 kPa (20 psi), thickness as indicated on Drawings. Supply boards with shiplapped edges at horizontal locations and butt joints elsewhere; "STYROFOAM™ Brand Cladmate™ CM20 Extruded Polystyrene Foam Insulation" by DuPont de Nemours Inc., "FOAMULAR® NGX C-200" by Owens Corning Canada LP or "SOPRA-XPS 2" by Soprema Inc.

2.2.4. Batt or Roll Insulation:

2.2.4.1. Miscellaneous Batt or Roll Insulation: CAN/ULC-S702.1.

2.2.5. Sound Attenuation Batts: CAN/ULC-S702.1, mineral (glass and stone wool) fibre, flame spread and smoke developed in conformance with OBC requirements and other authorities having jurisdiction in accordance with CAN/ULC-S102. Non-combustible in accordance with requirements of CAN/ULC-S114. Permitted Products: "EcoTouch™ QuietZone® PINK™ FIBERGLAS® Acoustic Insulation" by Owens Corning Canada LP, "ROCKWOOL™ AFB - Acoustical Fire Batt Insulation" by ROCKWOOL™ International A/S, "Sound-SHIELD® Formaldehyde-Free Fiber Glass Insulation" by Johns Manville Canada Inc., "NoiseReducer™ Sound Attenuation Batts" by CertainTeed Corporation or "Thermafiber® SAFB™ Mineral Wool Insulation" by Thermafiber, Inc. (Owens Corning Canada LP), of sufficient thickness to meet required STC rating for sound-rated partitions and of width to suit metal framing spacing and other miscellaneous spacings.

2.2.6. Vapour Barrier: Polyethylene film, CAN/CGSB-51.34-M, 0.15 mm (6 mils) thick.

2.2.7. Mechanical Fasteners:

2.2.7.1. Insulation Fasteners: 60 mm (2-3/8") diameter high density polyethylene (HDPE) fastener with integrated cap. Permitted Product: "Ramset T3 InsulFast™ System" by ITW Construction Products; www.itwconstruction.ca.

2.2.7.2. Self-Adhered Insulation Clips: Impale type, perforated 50 mm x 50 mm (2" x 2") cold rolled steel adhesive back, spindle of length to suit insulation plus 25 mm (1") with speed washers. Permitted Products: "Self-Adhering TACTOO® Insul-Hangers" by AGM Industries, Inc.; www.agmind.com or "Self-Adhering TACTOO® Insul-Hangers" by Continental Studwelding Ltd.; www.constud.ca.

2.2.7.3. Glued Insulation Clips: Impale type, perforated 50 mm x 50 mm (2" x 2") cold rolled galvanized steel, spindle of length to suit insulation plus 25 mm (1") with speed washers. Permitted Products: "Perforated TACTOO® Insul-Hangers" by AGM Industries, Inc.; www.agmind.com or "Perforated TACTOO® Insul-Hangers" by Continental Studwelding Ltd.; www.constud.ca.

- 2.2.7.4. Strip Impalement Clips: 25 mm (1") wide strip of "Insul Hold Clips" by Insul Hold Canada Ltd., fabricated from galvanized sheet in rolls with punch out insulation securement arrows.
- 2.2.7.5. Nails: Galvanized steel, length 25 mm (1") longer than insulation thickness.
- 2.2.7.6. Staples: Galvanized wire, 13 mm (1/2") minimum.

PART 3 - EXECUTION

3.1. PREPARATION

- 3.1.1. Surface Preparation: Ensure surfaces to receive adhesive or insulation are dry, firm, straight and free from loose material, projections, ice, frost, slick, grease, oil or other matter detrimental to bond of adhesive or uniform bedding of insulation.

3.2. INSTALLATION

- 3.2.1. Install insulation when conditions meet requirements specified under "Preparation".
- 3.2.2. Install insulation to maintain continuity of thermal protection to building elements and spaces as indicated on Drawings.
- 3.2.3. Fit insulation tight to electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other projections or openings.
- 3.2.4. Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation panels free from ripped backs or chipped or broken edges. Ensure integrity and continuity of insulation at juncture with different types of materials and seal in permitted manner. Stagger joints in row.
- 3.2.5. Install materials in accordance with manufacturer's instructions.
- 3.2.6. Do not cover insulation and air/vapour barrier installed under this Section or other Sections until it has been reviewed by Consultant.
- 3.2.7. Batt or Roll Insulation:
 - 3.2.7.1. Install batt or roll insulations where indicated on Drawings.
 - 3.2.7.2. Fit batt between framing and press firmly into place. Butt tightly at joints, free of gaps.
 - 3.2.7.3. Insulate behind pipes, ducts, electric conduits and outlets or junction boxes. Cut insulation to fit around and behind obstructions and non-standard spaces.
 - 3.2.7.4. Place insulation over soffit grid system sealing around metal hangers and at wall on all sides. Carry insulation up wall and fit around steel or in masonry voids and over plaster ceiling.
- 3.2.8. Vapour Barrier:
 - 3.2.8.1. Staple vapour barrier to inside face of insulation. Ensure continuous vapour barrier envelope of entire building.
 - 3.2.8.2. Staple vapour barrier securely in place at 400 mm (16") oc both directions.
 - 3.2.8.3. Lap joints 150 mm (6").
 - 3.2.8.4. Tape joints with polyethylene tape.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide firestopping and smoke seals including but not limited to following:

1.2.1.1. firestopping and smoke seals in accordance with Code requirements, at openings and around penetrations, at un-penetrated openings, at projecting and recessed items and at openings and joints within fire separations and assemblies having fire resistance rating, excluding those inside sealed mechanical and electrical assemblies (e.g. inside ducts, dampers, bus ducts, etc.).

1.2.1.2. seals to form draft tight barriers to retard passage of flame and smoke and where specifically designated, passage of liquids while passing hose stream test.

1.2.1.3. ensure seal provides and maintains a fire-resistance rating as determined by OBC for adjacent floor, wall or other fire separation assembly to requirements of and as acceptable to authorities having jurisdiction and to Consultant.

1.2.1.4. firestopping and smoke seals in and around fire separations, including spaces around mechanical and electrical penetrations, at tops of fire walls and other gaps and penetrations at fire assemblies.

1.2.1.5. ensure Divisions 20, 21, 22, 23, 26, 27 and 28 respectively are responsible for firestopping and smoke seals within mechanical (i.e. inside ducts, dampers) and electrical assemblies (i.e. inside electrical bus ducts). Ensure firestopping and smoke seals around outside of such mechanical and electrical assemblies where they penetrate fire-rated separations are part of work of this Section.

1.2.1.6. systems and specified Products are only a guide and may not address all firestopping conditions pertaining to situations which may be present in the Work. Provide firestopping and smoke seal required for the Work. These Products and systems are not presented to restrict other tested and approved listed assemblies of other manufacturers designing assemblies conforming to Code and resolving firestopping required for the Work.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Demolition: Section 02 41 00, Demolition and Salvage.

1.2.2.2. Temporary sheet steel covers: Section 05 50 00, Metal Fabrications.

1.2.2.3. Sealants and caulking: Section 07 92 00, Joint Sealants.

1.2.2.4. Gypsum board partitions: Section 09 21 16, Gypsum Board Assemblies.

1.2.2.5. Firestopping and smoke seals inside mechanical assemblies: Division 20, Mechanical General Requirements, Division 21, Fire Suppression, Division 22, Plumbing and Division 23, Heating Ventilating and Air Conditioning.

1.2.2.6. Firestopping and smoke seals inside electrical assemblies: Division 26, Electrical, Division 27, Communications and Division 28, Electronic Safety and Security.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. IFC: International Firestop Council; www.firestop.org.

- 1.3.1.2. OBC: Ontario Building Code.
- 1.3.1.3. UL: Underwriters Laboratories Inc.; www.ul.com.
- 1.3.1.4. ULC: Underwriters Laboratories of Canada; www.canada.ul.com.
- 1.3.2. Definitions:
 - 1.3.2.1. Firestop System Types:
 - 1.3.2.1.1. Head of Wall Joint Firestop Systems (HW): Systems intended for installation in vertical separations between wall and floor or roof structures. Ensure these systems do not incorporate penetrating items such as pipes or cables.
 - 1.3.2.1.2. Joint Firestop Systems (JF): Systems intended for installation in openings such as construction joints, gaps and spaces in floors or walls or at floor and wall intersections in accordance with approved systems. Ensure these systems do not incorporate penetrating items such as pipes or cables.
 - 1.3.2.1.3. Perimeter Joint Firestop Systems (PJ): Perimeter joint firestop system rating are governed by lowest of fire resistance ratings of individual components (i.e. wall, floor or joint system). These systems consist of floor with fire endurance rating, exterior wall with or without fire endurance rating and perimeter joint system. Ensure these perimeter joint firestop systems do not incorporate penetrating items such as pipes or cables.
 - 1.3.2.1.4. Service Penetration Firestop Systems (SP): Systems intended for installation in openings of limited dimensions and shape in floor or wall assemblies in accordance with approved systems. Ensure penetrating pipes, cable trays and similar items are in exact accordance with approved systems.
 - 1.3.2.1.5. Service Penetration for Combustible Systems (SPC): Systems intended for installation in openings of limited dimensions and shape in floor or wall assemblies in accordance with approved systems. Ensure penetrating pipes are in exact accordance with approved systems. These systems are tested with a minimum differential pressure of 50 Pa between exposed and unexposed surfaces of assembly to meet Code requirements for Combustible Pipes.
 - 1.3.2.2. Ratings: Rating of firestop system applies to its use in specific assembly of materials, penetration and floor or walls in which it is tested as follows:
 - 1.3.2.2.1. F Rating: When system remains in opening during fire test for rating period without permitting passage of flame through openings or occurrence of flaming on any element of unexposed side of assembly.
 - 1.3.2.2.2. FT Rating: When system remains in opening during fire test in accordance with F Rating requirement and additionally, transmission of heat through firestop system during rating period shall not have been such as to raise temperature of any thermocouple on unexposed surface of system more than 181 deg C (356 deg F) above initial temperature.
 - 1.3.2.2.3. FH Rating: When system remains in opening during fire and hose test in accordance with F Rating requirement and additionally, during hose stream test firestop system shall not develop any opening that would permit a projection of water from stream beyond unexposed side.
 - 1.3.2.2.4. FTH Rating: When system remains in opening during fire test and hose stream test within limitations described for F, FT and FH ratings.
 - 1.3.2.2.5. L Rating: Based on volume of air flowing, per unit of time through opening around test sample under specified pressure difference applied across surface of system. L Ratings are intended to determine acceptability of firestop systems with reference to control of air movement through assembly. Rating is expressed in litres per second (ℓ/s) per linear metre of opening for joint systems.
- 1.3.3. Reference Standards:
 - 1.3.3.1. ASTM G21-15(21)e1 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

- 1.3.3.2. CAN/ULC-S101-14 - Standard Methods of Fire Endurance Tests of Building Construction and Materials
- 1.3.3.3. CAN/ULC-S102:19(24) - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- 1.3.3.4. CAN/ULC-S115:23 - Standard Method of Fire Tests of Firestop Systems
- 1.3.3.5. UL Product iQ; www.ulprospector.com

1.4. ADMINISTRATIVE REQUIREMENTS

- 1.4.1. Preinstallation Meetings:
 - 1.4.1.1. Arrange preinstallation meeting 1 week before commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.
 - 1.4.1.2. Coordinate firestopping with other trades so obstructions are not placed in the way prior to installation of firestop systems.

1.5. SUBMITTALS

- 1.5.1. Product Data:
 - 1.5.1.1. Submit manufacturers' specifications and technical data for each material including compositions, limitations, documentation conforming ULC and/or cUL firestop system proposed for this Project and manufacturers' installation instructions.
- 1.5.2. Shop Drawings:
 - 1.5.2.1. Submit Shop Drawings in accordance with Section 01 30 00. Submit complete and detailed Shop Drawings for each condition encountered on site. Indicate following:
 - 1.5.2.1.1. ULC and/or cUL assembly number certification and material safety data sheets.
 - 1.5.2.1.2. required temperature rise and flame rating.
 - 1.5.2.1.3. hose stream rating (where applicable).
 - 1.5.2.1.4. thickness.
 - 1.5.2.1.5. proposed installation methods.
 - 1.5.2.1.6. material of firestopping and smoke seals, primers, reinforcements, support and securement methods, damming materials, reinforcements and anchorages /fastenings.
 - 1.5.2.1.7. size of opening.
 - 1.5.2.1.8. adjacent materials.
 - 1.5.2.1.9. number of penetrations.
 - 1.5.2.2. Designate on Shop Drawings fixed penetrants, relative positions, number of penetrations, expansion and control joints in rated slabs and walls, firestopping details at receptacles and similar poke-through devices and surrounding permanent materials. Identify re-entry locations.
 - 1.5.2.3. Submit fireproofing manufacturer's written verification that manufacturers have identified where firestopping is required, have selected correct firestop system and applicators have been trained by system manufacturers. Products, systems and assemblies have been installed in accordance with manufacturer's requirements.

- 1.5.3. Samples: Submit only as requested and in accordance with Section 01 30 00, various types of firestopping and smoke seal material.
- 1.5.4. Certificates:
 - 1.5.4.1. Submit manufacturer's verification that installed firestopping and smoke seal materials comply with specified requirements.
 - 1.5.4.2. Submit copies of ULC, Warnock Hersey and/or cUL Listing cards for review.

1.6. CLOSEOUT SUBMITTALS

- 1.6.1. Operational and Maintenance Data: Provide maintenance data for materials and prefabricated devices, providing descriptions sufficient for identification on site in accordance with requirements of Section 01 70 00.

1.7. MAINTENANCE MATERIAL SUBMITTALS

- 1.7.1. Firestop Documentation Software: Provide firestop documentation manager software capable of documenting and tracking firestop systems during construction and during Owner's operation activities. Ensure software solution tracks and documents every firestop system installed on Project and subsequent additions, changes or removals. Ensure software has internet connectivity and able to capture relevant information in real-time.
- 1.7.2. As a minimum following is required to be tracked for each firestop application:
 - 1.7.2.1. Product installed.
 - 1.7.2.2. system installed.
 - 1.7.2.3. date of installation.
 - 1.7.2.4. location including notations on Architectural Drawings.
 - 1.7.2.5. hourly ratings.
 - 1.7.2.6. name of installer.
 - 1.7.2.7. photos (pre-installation and post-installation).
 - 1.7.2.8. inspection status.
- 1.7.3. Basis-of-Design Software: "CFS-DM and Fieldwire" by Hilti (Canada) Corporation.

1.8. QUALITY ASSURANCE

- 1.8.1. Qualifications:
 - 1.8.1.1. Installers: Provide work of this Section executed by competent installers experienced, trained, licensed and approved, by material or system manufacturer for application of materials and systems being used having minimum 5 years' experience in application of Products, systems and assemblies specified. Ensure firestopping systems conform to requirements of CAN/ULC-S115 tested assemblies that provide fire rating as shown.
- 1.8.2. Mock-Ups: Construct minimum 5 mock-up samples of various firestopping systems at Project locations designated by Consultant for review by Consultant, Building Official and/or authority having jurisdiction. Once reviewed with no objections recorded, samples remain part of finished work and used as a quality reference standard for balance of Project.

1.9. DELIVERY, STORAGE AND HANDLING

- 1.9.1. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's sealed and labelled containers. Materials are subject to Consultant's inspection.
- 1.9.2. Storage and Handling Requirements:
 - 1.9.2.1. Store materials inside building for 24 hours prior to use; store in area designated by Consultant. Protect from damage and environmental conditions detrimental to material.

- 1.9.2.2. Comply with manufacturer's temperature, relative humidity and substrate moisture content for storage, mixing, application and curing of Products.

1.10. SITE CONDITIONS

- 1.10.1. Ambient Conditions:
- 1.10.1.1. Comply with manufacturer's recommended requirements for temperature, relative humidity, moisture content and presence of any sealer or release agents on substrate during application and curing of materials. Ensure surfaces are dry and frost free.
- 1.10.1.2. Maintain minimum temperature of 5 deg C (40 deg F) for minimum period of 1 week before application, during application and until application is fully cured.
- 1.10.1.3. Ventilate areas in which firestopping is being applied. Protect water-soluble material from wetting until fully cured.

1.11. WARRANTY

- 1.11.1. Manufacturer Warranty: Warrant work of this Section against defects and deficiencies for period of 5 years in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no additional expense to Owner. Defects include but are not limited to cracking, breakdown of bond, failure to stay in place or bleeding.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer Lists: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
- 2.1.1.1. 3M Canada; www.3m.ca
- 2.1.1.2. Hilti (Canada) Corporation; www.hilti.ca
- 2.1.1.3. Tremco Canada; www.tremcosealants.com
- 2.1.2. Substitution Limitations: This Specification is based on Hilti (Canada) Corporation's Products and tested systems; <https://constructionplatform.hilti.com>. Comparable Products from manufacturers listed herein may be reviewed provided they meet requirements of this Specification. No further substitutions will be permitted.

2.2. MATERIALS

- 2.2.1. Performance/Design Criteria:
- 2.2.1.1. Ensure firestop systems intended for installation in fire separations have assigned fire ratings as defined herein when tested in accordance with CAN/ULC-S115. Ensure firestop systems intended for use in fire resistive wall and/or floor assemblies are evaluated in accordance with CAN/ULC-S101 (Refer to "UL Product iQ").
- 2.2.1.2. For "L Rating" systems, ensure results do not exceed 5.0 cfm/sq ft of penetration opening at both ambient and elevated temperatures.
- 2.2.1.3. Mould Resistance: Provide penetration firestopping with mould and mildew resistance rating of 0 or 1 in accordance with ASTM G21.
- 2.2.1.4. Supply materials and systems capable of effectively impeding passage of fire, smoke, gasses and where specifically indicated passage of liquids. Use only firestop systems that have been ULC and/or cUL tested for specific fire rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire rating involved for each separate instance.

- 2.2.1.5. Ensure firestopping system provides fire-resistance rating, flame and temperature not less than fire resistance rating of surrounding floor, wall or assembly, in accordance with requirements of OBC.
- 2.2.1.6. Firestop System Rating: Where applicable, comply with F Rating based on number of hours system can resist flames and gases; T Rating based on maximum temperature rise of 181 deg C (356 deg F) above ambient for any thermocouple in addition to flame, gas and stream performance and H Rating based on capacity to withstand hose stream after burn. Design combined and/or built-up site systems in accordance with approved restrictions and technical evaluations permitted by Consultant and authorities having jurisdiction.
- 2.2.1.7. Ensure systems provide fire and temperature rating in accordance with those outlined in OBC and effectively impeding passage of flame, smoke and gasses.
- 2.2.1.8. Firestopping seals except for wall joints in visible areas (grey for visible areas) must be of easily identifiable colour, such as red or yellow to be clearly distinguished from other building materials.
- 2.2.1.9. Ensure service penetration components and assemblies, including back-up materials and supports are certified in accordance with CAN/ULC-S115 or CAN/ULC-S101 and be ULC listed by a certified authority recognized by building Code officials in locality in which Building is situated.
- 2.2.1.10. Ensure suitability of Products for application and compatibility of materials with surfaces to which it will be applied.
- 2.2.1.11. Ensure site system assembly is in accordance with CAN/ULC-S115 labeled and listed system design limitations, unless proposed assembly is approved by authorities having jurisdiction and meets Consultant's review. Design combined and/or built-up site systems in accordance with approved restrictions and technical evaluations acceptable to authorities having jurisdiction as reviewed by Consultant. Engineering Judgements from firestopping manufacturers reviewed by Consultant and authorities having jurisdiction may be used for conditions where a ULC and/or cUL firestopping system is not available. Ensure Engineering Judgements are performed in accordance with IFC's "Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments (EJs)"
- 2.2.1.12. Ensure sealants and putty for overhead and vertical joints are non-sagging; seals for floors, self-levelling. Ensure flexible fire stop sealant provides movement capability in fire rated joint applications. Ensure sealants are compatible with base materials such as without limitations masonry, concrete, metal, gypsum board and other similar items.
- 2.2.1.13. Ensure Products have a compressive strength capable of providing self support at a penetrating item and shall maintain their integrity as tested in a ULC vertical application.
- 2.2.1.14. Ensure Products are compatible with abutting dissimilar architectural coatings and finishes at floors, walls, ceilings, waterproofing membranes and the like. Check with Room Finish Schedule and manufacturer of selected materials being installed.
- 2.2.1.15. Integral Pipe Sleeves/Firestopping Components: Other Sections within Divisions 20, 21, 22 and 23 may specify fire-rated pipe sleeves, cast-in pipe/sleeve assemblies and integral firestopped penetration devices and accessories listed by authorized testing and certification authorities. These systems may eliminate need for separate firestopping applications at certain designated locations and it is responsibility of this Section to determine any and all locations where such devices will be utilized on Project.
- 2.2.1.16. Do not provide Products containing asbestos.
- 2.2.1.17. Firestopping System 1 (JF and/or PJ Systems):
 - 2.2.1.17.1. This Firestopping System is primarily an expansion, control and perimeter seal without smoke resistance and be non-combustible, semi-rigid, felt fire protection. Certified assembly of 1 of listed manufacturers and permitted by Consultant.

- 2.2.1.17.2. Ensure firestop systems are from "Manufacturer List" specified herein and listed in UL (XHEZ7 and XHBN7) Fire Resistance Directory provided they conform to construction type and fire resistance rating involved in each separate instance.
- 2.2.1.17.3. Where required by listing, ensure impaling clips are heavy gauge galvanized wire or 25 mm (1") wide x 0.607 mm (24 ga) galvanized steel, Z formed with horizontal bottom and dimensions conforming to location of firestopping and width of void to be filled. Ensure compression of joint do not damage clips.
- 2.2.1.18. Firestopping System 2: Same materials as in System 1, but without use of impaling clips and with smoke and fluid seal with hose stream resistance. Certified assembly of 1 of listed manufacturers and permitted by Consultant.
- 2.2.1.19. Firestopping System 3: Fire, gas, fluid and hose stream resistant elastomeric sealant with movement capabilities, ULC labeled assembly of 1 of listed manufacturers and permitted by Consultant. Ensure materials have elastic characteristics where used at openings subject to movement. Intumescent pads may form part of this system, at Contractor's option.
- 2.2.1.20. Firestopping System 4: Ensure firestopping, gas, fluid and hose stream resistant seals at openings intended for ease of re-entry such as cables be an elastomeric seal or proprietary assembly of following types; a cementitious or rigid seal at such locations is not permitted. Certified assembly of 1 of listed manufacturers and permitted by Consultant.
- 2.2.1.21. Firestopping System 4-A: Where openings are considered large such as at cable trays and bus ducts. Certified assembly of 1 of listed manufacturers and permitted by Consultant.
- 2.2.2. Primers: To manufacturer's recommendations for specific material, substrate and end use.
- 2.2.3. Damming and Backup Materials, Supports and Anchoring Devices: Non-combustible, to manufacturer's recommendations in accordance with tested assembly being installed and as acceptable to authorities having jurisdiction. Ensure sheet steel covers over temporarily unused sleeves in tenant and similar spaces are minimum 0.912 mm (20 ga) thick galvanized sheet steel formed to a tight fit over opening with specified firestopping materials installed beneath. Combustible materials are permitted only if they are approved under ULC or cUL systems, otherwise they should be removed after permanent firestop materials have cured.
- 2.2.4. Pre-Formed Materials: For use with standard head-joint top tracks and slip-type head joints in fire-rated construction at top of partition in concrete construction, provide following Product:
 - 2.2.4.1. "Firestop Top Track Seal (CFS-TTS)" by Hilti (Canada) Corporation.
 - 2.2.4.2. "Firestop Top Track Seal (CFS-TTS MD)" by Hilti (Canada) Corporation.
 - 2.2.4.3. "Firestop Top Track Cover (CFS-TTS MD C FS)" by Hilti (Canada) Corporation.
 - 2.2.4.4. "Firestop Top Track Plugs (CFS-TTS MD P FS)" by Hilti (Canada) Corporation.
- 2.2.5. Re-Penetrable, Round Cable Management Devices:
 - 2.2.5.1. For use with new cable bundles penetrating gypsum board or masonry walls, provide following Product:
 - 2.2.5.1.1. "Speed Sleeve (CP 653 BA / CFS SL GA L)" by Hilti (Canada) Corporation with integrated smoke seal fabric membrane.
 - 2.2.5.1.2. "CFS-MSL Modular Sleeve" by Hilti (Canada) Corporation.
 - 2.2.5.2. For use with existing cable bundles penetrating gypsum board or masonry walls, provide 1 of following Products:
 - 2.2.5.2.1. "Firestop Cable Collar (CFS-CC)" by Hilti (Canada) Corporation.
 - 2.2.5.2.2. "Firestop Retrofit Sleeve Kit (CFS-SL RK)" by Hilti (Canada) Corporation.
 - 2.2.5.2.3. "CFS-MSL Modular Sleeve" by Hilti (Canada) Corporation.

- 2.2.6. Single or Cable Bundles up to 25 mm (1") Diameter: Penetrating gypsum board, masonry, concrete walls or wood floor assemblies, provide following Product:
 - 2.2.6.1. "Firestop Cable Disc (CFS-D 1")" by Hilti (Canada) Corporation.
- 2.2.7. Pipe and Duct Insulation and Wrappings Compatible with Firestopping Systems: "TREMstop WS" by Tremco Canada or "3M™ Fire Barrier Duct Wrap 615" by 3M Canada.
- 2.2.8. Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical raceways, provide 1 of following:
 - 2.2.8.1. "Firestop Block (CFS-BL)" by Hilti (Canada) Corporation.
 - 2.2.8.2. "Composite Sheet (CFS-COS)" by Hilti (Canada) Corporation.
 - 2.2.8.3. "Firestop Mortar (CP 637)" by Hilti (Canada) Corporation.
 - 2.2.8.4. "Firestop Foam (CP 620)" by Hilti (Canada) Corporation.
 - 2.2.8.5. "Flexible Firestop Foam (CP 660)" by Hilti (Canada) Corporation.
- 2.2.9. Firestop Collar or Wrap Devices: Devices attached to assemble around combustible plastic pipe (closed and open piping systems) tested to 50 Pa pressure differential, following Products are permitted:
 - 2.2.9.1. "Firestop Collar (CP 643N)" by Hilti (Canada) Corporation.
 - 2.2.9.2. "Firestop Wrap Strip (CP 648-S/648-E)" by Hilti (Canada) Corporation.
- 2.2.10. Wall Opening Protective Devices: Wall opening protective materials for use with cUL/ULC listed metallic and specified nonmetallic outlet boxes, following Products are permitted:
 - 2.2.10.1. "Firestop CP 617 Putty Pad" by Hilti (Canada) Corporation.
 - 2.2.10.2. "Firestop Box Insert" by Hilti (Canada) Corporation.
- 2.2.11. Spray or Sealant Materials for Use with Fire-Rated Construction Joints: Provide 1 of following:
 - 2.2.11.1. "CFS-SP WB Firestop Joint Spray" by Hilti (Canada) Corporation.
 - 2.2.11.2. "CFS-SP SIL Firestop Silicone Joint Spray" by Hilti (Canada) Corporation.
 - 2.2.11.3. "CP 606 Flexible Firestop Sealant" by Hilti (Canada) Corporation.
 - 2.2.11.4. "CFS-S SIL GG Firestop Silicone Sealant, Gun-Grade" by Hilti (Canada) Corporation.
 - 2.2.11.5. "CFS-S SIL SL Firestop Silicone Sealant, Self-Leveling" by Hilti (Canada) Corporation.
- 2.2.12. Sealant Materials for Use with Fire-Rated Construction Penetrations: Provide 1 of following:
 - 2.2.12.1. "FS ONE MAX Firestop Intumescent Sealant" by Hilti (Canada) Corporation.
 - 2.2.12.2. "CFS-S SIL GG Firestop Silicone Sealant, Gun-Grade" by Hilti (Canada) Corporation.
 - 2.2.12.3. "CFS-S SIL SL Firestop Silicone Sealant, Self-Leveling" by Hilti (Canada) Corporation.
 - 2.2.12.4. "CP 606 Flexible Firestop Sealant" by Hilti (Canada) Corporation.
- 2.2.13. Spray or Sealant Materials for Use with Non-Fire-Rated Construction Joints and Other Gaps: Provide 1 of following:
 - 2.2.13.1. "Lightweight Smoke and Acoustic Sealant CS-S SA Light" by Hilti (Canada) Corporation.
 - 2.2.13.2. "CP 572 Smoke and Acoustic Spray" by Hilti (Canada) Corporation.
- 2.2.14. Pre-Formed Materials: For use with standard head-joint top tracks and slip type head joints in non-fire-rated construction at top of partition in flat concrete construction, provide following Product:
 - 2.2.14.1. "CS-TTS SA Smoke and Acoustic Track Seal" by Hilti (Canada) Corporation.

- 2.2.15. Pre-Formed Materials: For use with standard bottom of gypsum board joints for fire-rated and non-fire-rated construction at bottom of partition in flat concrete construction, provide following Product:
 - 2.2.15.1. "(CFS-BTS) Bottom Track Seal" by Hilti (Canada) Corporation.
- 2.2.16. Firestop Plugs: Non-curing, re-penetrable intumescent foam materials for use with flexible cables or cable bundles, provide following Product:
 - 2.2.16.1. "(CFS-PL) Firestop Plug" by Hilti (Canada) Corporation.
- 2.2.17. Mixes:
 - 2.2.17.1. Mix materials at correct temperature and in accordance with manufacturer's directions.
- 2.2.17.2. Cleaning Materials: As recommended by firestop manufacturer.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions:
 - 3.1.1.1. Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
 - 3.1.1.2. Verify openings, dimensions and surfaces conform to fire and smoke seal assembly.
 - 3.1.1.3. Examine sizes of penetrating service, percentage fill and sleeve or opening sizes with exact annular space calculations, anticipated movement and conditions necessary to establish correct type, thickness and installation of back-up materials and seals.
 - 3.1.1.4. Since firestop systems do not re-establish structural integrity of load bearing partitions/assemblies, or support live loads and traffic, consult structural engineer prior to penetrating any load bearing assembly.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. PREPARATION

- 3.2.1. Surface Preparation:
 - 3.2.1.1. Provide primer or surface conditioner if required by Product manufacturer. Prime surfaces in accordance with manufacturer's directions.
 - 3.2.1.2. Remove combustible material and loose material detrimental to bond from edges of penetration. Clean, prime or otherwise prepare substrate material to manufacturer's recommendation.
 - 3.2.1.3. Remove insulation from insulated pipe and duct where such pipes or ducts penetrate a fire separation unless ULC certified assembly permits such insulation to remain within assembly, or where mechanical trades have installed special fire rated insulated sleeves. Ensure continuity of thermal and vapour barriers where such are removed, altered or replaced, to satisfaction of Divisions 20, 21, 23 and 23 and Consultant.
 - 3.2.1.4. Alternatively, ensure pipe and duct insulation and wrappings occurring within openings to receive firestopping and smoke seals under this Section are installed prior to work of this Section and insulation and wrappings within fire seals are ULC listed components of system to be installed under this Section, unless ULC certified assembly permits such other insulation and wrappings to remain within assembly. Coordinate work of this Section with Divisions 20, 21, 22 and 23.
 - 3.2.1.5. Clean bonding surfaces to remove deleterious substances including dust, paint, rust, oil, grease, moisture, frost and other foreign matter which may otherwise impair effective bonding.

3.3. INSTALLATION

- 3.3.1. Do not apply firestop material to surfaces previously painted or treated with sealer, curing compound, water repellent to other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- 3.3.2. Provide temporary forming, packing and bracing materials necessary to contain firestopping. Upon completion, remove forming and damming materials not required to remain as part of system.
- 3.3.3. Install damming and firestopping materials as per manufacturer's instructions.
- 3.3.4. Mix and apply firestopping and smoke seals in accordance with manufacturer's instructions and tested designs to provide required fire (temperature and flame) rated seal, to prevent passage of smoke and where specifically designated, passage of fluids.
- 3.3.5. Provide temporary forming and packing as required. Apply materials with sufficient pressure to properly fill and consolidate mass to seal openings.
- 3.3.6. Tool or trowel exposed surfaces. Allow materials to cure by not covering up materials until full curing has taken place.
- 3.3.7. Where a designated system described hereinafter does not meet Code requirements for particular service condition, substitute with next higher system meeting required rating.
- 3.3.8. Notify Consultant when completed installations are ready for inspection and prior to concealing or enclosing firestopping and smoke seals.
- 3.3.9. System 1:
 - 3.3.9.1. Install fire rated joint firestopping by compressing material minimum of 25% to ensure complete sealing and to follow irregularities of concrete slabs at perimeter of building where junction occurs with back of cladding system. Apply firestopping sealant of spray over compressed mineral wool.
 - 3.3.9.2. Butt succeeding sections of firestopping material tightly up against preceding. Leave no voids.
 - 3.3.9.3. Use this System for joint seals through fire-resistance rated floor slabs, ceilings and roofs unless otherwise stipulated.
- 3.3.10. System 2:
 - 3.3.10.1. At fire-rated masonry walls and gypsum board partitions which extend nominally to within 19 mm (3/4") of underside of deck above, insert fire rated joint assembly firestopping material in 25% compression in accordance with ULC test requirements and manufacturer's instructions. Provide adequate depth of material to fill gap flush with face of wall, except as otherwise specified. Apply firestopping sealant of spray over compressed mineral wool.
 - 3.3.10.2. Insert at intersection of fire-resistance rated masonry and gypsum board partitions.
 - 3.3.10.3. Insert at both sides of control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - 3.3.10.4. Where wall/slab junction is exposed in finished work, keep fibre back 9 mm (3/8") from face of block and apply fire-resistant sealant to gap, tooling to a concave joint.
- 3.3.11. System 3:
 - 3.3.11.1. This System establishes fire rated firestopping for service penetrations throughout the Project. Seal gaps and holes in fire-rated walls and slabs and composite construction through which conduit, wire, cables, ductwork, piping and other protrusions pass as a result of work using fire-resistant penetration sealant. Include opening which have been formed, sleeved and cored.
 - 3.3.11.2. Apply at unpenetrated openings and sleeves installed for future use through fire-resistance rated assemblies.

- 3.3.11.3. Apply this System between spaces having different air pressures. (See Mechanical Drawings for pressurized areas and locations of moving penetrants.)
- 3.3.11.4. Apply at "wet" rooms supported by suspended slabs at locations over Electrical and Equipment Rooms or similar areas containing power devices in which future re-entry is not required.
- 3.3.11.5. Apply at Mechanical Rooms and similar rooms having systems containing liquids, including piping runs, unless such rooms are located over slab-on-grade.
- 3.3.11.6. Install System 3 materials at elevator shafts, duct shafts and other similar locations over occupied spaces.
- 3.3.11.7. Install 6 mm to 9 mm (1/4" to 3/8") bead of firestop caulking at interface of retaining angles around fire dampers, where angles meet fire-rated assembly and between retaining angles and fire damper, both sides of penetration. At floor locations, sealant bead at top of assembly is adequate.
- 3.3.11.8. Where necessary, remove insulation from insulated pipe and duct where such services penetrate a fire separation unless certified assembly permits such insulation to remain within assembly. Apply wrapping materials as listed herein.
- 3.3.11.9. Install System 3 materials at open wall joints, including expansion joints between fire rated enclosures and assemblies.
- 3.3.12. Systems 4 and 4A: Install at following locations:
 - 3.3.12.1. At Electrical, Electrical Switchgear, Electrical Transformer Rooms and at Telephone Equipment Rooms requiring re-entry for additional services.
 - 3.3.12.2. Install at communications and computer cable penetration points throughout.
- 3.3.13. Accessories: At hollow fire-rated walls, apply intumescent pads to back surfaces and cable entry points of electrical boxes, panels and other service penetration points, ensuring close coordination with electrical, mechanical and drywall trades. Where greater dimension of panel exceeds 500 mm (20"), gypsum board trades construct fire-rated enclosure around recessed panels.
- 3.3.14. Penetration Sizing: Ensure following regulates sizing of service penetrations to be firestopped, other than for fire dampered openings:
 - 3.3.14.1. Ensure single, circular penetration is sleeved by work of Divisions 20, 21, 22, 23, 26, 27 and 28.
 - 3.3.14.2. Multiple penetrations of circular elements are defined as more than 1 circular penetration having a maximum space of 100 mm (4") between closest faces of such penetrating elements. Forming of such multiple penetrations is responsibility of respective trades whose service penetrates rated assembly and such formed opening shall be square or rectangular frame around group of penetrations in which maximum clearance between outer penetration element and face of opening shall be 25 mm (1").
 - 3.3.14.3. Create single and multiple rectangular penetrations in same manner as specified above, but edge clearance may be increased to a maximum of 50 mm (2").
 - 3.3.14.4. Exception; at fire dampers, clearances are governed by testing authorities' requirements.
 - 3.3.14.5. For purposes of this Specification, a moving penetrant is defined as a penetrating device having an anticipated movement of greater than 9 mm (3/8") when measured at right angles to face of rated assembly.
- 3.3.15. Cable Tray Penetrations:
 - 3.3.15.1. Seal (firestop) cable tray penetrations with re-enterable/re-penetrable matrices/devices with applicable ratings determined in accordance with CAN/ULC-S115 having a minimum L Rating not exceeding 5.0 cfm/sq ft of penetration opening at both ambient and elevated temperatures. For penetrations through a fire wall or horizontal fire separation provide a firestop system with a FT Rating as determined by ULC or cUL which is equal to fire resistance rating of construction being penetrated.

- 3.3.15.2. Ensure ULC or cUL tested listings for cable tray and cable penetrations conform to annular space requirements, (construction assembly type, penetrating item type and fire rating) for each separate instance per manufacturer's listings.

3.4. SITE QUALITY CONTROL

- 3.4.1. Ensure firestopping systems do not affect structural integrity of load bearing walls and assemblies. Coordinate with Consultant prior to penetrating any load bearing assembly. For unusual firestop application for which no tested system is available, ensure manufacturers submit their proposal to local authorities having jurisdiction for their review and approval prior to installation.
- 3.4.2. Ensure work of this Section is by 1 Subcontractor responsible for firestopping materials and systems for all work except as specified herein.
- 3.4.3. Conform to both temperature and flame ratings of standards listed hereinafter and other requirements of authorities having jurisdiction.
- 3.4.4. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.
- 3.4.5. Manufacturer Services: Consult with Product manufacturer's technical representative about following items:
- 3.4.5.1. fire stopping system for fire separation required.
- 3.4.5.2. curing characteristics of materials specified.
- 3.4.5.3. joint characteristics as built.
- 3.4.5.4. to be on-site during initial installation of firestop systems to train appropriate Subcontractor personnel in proper selection and installation procedures. Ensure this is done per manufacturer's written recommendations published in their literature and drawing details.

3.5. CLEANING

- 3.5.1. Remove excess materials and debris and clean adjacent surfaces immediately after application to satisfaction of Consultant. Remove and or correct staining and discolouring of adjacent surfaces as directed.
- 3.5.2. Remove temporary dams after initial set of firestopping and smoke seal materials where such materials are left exposed in finished areas and flame spread rating of such materials exceed a value of 25, in accordance with CAN/ULC-S102.

3.6. PROTECTION

- 3.6.1. Fully protect walls, windows, floors and other surfaces around areas to be firestopped from marring or damage. Mask where necessary to avoid spillage on to adjoining surfaces. Mask areas adjacent to openings, where necessary to prevent contamination or marring of adjacent surface materials. Remove masking after seal has been completed and an initial set has been achieved. Remove stains on adjacent surfaces as required.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide joints sealants including but not limited to following:

1.2.1.1. Interior:

1.2.1.1.1. control and expansion joints on exposed interior surfaces of exterior walls.

1.2.1.1.2. perimeter joints of exterior openings where indicated.

1.2.1.1.3. perimeter joints between interior wall surfaces and frames for interior doors and windows.

1.2.1.1.4. joints between plumbing fixtures and adjoining counters.

1.2.1.1.5. joints between different materials listed above.

1.2.1.1.6. other joints as indicated.

1.2.1.2. mildew resistant sealants.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Firestopping and smoke seals: Section 07 84 00, Firestopping and Smoke Seals.

1.2.2.2. Sealing of joints around sound attenuating gypsum board partitions: Section 09 21 16, Gypsum Board Assemblies.

1.2.2.3. Read other Sections of Specifications for extent of sealing specified in those Sections. Do other sealing indicated, specified or required.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. IPA: Isopropyl Alcohol (99.9% pure).

1.3.1.2. MEK: Methyl-ethyl-ketone.

1.3.1.3. SWRI: Sealant, Waterproofing, & Restoration Institute; www.swrionline.org.

1.3.2. Reference Standards:

1.3.2.1. ASTM C834-17 - Standard Specification for Latex Sealants

1.3.2.2. ASTM C920-18 - Standard Specification for Elastomeric Joint Sealants

1.3.2.3. ASTM C1248-22 - Standard Test Method for Staining of Porous Substrate by Joint Sealants

1.4. SUBMITTALS

1.4.1. Product Data:

1.4.1.1. Submit Product information from sealant manufacturer prior to commencement of work of this Section verifying:

1.4.1.1.1. selected sealant materials are from those specified.

1.4.1.1.2. composition and physical characteristics.

- 1.4.1.1.3. surface preparation requirements.
- 1.4.1.1.4. priming and application procedures.
- 1.4.1.1.5. suitability of sealants for purposes intended and joint design.
- 1.4.1.1.6. test report on adhesion, compatibility and staining effect on samples of adjacent materials used on Project.
- 1.4.1.1.7. sealants compatibility with other materials and Products with which they come in contact including but not limited to sealants provided under other Sections, insulation adhesives, bitumens, brick, stone, concrete, masonry, metals and metal finishes, ceramic tile, plastic laminates and paints.
- 1.4.1.1.8. suitability of sealants for temperature and humidity conditions at time of application.
- 1.4.2. Samples: Submit samples in accordance with Section 01 30 00. Provide cured, colour samples of manufacturer's standard range of colours in each type of sealant and caulking compound for colour selection by Consultant. Submit samples of primer, bond breaker tape and joint backing material, if requested.

1.5. QUALITY ASSURANCE

- 1.5.1. Qualifications:
 - 1.5.1.1. Installers: Provide work of this Section executed by competent installers who have minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.

1.6. DELIVERY, STORAGE AND HANDLING

- 1.6.1. Delivery and Acceptance Requirements: Deliver caulking and sealant materials to site in original, unopened containers with manufacturers' labels and seals intact. Labels to identify manufacturer's name, brand name of Product, grade and type, application directions and shelf life or expiry date of Product.
- 1.6.2. Storage and Handling Requirements:
 - 1.6.2.1. Handle and store materials in accordance with manufacturer's printed directions. Store flammable materials in safe, approved containers to eliminate fire hazards.
 - 1.6.2.2. Do not use caulking and sealant materials that have been stored for period of time exceeding maximum recommended shelf life of materials.

1.7. SITE CONDITIONS

- 1.7.1. Ambient Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated and until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8. WARRANTY

- 1.8.1. Manufacturer Warranty: Warrant work of this Section for period of 10 years for silicone type sealants and 5 years for other sealants against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner. Defects include but are not limited to; cracking, crumbling, melting, shrinkage, sag, failure of adhesion, cohesion or reversion, air and moisture leakage, marbling or streaking due to improper mixing, discolouration due to dirt pick-up during curing and staining of adjacent materials.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:

- 2.1.1.1. BASF; www.master-builders-solutions.basf.com
- 2.1.1.2. The Dow Chemical Company; www.consumer.dow.com
- 2.1.1.3. Euclid Chemical Canada Ltd.; www.euclidchemical.com
- 2.1.1.4. Momentive Performance Materials; www.momentive.com
- 2.1.1.5. Pecora Corporation; www.pecora.com
- 2.1.1.6. Sika Canada Inc.; www.sika.ca
- 2.1.1.7. Tremco Canada; www.tremcosealants.com

2.2. MATERIALS

2.2.1. Performance/Design Criteria:

2.2.1.1. Carbon Impact Design: Preference will be given to those manufacturers who have provided EPDs outlining their programs for reducing their Operational and Embodied Carbon footprints as specified herein.

2.2.1.2. Material Ingredient Disclosure: Preference will be given to those manufacturers who have provided HPDs or similar documentation identifying their Product chemical content as specified herein.

2.2.2. General: Ensure elastomeric sealants comply with Standards specified herein for type, grade, class and uses.

2.2.3. Where non-staining elastomeric sealants are applied to porous substrates, provide Products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.

2.2.4. Type B Sealant: Non-sag type, 1 component, mildew resistant silicone containing non-toxic fungicidal agents sealant conforming to ASTM C920, Type S, Grade NS, Class 25, Use NT. Supply in clear or white as selected. Supply 1 of following:

- 2.2.4.1. "DOWSIL™ 786" by The Dow Chemical Company.
- 2.2.4.2. "DOWSIL™ Tub, Tile & Ceramic Silicone Sealant" by The Dow Chemical Company.
- 2.2.4.3. "GE Sanitary SCS1701 or SCS1702" by Momentive Performance Materials.
- 2.2.4.4. "Sikasil®-GP" by Sika Canada Inc.
- 2.2.4.5. "Tremsil® 200" by Tremco Canada.

2.2.5. Type C Sealant: Provide 1 of following:

2.2.5.1. Non-sag type, 1 component, acrylic latex sealant conforming to ASTM C834, Type OP, Grade - 18°C. Supply in standard colours as selected. Supply 1 of following:

- 2.2.5.1.1. "GE RCS20" by Momentive Performance Materials.
- 2.2.5.1.2. "AC-20® +Silicone" by Pecora Corporation.
- 2.2.5.1.3. "Tremflex® 834" by Tremco Canada.

2.2.5.2. Non-sag type, multi-component polyurethane sealant conforming to ASTM C920, Type M, Grade NS, Class 50, Use T, I, M, A and O. Supply in standard colours as selected. Supply 1 of following:

- 2.2.5.2.1. "MasterSeal® NP 2™" by BASF.

- 2.2.5.2.2. "Sikaflex® 2c NS" by Sika Canada Inc.
- 2.2.5.2.3. "Dymeric® 240FC" by Tremco Canada.
- 2.2.5.3. Non-sag type, 1 component polyurethane sealant conforming to ASTM C920, Type S, Grade NS, Class 25, Use NT, M, A and O. Supply in standard colours as selected. Supply 1 of following:
 - 2.2.5.3.1. "MasterSeal® NP 1™" by BASF.
 - 2.2.5.3.2. "Eucolastic 1NS" by Euclid Chemical Canada Ltd.
 - 2.2.5.3.3. "Sikaflex® 1a" by Sika Canada Inc.
 - 2.2.5.3.4. "Dymonic® FC" or "Dymonic® 100" or "Vulkem 116" by Tremco Canada.
- 2.2.6. Joint Primer: Non-staining, suitable for substrate surfaces, compatible with joint forming materials and as recommended by sealant manufacturer for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- 2.2.7. Joint Backing: Preformed, compressible, resilient, non-waxing, non-extruding, non-staining strips of closed cell polyethylene or urethane foam, compatible with joint substrates and are approved by sealant manufacturer based on field experience and laboratory test. Sizes and shapes to suit various conditions, diameter 25% greater than joint width. Ensure backing is compatible with sealant, primer and substrate.
- 2.2.8. Bond Breaker Tape: As recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.
- 2.2.9. Masking Tape: Provide non-staining, non-absorbent tapes and sheets which effectively mask substrate without leaving an adhesive residue compatible with joint sealants and surfaces adjacent to joints.
- 2.2.10. Cleaning Material: Non-corrosive, non-staining, solvent type, xylol, MEK, toluol, IPA or as recommended by sealant manufacturer and acceptable to material or finish manufacturers for surfaces adjacent to sealed areas free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants with joint substrates.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions:
 - 3.1.1.1. Examine joints for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealant performance. Ensure joints are suitable to accept and receive sealants.
 - 3.1.1.2. Verify joint surfaces are clean, sound, free of defects and dimensions are within sealant manufacturer's size requirements.
 - 3.1.1.3. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.1.2. Preinstallation Testing: Before any sealing work is commenced, test materials for indications of staining or poor adhesion.
- 3.1.3. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. PREPARATION

- 3.2.1. Protection of In-Place Conditions: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.
- 3.2.2. Surface Preparation:
 - 3.2.2.1. Clean joints and spaces which are to be sealed and ensure they are dry and free of dust, loose mortar, oil, grease, oxidation, coatings, form release agents, sealers and other foreign material.
 - 3.2.2.2. Remove oils by sandblast cleaning.
 - 3.2.2.3. Remove loose particles present or resulting from grinding, abrading or sandblast cleaning by thorough brushing.
 - 3.2.2.4. Clean ferrous metals of rust, mill scale and foreign materials by wire brushing, grinding or sanding.
 - 3.2.2.5. Wipe non-porous surfaces such as metal and glass to be sealed, except pre-coated metals, with cellulose sponges or clean rags soaked with ethyl alcohol, ketone solvent, xylol or toluol and wipe dry with clean cloth. Where joints are to be sealed with silicone based sealants clean joint with MEK or xylol. Do not allow solvent to air-dry without wiping. Clean pre-coated metals with solutions or compounds which will not injure finish and which are compatible with joint primer and sealant. Check ferrous metal surfaces are painted before applying sealant.
 - 3.2.2.6. Examine joint sizes and where depth of joint exceed required depth of sealant correct to achieve proper following width/depth ratio:
 - 3.2.2.6.1. Maintain 2:1 Width/Depth Ratio: Ensure maximum sealant depth is 13 mm (1/2") and minimum contact width with each substrate is 6 mm (1/4"). Confirm width/depth ratios with sealant manufacturers.
 - 3.2.2.7. Install joint backing material to achieve correct, uniform joint profile and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 3.2.2.8. Do not leave gap between ends of sealant backing; do not stretch, twist, puncture, or tear sealant backings; remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
 - 3.2.2.9. Confirm with sealant manufacturer selected bond breaker material works with chosen sealant.
 - 3.2.2.10. Where joint design or depth of joint prevents use of joint backing material, apply bond breaker tape at back of joint to prevent 3-sided adhesion.
 - 3.2.2.11. Do not stretch, twist, puncture or tear joint backing. Butt joint backing at intersections. Install bond breaker tape at back of joint where joint backing is not required or cannot be installed.
 - 3.2.2.12. Where surfaces adjacent to joints are likely to become coated with sealant during application, mask them prior to priming and sealing.
 - 3.2.2.13. Do not exceed shelf life and pot life of materials and installation times, as stated by manufacturer.
 - 3.2.2.14. Be familiar with work life of sealant to be used. Do not mix multiple component materials until required for use.
 - 3.2.2.15. Use materials as received from manufacturer, without additions, deletions and adulterations of materials.
 - 3.2.2.16. Mix multiple component sealants and bulks sealants using mechanical mixer capable of mixing without mixing air into material, in accordance with manufacturer's directions and recommendations. Continue mixing until material is homogeneously blended, uniform in colour and free from streaks of unmixed material. Install compound prior to start of hardening or curing cycle.

- 3.2.2.17. Prior to painting, seal joints in surfaces to be painted. Where surfaces to be sealed are prime painted in shop before sealing ensure prime paint is compatible with primer and sealant. If they are incompatible, inform Consultant and change primer and sealant to compatible types reviewed by Consultant.
- 3.2.2.18. Where irregular surface or sensitive joint border exists, apply masking tape at edge of joint to ensure joint neatness and protection.
- 3.2.2.19. Prime sides of joints for type of surface being sealed prior to application of joint backing, bond breaker or sealant as recommended by sealant manufacturer.
- 3.2.3. Removal:
 - 3.2.3.1. Remove existing caulking and/or sealant from joints as required.
 - 3.2.3.2. Remove existing caulking and/or sealants including any residual caulking/sealant material using suitable methods to prevent damage to adjacent surfaces. Take care to ensure no damage or visible changes take place to surface of substrate not covered by replacement sealant material.
 - 3.2.3.3. Clean surfaces of joints and spaces in accordance with procedures specified herein under "Surface Preparation".
 - 3.2.3.4. Ensure materials in contact with sealant are compatible.
 - 3.2.3.5. Where required, mask adjacent surfaces prior to priming and application of sealant to prevent staining.
 - 3.2.3.6. Prime inner surfaces of joint, where required, immediately prior to caulking, in accordance with sealant manufacturer's recommendations, to provide full adhesion and to prevent staining of adjacent exposed surfaces.

3.3. APPLICATION

- 3.3.1. Apply in accordance with manufacturer's directions and recommendations unless more stringent requirements apply.
- 3.3.2. Apply sealant by proven techniques using hand operated guns or pressure equipment fitted with suitable nozzle size and equipment approved by sealant manufacturer.
- 3.3.3. Force sealant into joint and against sides of joints to obtain uniform adhesion. Use sufficient pressure to completely fill voids in joint regardless of variation in joint widths and to proper joint depth as prepared. Ensure full firm contact with interfaces of joint. Superficial pointing with skin bead is not permitted.
- 3.3.4. Finish face of compound to form smooth, uniform beads. At recesses in angular surfaces, finish compound with flat face, flush with face of materials at each side. At recesses in flush surfaces, finish compound with concave face flush with face of materials at each side.
- 3.3.5. Compound may be tooled, provided such tooling does not damage seal or tear compound. Avoid pulling of sealant from sides.
- 3.3.6. Tool surfaces as soon as possible after sealant application or before any skin formation has occurred, particularly when using silicone sealants.
- 3.3.7. Ensure joint surfaces are straight, neatly finished, free from ridges, wrinkles, sags, dirt, stains, air pockets and embedded foreign matter or other defacement and be uniform in colour, free from marbling and/or colour streaking due to improper mixing or use of out of shelf life Products.
- 3.3.8. Do not use solvent curing sealants indoors.
- 3.3.9. Joint designation in "SEALANT LOCATION SCHEDULE" specified herein and the fact that Drawings do not show all locations to be sealed does not limit responsibility of this Section to seal all locations except those indicated in other Sections of work, required to create and ensure continuous enclosure.

- 3.3.10. Firestopping and Smoke Seal: Sealants part of firestopping systems and smoke seals provided within fire rated assemblies are part of work of Section 07 84 00 and carried out under supervision of this Section.

3.4. REPAIR

- 3.4.1. Repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.5. SITE QUALITY CONTROL

- 3.5.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

- 3.5.2. Manufacturer Services: Prior to commencement of sealing, arrange for sealant manufacturer's technical representative to visit the Place of the Work and inspect surfaces and joints to be sealed.

3.6. CLEANING

- 3.6.1. Immediately clean adjacent surfaces which have been soiled and leave work in neat, clean condition. Remove excess materials, compounds smears or other soiling resulting from application of sealants. Use recommended cleaners and solvents. Leave finished work in neat, clean condition with no evidence of spillovers onto adjacent surfaces.

3.7. PROTECTION

- 3.7.1. Provide permitted, non-staining means of protection for completed joint sealant installations where required to protect work from mechanical, thermal, chemical and other damage by construction operations and traffic.

- 3.7.2. Maintain protection securely in place until completion of Work. Remove protection when so directed by Consultant.

3.8. ATTACHMENTS

- 3.8.1. SEALANT LOCATION SCHEDULE

- 3.8.1.1. Use 1 of sealants specified for each type in following locations. Ensure sealant chosen (from several specified under each type under "MATERIALS") for each location is recommended by manufacturer for use for conditions encountered:

- 3.8.1.1.1. Type B: Typically used in joints between urinals and walls, around washrooms accessories, at corners of walls, between splash backs and walls, in shower, damp or wet areas, at ceramic tiles where mildew resistant sealant is required.

- 3.8.1.1.2. Type C: Typically used in joints between interior metal and/or wood frames and adjacent construction in interior partitions.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide hollow metal doors and frames including but not limited to following:

1.2.1.1. supply of interior hollow metal doors.

1.2.1.2. supply of hollow metal door frames.

1.2.1.3. supply of hollow metal frames and mullions for borrowed lights and glazed screens.

1.2.1.4. preparation of hollow metal doors and frames for door hardware.

1.2.1.5. glazing stops.

1.2.1.6. preparation of hollow metal doors and frames for security system including CSA approved wiring, conduit and junction boxes for electronic hardware.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Hanging of doors and installation of door hardware: Section 06 90 00, General Installations.

1.2.2.2. Caulking and/or sealing door frames: Section 07 92 00, Joint Sealants.

1.2.2.3. Supply of door hardware: Section 08 71 00, Door Hardware.

1.2.2.4. Provision of glazing: Section 08 80 00, Glass and Glazing.

1.2.2.5. Installation of snap-in clips and frames in gypsum board partitions: Section 09 21 16, Gypsum Board Assemblies.

1.2.2.6. Finish painting doors and frames: Section 09 91 00, Painting.

1.2.2.7. Wiring and conduit for electronic hardware in frame: Division 26, Electrical.

1.2.2.8. Provision of security system: Division 28, Electronic Safety and Security.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. CSDMA: Canadian Steel Door Manufacturers Association; www.csdma.org.

1.3.1.2. HMMA: Hollow Metal Manufacturers Association; www.naamm.org/hmma/.

1.3.1.3. NAAMM: National Association of Architectural Metal Manufacturers; www.naamm.org.

1.3.2. Reference Standards:

1.3.2.1. ANSI/SDI A250.4-18 - Test Procedure and Acceptance Criteria for - Physical Endurance for Steel Doors, Frames and Frame Anchors

1.3.2.2. ANSI/SDI A250.10-20 - Test Procedure and Acceptance Criteria for - Prime Painted Steel Surfaces for Steel Doors and Frames

1.3.2.3. ASTM A568/A568M-19a - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

1.3.2.4.	ASTM A653/A653M-25a	- Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
1.3.2.5.	CSA W59:24	- Welded steel construction
1.3.2.6.	NAAMM-HMMA 840-24	- Guide Specification for Receipt, Storage and Installation of Hollow Metal Doors and Frames
1.3.2.7.	NAAMM-HMMA 860-18	- Guide Specifications for Hollow Metal Doors and Frames
1.3.2.8.	CAN/ULC-S702.1-21	- Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification

1.4. ADMINISTRATIVE REQUIREMENTS

- 1.4.1. Scheduling: Submit a schedule indicating each door and frame related to the Door Schedule.

1.5. SUBMITTALS

- 1.5.1. Shop Drawings:

1.5.1.1. Submit Shop Drawings in accordance with Section 01 30 00. Show each type of frame, door, core, metal thicknesses and finishes, openings (glazing), location of exposed fasteners, cutouts, hardware blanking, reinforcing, tapping and drilling arrangements. Show large scale frame sections and anchoring details. Submit door and frame schedule identifying each unit. Ensure each unit bears legible identifying mark corresponding to that listed in Door Schedule.

1.5.1.2. For each door and frame scheduled for electrical hardware, show following items in addition to minimum requirements (coordinate with Division 26):

1.5.1.2.1. location and size of junction boxes and conduit for electrical hardware and wiring (electrical junction back boxes by this Section).

1.5.1.2.2. conduit cutouts (conduit and connectors by Division 26).

1.5.1.2.3. other information related to electrical hardware or interrelated systems such as fire alarm and security systems/controls.

1.5.2. Samples: Submit samples in accordance with Section 01 30 00. Provide 1 cut-away corner sample minimum 300 mm (12") square for each type of door and frame to indicated following:

1.5.2.1. Doors:

1.5.2.1.1. core.

1.5.2.1.2. reinforcing.

1.5.2.1.3. facing.

1.5.2.1.4. frame.

1.5.2.1.5. insulation if applicable.

1.5.2.1.6. glazing if applicable.

1.5.2.1.7. factory applied finishes if applicable.

1.5.2.2. Frames:

1.5.2.2.1. frame profile.

1.5.2.2.2. corner joints.

1.5.2.2.3. floor and wall anchors.

1.5.2.2.4. silencers.

- 1.5.3. Test and Evaluation Reports: Submit following test and evaluation reports in accordance with NAAMM/HMMA 860:
 - 1.5.3.1. Hollow metal door and frame assemblies supplied under this Section meet acceptance criteria of ANSI/SDI A250.4, Level A.
 - 1.5.3.2. Primer applied on hollow metal door and frame assemblies meet acceptance criteria of ANSI/SDI A250.10.
 - 1.5.3.3. Ensure reports include name of testing authority, date of test, location of test facility, description of test specimen, procedures used in testing and indicate compliance with specified acceptance criteria.
 - 1.5.3.4. Submit in addition to fire label, certificate to substantiate design and construction of fire-rated screen assemblies, if required by Consultant or authorities having jurisdiction.

1.6. QUALITY ASSURANCE

- 1.6.1. Qualifications:
 - 1.6.1.1. Manufacturers: Execute work of this Section by a manufacturer who is a member of CSDMA and/or HMMA ensuring Product quality meets standards set by these associations.

1.7. DELIVERY, STORAGE AND HANDLING

- 1.7.1. Delivery and Acceptance Requirements:
 - 1.7.1.1. Identify Products with a label indicating: manufacturer's name, Consultant's opening number, Product description and dimensions.
 - 1.7.1.2. Protect doors and frames during shipping.
 - 1.7.1.3. Inspect materials thoroughly upon receipt and report discrepancies, deficiencies and damage immediately in writing to Consultant. Note damages on carrier's Bill of Lading.
- 1.7.2. Storage and Handling:
 - 1.7.2.1. Store and protect doors and frames during storage in accordance with NAAMM-HMMA 840. Coordinate this requirement with Section 06 90 00 for installing doors.
 - 1.7.2.2. Remove wrappings or coverings from doors upon delivery at site. Store doors in vertical position, spaced by blocking at least 100 mm (4") off ground to permit air circulation between them.

1.8. WARRANTY

- 1.8.1. Manufacturer Warranty: Warrant work manufactured from ASTM A653/A653M, A40 galvanized steel, touched up only with zinc-rich rust inhibitive primer where coating was removed during its manufacture for period of 10 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner. Defects include but are not limited to; rust perforation when stored, installed and finish painted in accordance with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
 - 2.1.1.1. Artek Door Ltd.; www.artekdoor.com
 - 2.1.1.2. Baron Steel Doors & Frames; www.baronmetal.com
 - 2.1.1.3. Daybar Industries Limited; www.daybar.com

- 2.1.1.4. Fleming Door Products Ltd.; www.flemingdoor.com
- 2.1.1.5. Gensteel Doors, Inc.; www.gensteeldoors.com
- 2.1.1.6. Shanahan's Limited Partnership; www.shanahans.com
- 2.1.2. Provide doors and frames for work of this Section by a single source manufacturer.

2.2. MATERIALS

- 2.2.1. Performance/Design Criteria:
 - 2.2.1.1. Ensure Product is manufactured by a firm experienced in design and production of standard and custom commercial metal door and frame assemblies, integration of builders' or electronic hardware and glazing assemblies and other items affecting work.
 - 2.2.1.2. Cycle Test Acceptance Criteria: Ensure door and frame assembly is testing in accordance with ANSI/SDI A250.4 for "High Usage" and is certified as Level "A" (1,000,000 cycles).
 - 2.2.1.3. Twist Test Acceptance Criteria: Maximum permanent deflection not to exceed 3 mm (1/8") under a maximum 136 kg (300 lb) load, total deflection not to exceed 32 mm (1-1/4") when tested in accordance with ANSI/SDI A250.4. Ensure tests are conducted by an independent nationally recognized accredited laboratory.
- 2.2.2. Sheet Steel:
 - 2.2.2.1. Doors and Frames: Commercial grade steel to ASTM A568/A568M, Class 1, hot-dip galvanized to ASTM A653/A653M, ZF120 (A40), known commercially as "Galvanneal". Steel sheet thicknesses specified are base metal thicknesses prior to galvanizing.
- 2.2.3. Door Cores:
 - 2.2.3.1. Steel Stiffened: Continuous vertically formed steel sections, full thickness of interior space between door faces. Stiffeners 0.66 mm minimum thickness, spaced 150 mm (6") apart and securely fastened to both face sheets by industrial glue for moderate duty doors or laser welds for heavy duty doors spaced a maximum of 125 mm (5") oc vertically.
 - 2.2.3.2. Insulation: Mineral wool insulation, density 24 kg/m³ (1.5 pcf) minimum consisting of durable fibrous material processed from rock, slag or glass, bound with deterioration resistant binders, CAN/ULC-S702.1, Type 1.
- 2.2.4. Adhesives:
 - 2.2.4.1. Steel Components: Heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- 2.2.5. Primer: Rust inhibitive touch-up only.
- 2.2.6. Door Silencers (Bumpers): Single stud rubber/neoprene type.
- 2.2.7. Fasteners for Stops: Cadmium plated steel, counter sunk flat or oval head sheet metal Phillips screws.
- 2.2.8. Frame Anchors:
 - 2.2.8.1. Floor Anchors: Minimum 3 mm (1/8") thick adjustable floor anchors with 2 holes for bolting to floor.
 - 2.2.8.2. Wall Anchors:
 - 2.2.8.2.1. Steel/Wood Stud Type: Minimum 0.81 mm thick steel.
 - 2.2.8.2.2. Steel/Wood Stud Tension and Associated Wall Type: Minimum 0.81 mm thick steel.
- 2.2.9. Fabrication:
 - 2.2.9.1. Welding: Carry out welding in accordance with CSA W59.

- 2.2.9.2. Grind exposed welds smooth and flush. Fill open joints, seams and depressions with filler or by continuous brazing or welding. Grind smooth to true sharp arises and profiles and sand down to smooth, true, uniform finish.
- 2.2.9.3. Hardware Requirements: Blank, mortise, reinforce, drill and tap doors and frames to receive mortised templated hardware. Check hardware list for requirements.
- 2.2.9.4. Frames - General:
 - 2.2.9.4.1. Fabricate frames for doors, screens and borrowed lights to profiles indicated.
 - 2.2.9.4.2. Ensure frames are welded type construction.
 - 2.2.9.4.3. Reinforce frame as required for surface mounted hardware. For door frames wider than 1500 mm (5'), reinforce door frame head and jamb and mullions at junction of head.
 - 2.2.9.4.4. Where frames occur in gypsum board provide stud type anchors.
 - 2.2.9.4.5. Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb. Provide 2 anchors for rebate opening heights up to and including 1500 mm (5') and 1 additional anchor for each additional 760 mm (30") of height or fraction thereof, except as indicated below. For frames in previously placed concrete, masonry or structural steel provide anchors located not more than 150 mm (6") from top and bottom of each jamb and intermediate anchors at 660 mm (26") on centre maximum.
 - 2.2.9.4.6. Where floor finishes allow, fabricate frames to extend 38 mm (1-1/2") below finished floor level. Where frames are to terminate at finished floor level, provide plates for anchorage to slabs.
 - 2.2.9.4.7. Prepare each door opening for single stud door silencers: 3 for single door openings placed opposite hinges: 2 for double door openings approximately 150 mm (6") each side of centreline of head stop.
 - 2.2.9.4.8. Provide 0.81 mm thick steel snap-in or welded-in "Z" type stud anchors for door frames installed in steel stud gypsum board partitions. Ensure snap-in clips are supplied to Section 09 21 16.
 - 2.2.9.4.9. Factory apply touch-up primer to areas where zinc coating has been removed during fabrication.
- 2.2.9.5. Hollow Metal Door Frames and Transom Frames:
 - 2.2.9.5.1. Steel: Minimum 1.34 mm thick steel.
 - 2.2.9.5.2. Reinforcements:
 - 2.2.9.5.2.1. Lock and Strike Reinforcements: Minimum 1.34 mm thick steel.
 - 2.2.9.5.2.2. Hinge Reinforcements: Minimum 3.12 mm thick steel.
 - 2.2.9.5.2.3. Flush Bolt Reinforcement: Minimum 1.34 mm thick steel.
 - 2.2.9.5.2.4. Reinforcement for Surface Applied Hardware: Minimum 1.06 mm thick steel.
 - 2.2.9.5.2.5. Top and Bottom End Channels: Minimum 1.06 mm thick steel.
 - 2.2.9.5.3. Jamb Shipping Bars: Minimum 0.81 mm thick steel.
- 2.2.9.6. Sidelight and Window Frame Assemblies:
 - 2.2.9.6.1. Steel: Minimum 1.34 mm thick steel.
 - 2.2.9.6.2. Glazing Stops: Minimum 0.81 mm thick steel, formed, drilled and countersunk for fastenings.
- 2.2.9.7. Welded Type Frames:
 - 2.2.9.7.1. Punch mitre corners of frames. Punch mitres accurately with slots and tabs and weld continuously on inside of frame faces.

- 2.2.9.7.2. When required due to site access or due to shipping limitations, fabricate frame Product for large openings in sections, with splice joints for field assembly. Provide alignment plates or angles at each joint, fabricated of same metal thickness as frame. Indicate joints for field assembly on Shop Drawings.
- 2.2.9.7.3. Accurately cope and securely weld butt joints of mullions, transom bars, centre rails and sills. Grind welded joints to a smooth, uniform finish.
- 2.2.9.7.4. Securely attach floor anchors to inside of each jamb profile.
- 2.2.9.7.5. Weld in 2 temporary jamb shipping bars at each frame to maintain alignment during shipment.
- 2.2.9.7.6. Use formed channel glazing stops, minimum 16 mm (5/8") in height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- 2.2.9.8. Doors - General:
 - 2.2.9.8.1. Fabricate doors to be swing type flush with 1 continuous face free from joints, tool markings and abrasions and with provisions for glass and/or louvre openings as indicated on Door Schedule and Drawings.
 - 2.2.9.8.2. Fabricate doors using steel stiffened construction.
 - 2.2.9.8.3. Fabricate doors with top and bottom inverted recessed spot-welded channels.
 - 2.2.9.8.4. Reinforce, blank, drill and tap doors for mortised, templated hardware.
 - 2.2.9.8.5. Reinforce doors for surface mounted hardware.
 - 2.2.9.8.6. Factory prepare holes 13 mm (1/2") diameter and larger. Factory prepare holes less than 13 mm (1/2") when required for function of device for knob, lever, cylinder, turn pieces or when these holes overlap function holes.
- 2.2.9.9. Hollow Metal Doors and Transom Panels:
 - 2.2.9.9.1. Face Sheets: 1.06 mm thick minimum galvanized steel sheet.
 - 2.2.9.9.2. Vertical Stiffeners: 0.81 mm thick minimum unprimed steel sheet.
 - 2.2.9.9.3. Glazing Stops: 0.81 mm thick minimum unprimed steel sheet, formed, drilled and countersunk for fastenings.
- 2.2.9.10. Doors (Steel Stiffened Construction):
 - 2.2.9.10.1. Fabricate door faces with a single sheet of galvanized steel welded to steel stiffeners.
 - 2.2.9.10.2. Reinforce steel stiffened doors with 0.81 mm thick continuous interlocking vertical steel stiffeners spaced 150 mm (6") oc maximum, spot welded at 150 mm (6") oc maximum to face sheets. Fill voids with mineral wool insulation specified herein.
- 2.2.9.11. Fabrication Tolerances:
 - 2.2.9.11.1. Frames:
 - 2.2.9.11.1.1. Width and Height: +1.6 mm (+1/16"), -0.8 mm (-1/32").
 - 2.2.9.11.1.2. Face, Stop and Rabbet: +/-0.8 mm (+/-1/32").
 - 2.2.9.11.1.3. Jamb Depth: +/-1.6 mm (+/-1/16").
 - 2.2.9.11.2. Doors:
 - 2.2.9.11.2.1. Width and Height: +/-1.2 mm (+/-3/64").
 - 2.2.9.11.2.2. Thickness: +/-1.6 mm (+/-1/16").
 - 2.2.9.11.2.3. Edge Flatness: 1.6 mm (1/16") maximum.
 - 2.2.9.11.2.4. Surface Flatness: 3 mm (1/8") maximum.

- 2.2.9.11.2.5. Door Twist: +/-1.6 mm (+/-1/16").
- 2.2.9.11.3. Hardware:
- 2.2.9.11.3.1. Cutouts: Template dimension +0.38 mm (+0.015"), -0 mm (-0").
- 2.2.9.11.3.2. Location: +/-0.8 mm (+/-1/32").
- 2.2.9.11.3.3. Between Hinge Centrelines: +/-0.4 mm (+/-1/64").
- 2.2.9.12. Prime Painting: Apply factory touch up primer at areas where zinc coating has been damaged during fabrication.

2.3. SOURCE QUALITY CONTROL

- 2.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1. Supply hollow metal doors and frames to Section 06 90 00 for installation.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide wood doors including but not limited to following:

1.2.1.1. wood veneer faced particle core doors.

1.2.1.2. glass stops.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Setting steel door frames in place: Section 06 90 00, General Installations.

1.2.2.2. Installation of wood doors and door hardware: Section 06 90 00, General Installations.

1.2.2.3. Supply steel door frames: Section 08 11 13, Hollow Doors and Frames.

1.2.2.4. Supply of door hardware: Section 08 71 00, Door Hardware.

1.2.2.5. Supply of glass: Section 08 80 00, Glass and Glazing.

1.2.2.6. Setting steel door frames in gypsum board partitions: Section 09 21 16, Gypsum Board Assemblies.

1.2.2.7. Site painting of doors: Section 09 91 00, Painting.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. HVAC: Heating, Ventilating and Air Conditioning.

1.3.1.2. NAAWS: North American Architectural Woodwork Standards – 4.0, 2021, as amended.

1.3.2. Reference Standards:

1.3.2.1. ANSI/WDMA I.S. 1A-21 - Industry Standard for Interior Architectural Flush Wood Doors

1.4. SUBMITTALS

1.4.1. Product Data: Submit Product data indicating door core materials and construction and face type wood veneer.

1.4.2. Shop Drawings:

1.4.2.1. Submit Shop Drawings in accordance with Section 01 30 00.

1.4.2.2. Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special bevelling, special blocking for hardware, identify cut outs for glazing and other openings.

1.4.3. Samples: Submit 1 cut away corner sample minimum 300 mm (12") square to clearly indicate construction and finish characteristics of each type of door assembly.

1.5. QUALITY ASSURANCE

1.5.1. Qualifications:

1.5.1.1. Provide work of this Section in accordance with Section 09 of NAAWS produced by AWMAC/WI, except as specified otherwise herein and by reference are hereby made a part of this Section. Ensure any reference to grades and terminology in this Section is as defined in NAAWS.

1.5.1.2. Requirements of this Section govern and modify NAAWS.

1.5.1.3. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and be a member of AWMAC/WI.

1.6. DELIVERY, STORAGE AND HANDLING

1.6.1. Delivery and Acceptance Requirements:

1.6.1.1. Do not subject interior wood doors to extremes in either heat or humidity. Do not receive delivery to site until HVAC systems are operational and balanced, providing temperature range of 10 deg C to 32 deg C (50 deg F to 90 deg F) and 25% to 55% relative humidity.

1.6.1.2. Receive doors at site in manufacturer's standard packaging.

1.6.2. Storage and Handling Requirements: Store and protect wood doors in accordance with manufacturer's recommendations and ANSI/WDMA I.S. 1A's Appendix Section "Care and Installation at Job Site". Ensure Contractor responsible for receiving and storing wood doors has a copy of ANSI/WDMA I.S. 1A.

1.7. WARRANTY

1.7.1. Manufacturer Warranty: Warrant work of this Section against defects and deficiencies for a period of 3 years. Promptly correct defects and deficiencies which become apparent during warranty period, to satisfaction of Consultant and at no expense to Owner. Defects include, but are not limited to, bubbling, delamination of faces, or edges, warp, twist bow exceeding 6 mm (1/4") and telegraphing of core. "Correct" referred to herein includes labour and materials for removal, repair, refinishing and replacement of Products provided as part of work of this Section, installing hardware, finishing, hanging and fitting.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Door Schedule and Specifications:

2.1.1.1. Baillargeon; www.masonitearchitectural.ca

2.1.1.2. Lambton Doors; www.lambtondoors.com

2.1.1.3. Masonite Architectural; www.masonitearchitectural.com

2.1.1.4. RK Doors Inc.; www.rkdoors.ca

2.1.1.5. VT Industries, Inc.; www.vtindustries.com

2.2. MATERIALS

2.2.1. Conform to NAAWS, Section 09 or ANSI/WDMA I.S. 1A for wood flush doors, except as specified herein.

2.2.2. Supply wood doors from same manufacturer.

2.2.3. Interior Solid Particleboard Core Wood Flush Doors:

2.2.3.1. Construction: 5 ply.

- 2.2.3.2. Core: Solid mat-formed wood particleboard core. Minimum 513 kg/m³ (32 pcf) density.
- 2.2.3.3. Stiles: 2 ply, minimum 30 mm (1-3/16") laminated with 22 mm (7/8") hardwood edge.
- 2.2.3.4. Bottom Rail: Minimum 30 mm (1-3/16") hardwood or oriented strand board (manufacturer's option).
- 2.2.3.5. Top Rail: Minimum 30 mm (1-3/16") hardwood or oriented strand board (manufacturer's option) for 5 ply construction.
- 2.2.4. Door Facing:
 - 2.2.4.1. Veneer Exterior Flush: AWMAC/WI or ANSI/WDMA I.S. 1A Custom grade, 0.8 mm (1/32") thick mechanically spliced, rift-cut for transparent finish.
 - 2.2.4.2. Veneer Interior Flush: AWMAC/WI or ANSI/WDMA I.S. 1A Custom grade, 0.8 mm (1/32") thick mechanically spliced, rift-cut for transparent finish.
 - 2.2.4.3. Exposed Vertical Edges: Veneer minimum 13 mm (1/2") thick. Of same species as face veneer for transparent finish.
- 2.2.5. Adhesive: Provide in accordance with Section 04, 04.5.5.2 and "Adhesive Usage Guide" in "Appendix" of NAAWS.
- 2.2.6. Vision Frames for Unrated Doors: Wood, of same species as door facing; channel shape; mitre corners; prepared for countersink style tamper proof screws.
- 2.2.7. Fabrication:
 - 2.2.7.1. Fabricate flush doors in accordance with NAAWS, Section 09 or ANSI/WDMA I.S. 1A, except as specified herein.
 - 2.2.7.2. Size doors for 3 mm (1/8") clearance of heads and jambs and maximum 19 mm (3/4") at bottom.
 - 2.2.7.3. Bevel vertical edges of single acting doors 3 mm in 50 mm (1/8" in 2") on lock and hinge sides.
 - 2.2.7.4. Radius vertical edges of double acting doors to 60 mm (2-3/8") radius.
 - 2.2.7.5. Seal wood edges and edges of cut outs before units are placed in unheated storage areas at plant or shipped to site.
 - 2.2.7.6. Flush Doors:
 - 2.2.7.6.1. Fabricate solid core doors using hot or cold press construction technology. Bond stiles and rails to core using Type I or II adhesive. Sand for uniform thickness. Laminate door facing, crossbanding and assembled core in hot or cold press.
 - 2.2.7.6.2. Factory sand assembled door leaf.
 - 2.2.7.6.3. Factory machine doors for door hardware in accordance with hardware requirements and dimensions.
 - 2.2.7.6.4. Factory cut glass light openings. Ensure openings are square with internal corners slightly rounded. Ensure portion between cutout and door edge is not less than 125 mm (5") wide at any point. Ensure cut out area is not greater than 40% of area of door face. Ensure cut out does not exceed half height of door.
 - 2.2.7.6.5. Provide hardwood glass stops, finished to match face veneer, for vision panels in un-rated doors.
 - 2.2.7.6.6. Factory fit doors for frame opening dimensions identified on Shop Drawings.
 - 2.2.7.6.7. Provide inner blocks at lock edge, top of door closer and bottom for hardware reinforcement.

2.3. SOURCE QUALITY CONTROL

- 2.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

PART 3 - EXECUTION

3.1. INSTALLATION

3.1.1. Installation of wood doors and door hardware forms part of the work of Section 06 90 00.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide access doors and frames including but not limited to following:

1.2.1.1. access doors and frames.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. SSPC: The Society for Protective Coatings (formerly known as Steel Structures Painting Council); www.sspc.org.

1.3.2. Reference Standards:

1.3.2.1. ASTM A653/A653M-25a - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.3.2.2. CSA G40.20-13(23) - General requirements for rolled or welded structural quality steel

1.3.2.3. CSA G40.21-13(23) - Structural quality steel

1.3.2.4. SSPC-Paint 20 - Zinc-Rich Coating (Type I – Inorganic, and Type II – Organic)

1.4. SUBMITTALS

1.4.1. Product Data: Submit Product data for each type of access door and frame indicated.

1.4.2. Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00. In addition to the minimum requirements indicate following:

1.4.2.1. face or ceiling placement.

1.4.2.2. tolerances and clearances.

1.4.2.3. finishes.

1.4.2.4. hardware.

1.4.3. Samples: Submit samples in accordance with Section 01 30 00. Provide 1 cut-away corner sample minimum 300 mm (12") square for each type of access door to indicated following:

1.4.3.1. core.

1.4.3.2. facing.

1.4.3.3. frame.

1.5. QUALITY ASSURANCE

1.5.1. Qualifications:

1.5.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
- 2.1.1.1. Acudor Products, Inc.; www.acudor.com
 - 2.1.1.2. Bauco Access Panel Solutions Inc.; www.accesspanelsolutions.com
 - 2.1.1.3. Cendrex Inc.; www.cendrex.com
 - 2.1.1.4. Jensen Industries; www.jensen-ind.com
 - 2.1.1.5. Karp Associates, Inc.; www.karpinc.com
 - 2.1.1.6. Larsen's Manufacturing Company; www.larsensmfg.com
 - 2.1.1.7. Nystrom Building Products Co.; www.nystrom.com

2.2. MATERIALS

- 2.2.1. Steel Plates, Shapes and Bars: New material conforming to CSA G40.20 and CSA G40.21, Grade 300W.
- 2.2.2. Steel Sheet:
- 2.2.2.1. Metallic Coated: ASTM A653/A653M, Commercial Steel (CS), Type B, with A60 zinc-iron-alloy (galvannealed) coating or G60 mill-phosphatized zinc coating; stretcher-leveled standard of flatness.
- 2.2.3. Drywall Beads: Edge trim formed from 0.759 mm (22 ga) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum panels indicated.

2.3. MANUFACTURED UNITS

- 2.3.1. Recessed Access Doors and Trimless Frames:
- 2.3.1.1. Material: Metallic-coated steel sheet.
 - 2.3.1.2. Surface Type: Gypsum board.
 - 2.3.1.3. Locations: Walls.
 - 2.3.1.4. Door: Minimum 1.519 mm (16 ga) thick sheet metal in the form of a pan recessed 16 mm (5/8") for infill of finish matching surface type indicated.
 - 2.3.1.5. Reinforce panel as required to prevent buckling.
 - 2.3.1.6. Frame: Minimum 1.519 mm (16 ga) thick sheet metal with bead or edge for surface type indicated.
 - 2.3.1.7. Hinges: Spring-loaded concealed pin type.
 - 2.3.1.8. Latch: Screwdriver-operated cam latch with plastic grommet for access through pan recess.
- 2.3.2. Acoustic Access Panels for Gypsum Board Ceilings:
- 2.3.2.1. Material: Aluminum.
 - 2.3.2.2. Surface Type: Gypsum board.
 - 2.3.2.3. Locations: Ceilings.
 - 2.3.2.4. Door: Aluminum in the form of a pan recessed 16 mm (5/8") for infill of finish matching surface type indicated. Door can be lifted out and have safety cables.
 - 2.3.2.5. Frame: Aluminum with continuous EPDM gasket
 - 2.3.2.6. Hinges: Concealed pivoting rod hinge.

- 2.3.2.7. Latch: Concealed touch latch.
- 2.3.2.8. Options:
 - 2.3.2.8.1. Barymat 5 - barium loaded rubber matt attached to gypsum board in access panel.
 - 2.3.2.8.2. 2nd layer of gypsum board laminated to back of access door.
- 2.3.2.9. Permitted Product: "Bauco-Plus II" by Bauco Access Panel Solutions Inc.
- 2.3.3. Finishes:
 - 2.3.3.1. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated and capability to provide sound foundation for field-applied topcoats despite prolonged exposure.
 - 2.3.3.2. Shop Primer for Metallic-Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.
 - 2.3.3.3. Galvanizing Repair Paint: High-zinc-dust-content paint for reglazing welds in steel, complying with SSPC-Paint 20.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions:
 - 3.1.1.1. Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
 - 3.1.1.2. Size and Location Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment and indicate on schedule.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts and anchoring devices.
- 3.2.2. Install access doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3. SITE QUALITY CONTROL

- 3.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.4. ADJUSTING

- 3.4.1. Adjust doors and hardware after installation for proper operation.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide glass and glazing including but not limited to following:

1.2.1.1. glazing hollow metal doors.

1.2.1.2. glazing borrowed lights and screens.

1.2.1.3. glazing borrowed lights and screens with fire-rated ceramic glass.

1.2.1.4. glazing wood doors.

1.2.1.5. window film.

1.2.1.6. miscellaneous specialty glass, gaskets, tapes and glazing materials.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of architectural woodwork: Section 06 40 00, Architectural Woodwork.

1.2.2.2. Supply of hollow steel doors and frames: Section 08 11 13, Hollow Metal Doors and Frames.

1.2.2.3. Supply of wood doors: Section 08 14 00, Wood Doors.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. EPDM: Ethylene Propylene Diene Monomer.

1.3.1.2. GANA: Glass Association of North America; www.glass.org.

1.3.1.3. OBC: Ontario Building Code.

1.3.1.4. PVB: Polyvinyl Butyral.

1.3.1.5. ULC: Underwriters Laboratories of Canada; www.canada.ul.com.

1.3.2. Definitions:

1.3.2.1. Glass Terminology: Conform to ASTM C162 for glossary of terms and definitions of glazing terminology.

1.3.2.2. United Inches: Total of 1 width and 1 height of a lite of glass in inches.

1.3.3. Reference Standards:

1.3.3.1. ASTM C162-23 - Standard Terminology of Glass and Glass Products

1.3.3.2. ASTM C509-06(21) - Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material

1.3.3.3. ASTM C864-05(19) - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers

1.3.3.4. ASTM C920-18(24) - Standard Specification for Elastomeric Joint Sealants

1.3.3.5. ASTM C1048-25 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass

1.3.3.6.	ASTM C1115-17(22)	- Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories
1.3.3.7.	ASTM C1172-24	- Standard Specification for Laminated Architectural Flat Glass
1.3.3.8.	CAN/CGSB-12.1-22	- Safety glazing
1.3.3.9.	CAN/CGSB-12.20-M89	- Structural Design of Glass for Buildings
1.3.3.10.	CAN/ULC-S104-15(20)	- Standard Method for Fire Tests of Door Assemblies
1.3.3.11.	CAN/ULC-S106-15(20)	- Standard Method for Fire Tests of Window and Glass Block Assemblies
1.3.3.12.	GANA 01-0300	- Glass Information Bulletin – Proper Procedures for Cleaning Architectural Glass Products

1.4. ADMINISTRATIVE REQUIREMENTS

- 1.4.1. Preinstallation Meetings:
- 1.4.1.1. Arrange pre-installation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.
- 1.4.1.2. Review installation methods, procedures, time schedule and conditions under which work shall proceed including manufacturer's written instructions and coordination required with related work.
- 1.4.1.3. Review and finalize construction schedule, verify availability of materials, experienced installer, equipment and facilities needed to make progress and avoid delays.

1.5. SUBMITTALS

- 1.5.1. Samples:
- 1.5.1.1. Submit samples of materials in accordance with Section 01 30 00 identifying quality and type of glass if required by Consultant before commencing work. Ensure samples are clearly labelled with manufacturer's name and type.
- 1.5.1.2. Submit following samples:
- 1.5.1.2.1. fire-rated ceramic glass.
- 1.5.1.2.2. window film.

1.6. CLOSEOUT SUBMITTALS

- 1.6.1. Operational and Maintenance Data: Provide maintenance data in accordance with Section 01 70 00 indicating cleaning instructions for inclusion into Maintenance Manual.

1.7. QUALITY ASSURANCE

- 1.7.1. Qualifications:
- 1.7.1.1. Installers: Provide experienced installer who is trained and experienced in glass and glazing requirements of this Section including familiarization with standards specified herein and capable to instruct installation requirements of this Section.

1.8. DELIVERY, STORAGE AND HANDLING

- 1.8.1. Delivery and Acceptance Requirements: Deliver glass and associated materials to site in original crates and containers with manufacturer's name and brand distinctly marked thereon and with glass labelled as to types. Do not remove labels on glass until after work is reviewed by Consultant.
- 1.8.2. Storage and Handling Requirements: Store materials within the building, in a clean, dry location, reviewed by Consultant. Fully protect materials from damage of any kind until ready for use.

1.9. SITE CONDITIONS

- 1.9.1. Ambient Conditions: Do not perform glazing when temperature is less than 7 deg C (44 deg F) or sash or frames are wet, damp or frosted.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
- 2.1.1.1. AGC Glass Company North America; www.agc-yourglass.com
- 2.1.1.2. Cardinal Glass Industries; www.cardinalcorp.com
- 2.1.1.3. The Dow Chemical Company; www.consumer.dow.com
- 2.1.1.4. Guardian Industries Corp.; www.guardian.com
- 2.1.1.5. Momentive Performance Materials; www.momentive.com
- 2.1.1.6. Pilkington Special Glass Limited; www.pilkington.com
- 2.1.1.7. TGP Technical Glass Products; www.fireglass.com
- 2.1.1.8. Tremco Canada; www.tremcosealants.com
- 2.1.1.9. Vetrotech USA; www.vetrotechusa.com
- 2.1.1.10. Vitro Architectural Glass; www.vitro.com
- 2.1.2. Single Source Responsibility for Sealants, Gaskets and Other Glazing Accessories: Ensure consistent quality of performance by providing glazing sealant and seals from single manufacturer.

2.2. MATERIALS

- 2.2.1. Performance/Design Criteria:
- 2.2.1.1. Design glass and glazing to CAN/CGSB-12.20-M complying to OBC requirements and regulations of authorities having jurisdiction, being the minimum, except where more stringent requirements are specified herein. In case of conflict of requirements comply with most stringent requirements.
- 2.2.1.2. Verify glass thicknesses in accordance with ASTM E1300.
- 2.2.1.3. Provide accessories, closures and trims required and necessary to complete work.
- 2.2.1.4. Deflection: Limit glass deflection to flexural limit of glass with full recovery of glazing materials.
- 2.2.2. Glass:
- 2.2.2.1. Free from bubbles, waves, discolouration and other defects and of following types for locations indicated on Drawings or noted on Door Schedule. Ensure glass (particularly heat-strengthened, tempered and laminated) bears manufacturer's labels on bottom inner right hand corner indicating quality.

- 2.2.2.2. Tempered Glass (GL-1): Clear transparent tempered glass conforming to ASTM C1048, Kind FT and meeting requirements of CAN/CGSB-12.1, minimum 13 mm (1/2") thick. Ensure surface compression is equal to or greater than 69 MPa (10 000 psi).
- 2.2.2.3. Laminated Glass (GL-2): Clear transparent laminated float glass (CGL) conforming to ASTM C1172, Type I and meeting requirements of CAN/CGSB-12.1, minimum 13 mm (1/2") thick overall; clear PVB interlayer of 1.6 mm (0.060") thickness. Ensure mismatch of glass lites after laminating process is +3.2 mm (1/8"), -1.6 mm (1/16") maximum for exposed edges after installation. Provide edge seal protection at exposed edges of glass.
- 2.2.2.4. Tempered Glass (GL-3): Clear transparent tempered glass conforming to ASTM C1048, Kind FT and meeting requirements of CAN/CGSB-12.1, minimum 6 mm (1/4") thick. Ensure surface compression is equal to or greater than 69 MPa (10 000 psi).
- 2.2.2.5. Fire-Rated Ceramic Glass (FRCGL):
 - 2.2.2.5.1. Fire-rated ceramic glass clear and wireless glazing materials installed as transoms, borrowed lights and screens in fire-rated frames.
 - 2.2.2.5.2. Impact and safety rating conforming to CAN/CGSB-12.1; thickness to suit design, fire-rating requirements and in accordance with manufacturer's recommendations conforming to testing agencies acceptable to authorities having jurisdiction for respective performance criteria.
 - 2.2.2.5.3. Test fire-rating in accordance with CAN/ULC-S104 and CAN/ULC-S106 as applicable and acceptable to authorities having jurisdiction for specific application.
 - 2.2.2.5.4. 5 mm (3/16") thick, (20 minute to 3 hour fire-rating), impact safety fire-rated ceramic glass with an approved surface-applied safety film; "FireLite® Premium NT" or "PYRAN® Platinum F" by TGP Technical Glass Products or "Keralite® Select Filmed" by Vetrotech USA.
 - 2.2.2.5.5. 8 mm (5/16") total thickness, (20 minute to 3 hour fire-rating), impact safety laminated fire-rated ceramic glass; "FireLite Plus®" or "PYRAN® Platinum L" by TGP Technical Glass Products or "Keralite® Select Laminated" by Vetrotech USA.
 - 2.2.2.5.6. Provide glazing tapes and setting blocks in accordance with applicable ULC Listing for approved fire-rated glazing Product. Butyl tapes and setting blocks are not permitted.
- 2.2.3. Window Film (FLM-1): Provide "3M Scotchcal ElectroCut Special Effects Film" by 3M; www.3m.com in colour selected later by Consultant, translucent opacity, transparent synthetic liner, clear pressure sensitive adhesive. Ensure film cutouts suit design and are located on glass doors and other areas as indicated on Drawings.
- 2.2.4. Glazing, Sealing Compounds and Accessories:
 - 2.2.4.1. Ensure glazing, sealing compounds and accessories are compatible with contact surfaces of frames, other accessories used in glazing system and contact surfaces of compounds used on insulated glass units. Wood or other organic materials are not permitted for use in glazing systems including spacer blocks.
 - 2.2.4.2. Glazing Compound: Non-hardening modified oil type. Colour to match adjacent surfaces unless indicated otherwise.
 - 2.2.4.3. Sealant Compound: One component type, elastomeric chemical curing, ASTM C920, Type S, Grade NS. Colour to match adjacent surfaces unless indicated otherwise.
 - 2.2.4.4. Sealant Compound: ASTM C920, multi-component chemical curing, Type M, Grade NS. Colour to match adjacent surfaces.
 - 2.2.4.5. Sealant Compound: One component, silicone base chemical curing. Colour to match adjacent surfaces.
 - 2.2.4.6. Cellular Gaskets for Compression Glazing: ASTM C509 cellular, elastomeric, preformed, black. Closed cell neoprene or EPDM extrusions including molded corners where applicable by Cellular Rubber Extrusions, Tremco Canada.

- 2.2.4.7. Dense Gaskets for Compression Glazing: ASTM C864, Option II or ASTM C1115, Type C, dense neoprene or EPDM extrusions, 60 and 70 Durometer density including molded corners where applicable by Poly-Wej Gaskets, Tremco Canada.
- 2.2.4.8. Glazing Splines: Neoprene or EPDM manufacturer's standard dry glazing splines to suit aluminum extrusions. Colour to match adjacent surfaces unless indicated otherwise.
- 2.2.4.9. Glazing Points and Wire Spring Clips: Corrosion resistant, manufacturer's standards.
- 2.2.4.10. Edge Blocking, Setting Blocks, Lateral Shims, Gaskets and Tapes:
 - 2.2.4.10.1. Edge Blocking for Glass: 60 - 70 Durometer neoprene, silicone or EPDM, channel shaped, 100 mm - 150 mm (4" - 6") long.
 - 2.2.4.10.2. Setting Blocks: 7 mm x 100 mm (5/16 x 4") EPDM or extruded 80 - 90 Durometer neoprene; at insulating glass, use EPDM only. At fire-rated glazed doors and partitions, use similar sized fire-rated silicone GE "Gel 516" or asbestos cement blocks. Width; 1.6 mm to 3 mm (1/16" to 1/8") less than design glazing pocket width. For 4 sided structural glazing, use silicone compatible rubber or silicone.
 - 2.2.4.10.3. Lateral Shims: Neoprene, silicone or EPDM, 40 - 60 Durometer, 100 mm (4") long or as required.
 - 2.2.4.10.4. Compression Glazing Tape: Preformed, ribbon-shaped, non-skinning, 100% solids, non-oxidizing polyisobutylene: butyl, paper release, EPDM shim with continuous synthetic rubber spacer rod of 60 Durometer hardness. Permitted Product: "Polyslim II Tape" by Tremco Canada. Ensure tape is sufficiently wide and thick to completely cover bite area of glazing unit when unit is pushed into place.
- 2.2.5. Primer Sealers and Cleaners: To glass and plastic glazing manufacturer's standards.
- 2.2.6. Fabrication:
 - 2.2.6.1. Label each light of glass with registered name of Product and weight and quality of glass.
 - 2.2.6.2. Check dimensions on job site before cutting materials.
 - 2.2.6.3. Ensure minimum bite or lap of glass on stops and rabbets as recommended by glass manufacturer.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions:
 - 3.1.1.1. Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
 - 3.1.1.2. Ensure glass is not more than 4 mm (3/16") less than the rebate size in either dimension, with allowance for edge spacers, shims and setting blocks as required.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. PREPARATION

- 3.2.1. Surface Preparation: Thoroughly clean glass rebates and glass of dust, dirt, mortar and other foreign materials prior to glazing. Remove oils and grease with non-staining solvents such as Xycol or Methyl Ethyl Ketone solutions.

3.3. INSTALLATION

- 3.3.1. Perform work of this Section in accordance with "GANA Glazing Manual, 50th Anniversary Edition" and "GANA Laminated Glazing Reference Manual, 2009" for laminated glazing installation methods.

- 3.3.2. If required, thoroughly mix glazing compound as recommended by manufacturer. Thinning of glazing compound will not be permitted.
- 3.3.3. Carefully remove glazing stops and replace after glazing. Take care to prevent damage to stops.
- 3.3.4. Doors, Screens and Sidelites:
 - 3.3.4.1. Place setting blocks on sill at 1/4 points from each corner unless otherwise directed by glazing manufacturer.
 - 3.3.4.2. Place continuous glazing gaskets on edges of glass.
 - 3.3.4.3. Centre and space each piece of glass with spacers located and installed according to manufacturer's directions.
 - 3.3.4.4. Place glass so no voids occur between glass and glazing material and glazing stops.
 - 3.3.4.5. Secure glass in place with stops, secured in place with screws.
- 3.3.5. Glazing Sealant:
 - 3.3.5.1. Apply glazing sealant to clean, dry, grease and oil free surfaces. Provide exposed glazing sealant smooth, free from ridges, wrinkles, air pockets and embedded foreign materials.
 - 3.3.5.2. Prime surfaces if required by glazing sealant manufacturer.
 - 3.3.5.3. Trim glazing sealant flush with tops of stops and glazing channels.
 - 3.3.5.4. Remove excess glazing sealant or droppings which would set up or become difficult to remove from finished surfaces. Do not use chemicals, scrapers, or other tools which would affect finished surfaces.
- 3.3.6. Interior Glazing:
 - 3.3.6.1. Tape/Tape Method:
 - 3.3.6.1.1. Cut glazing tape to proper length and install against permanent stop projecting 1.6 mm (1/16") above sightline.
 - 3.3.6.1.2. Place glazing tape on free perimeter of glass projecting 1.6 mm (1/16") above sightline.
 - 3.3.6.1.3. Trim off excess tape to sightline.
 - 3.3.6.2. Combination Method-Tape/Sealant:
 - 3.3.6.2.1. Cut glazing tape to proper length and install against permanent stop projecting 1.6 mm (1/16") above sightline.
 - 3.3.6.2.2. Fill gap between glass and applied stop with sealant to depth equal to bite of frame on glass to uniform and level line.
 - 3.3.6.2.3. Trim off excess tape to sightline.
- 3.4. SITE QUALITY CONTROL**
 - 3.4.1. Site Tests and Inspections: Ensure framing to be glazed is plumb, secure and permanently fixed in position.
 - 3.4.2. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.
- 3.5. CLEANING**
 - 3.5.1. Clean installed glass and metal frequently during construction. Avoid etching and staining glass and metal during construction.
 - 3.5.2. Remove sealant and compound droppings from finished surface.
 - 3.5.3. Clean and polish glass in accordance with GANA 01-0300 including removal of markings indicating presence of glass.

3.6. PROTECTION

- 3.6.1. Provide and maintain necessary protection of completed work against damage.
- 3.6.2. Do not mark or attach anything directly to exposed glass and framing surfaces.
- 3.6.3. If welding is to take place above or near completed glazing work, protect glass with plywood or other suitable means to reduce likelihood of weld spatter damaging glass surfaces.
- 3.6.4. Protect glass from other trades, workers, tools and other similar materials. Avoid storing materials adjacent to glass.
- 3.6.5. Replace cracked, broken, or defective glass at no additional cost to Owner.
- 3.6.6. Identification of Glazing: Mark glass lites with temporary, easily removable, large safety markings, immediately after glass installation. Maintain safety markings until final clean-up.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide gypsum board assemblies work including but not limited to following:

1.2.1.1. supplementary steel supports for ceilings.

1.2.1.2. reinforcement for suspension systems for lighting fixtures, access hatches, etc.

1.2.1.3. steel studs and furring channels.

1.2.1.4. concealed sheet steel reinforcing.

1.2.1.5. ceiling, bulkhead and soffit suspension system.

1.2.1.6. gypsum board ceilings, partitions and bulkheads.

1.2.1.7. corner beads, casing beads, trim, control joints and corner reinforcement.

1.2.1.8. taping and filling.

1.2.1.9. acoustically insulated gypsum board partitions.

1.2.1.10. acoustic caulking to acoustically insulated gypsum board partitions.

1.2.1.11. fire rated wall assemblies.

1.2.1.12. installation of access hatches, panels and doors supplied by other trades in gypsum board walls and ceilings as required.

1.2.1.13. coordination of waterproofing membrane for installation under gypsum board for showers, etc.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of carbon impact design requirements: Section 01 33 30, Carbon Impact Design Requirements.

1.2.2.2. Miscellaneous steel sections and/or framing required to provide additional structural support to suit Project requirements: Section 05 50 00, Metal Fabrications.

1.2.2.3. Installation of hollow metal door and borrowed light frames and frame anchors in gypsum board partitions: Section 06 90 00, General Installations.

1.2.2.4. Firestopping, smoke seals and penetration firestopping: Section 07 84 00, Firestopping and Smoke Seals.

1.2.2.5. Finish painting of gypsum board: Section 09 91 00, Painting.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. OBC: Ontario Building Code.

1.3.1.2. STC: Sound Transmission Class.

1.3.1.3. ULC: Underwriters Laboratories of Canada; www.canada.ul.com.

1.3.2. Definitions:

1.3.2.1. Drywall: Gypsum board.

1.3.3.	Reference Standards:	
1.3.3.1.	ASTM A653/A653M-25a	- Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
1.3.3.2.	ASTM A666/A666M-25	- Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
1.3.3.3.	ASTM C475/C475M-17(22)	- Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
1.3.3.4.	ASTM C645-24	- Standard Specification for Nonstructural Steel Framing Members
1.3.3.5.	ASTM C754-20	- Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
1.3.3.6.	ASTM C840-24	- Standard Specification for Application and Finishing of Gypsum Board
1.3.3.7.	ASTM C954-22	- Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
1.3.3.8.	ASTM C1047-19	- Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
1.3.3.9.	ASTM C1280-18	- Standard Specification for Application of Exterior Gypsum Panel Products for use as Sheathing
1.3.3.10.	ASTM C1396/C1396M-24	- Standard Specification for Gypsum Board
1.3.3.11.	ASTM C1629/C1629M-24	- Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
1.3.3.12.	ASTM C1658/C1658M-19(24)	- Standard Specification for Glass Mat Gypsum Panels
1.3.3.13.	ASTM D3273-21	- Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
1.3.3.14.	ASTM D4060-25	- Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
1.3.3.15.	ASTM D4397-16(23)	- Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
1.3.3.16.	ASTM D5420-21	- Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
1.3.3.17.	ASTM E90-23	- Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
1.3.3.18.	ASTM E580/E580M-24a	- Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions
1.3.3.19.	ASTM E695-22	- Standard Test Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading

1.3.3.20.	CSA S136-16(21)	- North American specification for design of cold-formed steel structural members
1.3.3.21.	CAN/ULC-S102:19(24)	- Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
1.3.3.22.	CAN/ULC-S114-18	- Standard Method of Test for Determination of Non-Combustibility in Building Materials
1.3.3.23.	CAN/ULC-S702.1-21	- Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification

1.4. ADMINSTRATIVE REQUIREMENTS

- 1.4.1. Sequencing:
- 1.4.1.1. Coordinate installation and cooperate with mechanical and electrical trades to accommodate mechanical electrical items and any other work required to be incorporated into or coordinated with ceiling and soffit systems.
- 1.4.1.2. Cooperate and coordinate with Sections applying wet trades and trades installing mechanical and electrical services. Coordinate stud layout at partitions accommodating wall mounted fixtures by other trades.

1.5. SUBMITTALS

- 1.5.1. Shop Drawings: Submit Shop Drawings in accordance with Section 01 30 00 showing design, construction, control joint layout, sound attenuating construction, adjacent construction, elevations, finishes and relevant details of furring, enclosures and partitions which require fire rating in accordance with ULC Design Numbers shown on Drawings.
- 1.5.2. Samples: Submit samples in accordance with Section 01 30 00. Submit following samples in sizes indicated:
- 1.5.2.1. each trim accessory minimum 300 mm (12") long.
- 1.5.3. Certificates:
- 1.5.3.1. Submit certification from licensed engineer registered in Province of Ontario, ensuring his/her seal and signature is affixed to certificate, stating that installed suspended ceiling system is capable of supporting its own weight and weight of lighting, grilles and other mechanical and electrical fixtures required by Mechanical and Electrical Divisions.
- 1.5.3.2. Obtain approval of electrical utility authorities having jurisdiction for support of light fixtures, by ceiling grid and supports, to satisfy requirements of electrical inspection department of Ontario Hydro. Adjust grid, fixing devices and support hangers as required to obtain approval.

1.6. QUALITY ASSURANCE

- 1.6.1. Qualifications:
- 1.6.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
- 1.6.1.2. Licensed Professionals: Employ a licensed engineer carrying professional liability insurance and is registered in the Province of Ontario.

1.7. DELIVERY, STORAGE AND HANDLING

- 1.7.1. Delivery and Acceptance Requirements: Deliver materials to site with manufacturer's original labels intact. Do not remove wrappings until ready for use.

- 1.7.2. Storage and Handling Requirements:
- 1.7.2.1. No outside storage permitted. Store in clean, dry area, off ground. Provide adequate ventilation to avoid excess moisture, surface relative humidity and mould or fungal growth. Remove immediately any board showing signs of mould, mildew or fungal growth.
- 1.7.2.2. Stack gypsum board flat on level and dry surface without overhanging boards. Prevent sagging and damage to edges, ends and surfaces. Protect bagged Products from moisture or wetting.

1.8. SITE CONDITIONS

- 1.8.1. Ambient Conditions:
- 1.8.1.1. Do not install work of this Section in any area unless satisfied that work in place has dried out and that no further installation of materials requiring wetness, moisture or dampness is contemplated. Ensure relative humidity in area of work of this Section does not exceed 55% for duration of Project.
- 1.8.1.2. Ensure temperature of surrounding areas is min 13 deg C (55 deg F) and max 21 deg C (70 deg F) for 7 Days before and during application of gypsum board; maintain for 4 Days thereafter. Ensure heat is provided at appropriate time before work has started to bring surrounding and adjacent materials up to required temperature and maintained as specified. Avoid concentrated or irregular heating during drying by means of deflectors or protective screens.
- 1.8.1.3. Ensure ventilation is provided for proper drying of joint filler and adhesive and to prevent excessive humidity. Do not force dry adhesives and joint treatment.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
- 2.1.1.1. CertainTeed Corporation; www.certainteed.com
- 2.1.1.2. CGC Inc; www.cgcinc.com
- 2.1.1.3. Georgia-Pacific Canada LP; www.buildgpc.com

2.2. MATERIALS

- 2.2.1. Performance/Design Criteria:
- 2.2.1.1. Design ceiling suspension system in accordance with manufacturer's printed directions and conforming to ASTM C754 requirements. Do not suspend any items from structural steel deck. Do not support work of this Section from, nor make attachments to, ducts, pipes, conduits or support framing of other trades.
- 2.2.1.2. Design suspended ceiling system for adequate support of electrical fixtures as required by current bulletin of Electrical Inspection Department of Ontario Hydro.
- 2.2.1.3. Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.
- 2.2.1.4. Design suspension system to support weight of mechanical and electrical items such as air grilles, lighting fixtures, drapery track, drapes and with adequate support to allow rotation/ relocation of light fixtures.
- 2.2.1.5. Design interior partitions and ceilings using a maximum deflection criteria of L/240 with a minimum lateral load of 0.239 kPa (5 psf) unless otherwise specified herein. Where tile is being applied or height is greater than 3 m (10') use L/360 with a minimum lateral load of 0.239 kPa (5 psf).
- 2.2.1.6. Design sub-framing as necessary to accommodate and circumvent conflicts and interferences where ducts or other equipment prevent regular spacing of hangers.

- 2.2.1.7. Design steel stud reinforcements from hollow structural steel, stud, angle and steel plate sections, galvanized sheet steel minimum 43 mils designation thickness (1.087 mm (0.0428") minimum base steel thickness) (previously 18 ga) where required to support manufactured components without limitations items such as washroom accessories, expansion control covers and similar items. Design weld connections ensuring rigid and secure installation capable of offering resistance to minimum 227 kg (500 lb) pull force. Consider galvanized items in moist areas. Do not design using wood blocking for this purpose.
- 2.2.1.8. Design fire rated construction including ceiling, partition or fire protective membranes and furring to approved ULC design or other design acceptable to authorities having jurisdiction, to provide design fire rating indicated and/or required. Submit written evidence of permitted test design.
- 2.2.1.9. Provide sound rated construction having STC rating indicated and tested in accordance with ASTM E90.
- 2.2.1.10. Structural Design: Employ a licensed engineer specified herein to:
 - 2.2.1.10.1. design components for work of this Section requiring structural performance.
 - 2.2.1.10.2. be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.
- 2.2.2. Steel Studs: CSA S136 and ASTM C645, galvanized sheet steel, minimum 18 mils designation thickness (0.455 mm (0.0179") minimum base steel thickness) (previously 25 ga), minimum Z120 (G40) zinc coating, screw able with crimped web and returned flange, of depth shown in maximum continuous lengths possible. Provide thicker steel in accordance with Section 05 41 00 where required due to height.
- 2.2.3. Heavy Duty Steel Studs at Openings: CSA S136 and ASTM C645, galvanized sheet steel, minimum 54 mils designation thickness (1.367 mm (0.0538") minimum base steel thickness) (previously 16 ga), minimum Z120 (G40) zinc coating, screw able with crimped web and returned flange, of depth shown in maximum continuous lengths possible. Provide thicker steel where required due to height.
- 2.2.4. Provide knockout openings in web at 460 mm (18") oc to accommodate (if required) horizontal mechanical and electrical service lines and bracing.
- 2.2.5. Concealed Sheet Steel Reinforcing: Commercial quality galvanized sheet to ASTM A653/A653M, 1.214 mm (18 ga) thick minimum, Z275 (G90) zinc coated by hot-dip process or ASTM A666/A66M, Type 304 sheet stainless steel.
- 2.2.6. Floor and Ceiling Partition Track for Gypsum Board: CSA S136 and ASTM C645, galvanized sheet steel, minimum 18 mils designation thickness (0.455 mm (0.0179") minimum base steel thickness) (previously 25 ga), minimum Z120 (G40) zinc coating, with minimum 30 mm (1-1/4") legs, top track having longer legs where required to compensate for deflection of structure above. Width to suit steel studs.
- 2.2.7. Furring Channels: CSA S136 and ASTM C645, galvanized sheet steel, minimum 18 mils designation thickness (0.455 mm (0.0179") minimum base steel thickness) (previously 25 ga), minimum Z120 (G40) zinc coating, screw channels, 67 mm (2-5/8") wide x 22 mm (7/8") deep.
- 2.2.8. Carrying Channels for Gypsum Board: CSA S136 and ASTM C645, galvanized sheet steel, minimum 43 mils designation thickness (1.087 mm (0.0428") minimum base steel thickness) (previously 18 ga), minimum Z120 (G40) zinc coating, 38 mm (1-1/2") high with 19 mm (3/4") flanges, for primary carrying member in suspended ceilings and as horizontal stiffeners or bracing in steel stud systems.
- 2.2.9. Premanufactured Grid Suspension System for Ceilings: ASTM C645, direct-hung system composed of commercial-quality, cold-rolled steel, main beams and cross-furring members that interlock with following characteristics:
 - 2.2.9.1. Main Tees: Fire-Rated Heavy Duty classification with integral reversible splice with knurled face.

- 2.2.9.2. Cross Members: Fire-Rated members with knurled face.
- 2.2.9.3. Cross Tees: Cross tee 38 mm (1-1/2") high x 1220 mm (48") long with 38 mm (1-1/2") wide face.
- 2.2.9.4. Furring Channel: Furring channel 22 mm (7/8") high x 1220 mm (48") long with 38 mm (1-1/2") face.
- 2.2.9.5. Accessory Cross Tees: Complete with knurled faces.
- 2.2.9.6. Wall Mouldings: Single web with knurled face.
- 2.2.9.7. Accessories: Transition clips, Splice clips, wall attachment clips, splice plates and dome hubs as recommended by manufacturer for specific applications.
- 2.2.9.8. Finish: Hot-dipped galvanized.
- 2.2.9.9. Permitted Products: "Drywall Grid Systems" by Armstrong World Industries Canada Ltd.; www.armstrongceilings.com or "Drywall Suspension System" by CGC Inc.
- 2.2.10. Resilient Channel Furring: CSA S136 and ASTM C645, "RC-1 Resilient Channel" by CGC Inc. or other permitted manufacturer.
- 2.2.11. Core Board Runner: CSA S136 and ASTM C645, 35 mm x 22 mm x 0.914 mm (1-3/8" x 7/8" x 20 ga) galvanized metal angle runner.
- 2.2.12. Steel Spring Isolator Hangers for Sound Isolation: Steel spring encased in welded steel brackets of size recommended by manufacturer to suit load conditions and to provide minimum 30 mm (1-3/16") static deflection with at least 50% overload reserve deflection capacity. Factory pre-compress spring element to within 6 mm (1/4") of anticipated operating height. Ensure brackets are cadmium plated designed to carry 500% overload without failure. Design hangers to accommodate rod misalignment over 30° arc. Equip hanger assembly with eyebolts both top and bottom. Ensure sound spring isolator hangers are by Kinetics Noise Control, Inc.; www.kineticsnoise.ca, Vibro-Acoustics; www.vibro-acoustics.com or Mason Industries, Inc.; www.mason-industries.com represented by Tecoustics.
- 2.2.13. Hangers: 4.8 mm (3/16") nominal diameter mild steel rod coated with rust inhibitive paint for elsewhere.
- 2.2.14. Inserts for Concrete Slabs: Tie wire anchors, "Red Head TW-1614" by ITW Canada Inc., "Parabolt Wire Hanger" distributed by Acrow-Richmond Ltd., "T-14 Eyebolt" by Ramset Ltd., "HHDCA" or "HLC-T" by Hilti (Canada) Corporation or "Tie Wire Drive TW-932" by Isometric Ltd.
- 2.2.15. Tie Wire: 1.519 mm (16 ga) nominal diameter galvanized, soft annealed steel.
- 2.2.16. Screws for Sheet Steel Members: ASTM C954, self-drilling, self-tapping gypsum board screws, 25 mm (1") long #6 for single layer application, 41 mm (1-5/8") long #7 for double layer application and as follows:
 - 2.2.16.1. For single layer application over steel framing; self-drilling, self-tapping, case hardened, No. 6 contoured Phillips head or Type S bugle head, sized for minimum 15.9 mm (5/8") penetration into steel framing. Ensure fasteners are corrosion resistant.
 - 2.2.16.2. For double layer application over gypsum backing board and existing gypsum board; 38 mm (1-1/2") Type G bugle head. For each additional layer of board, increase length of fasteners proportionally.
- 2.2.17. Gypsum Board (GB or GWB): Conforming to ASTM C1396/C1396M. Unless indicated otherwise use 1200 mm (4') wide standard facing board in maximum continuous lengths up to 3600 mm (12'), beveled and/or tapered edges to suit design requirements with butted square ends:
 - 2.2.17.1. Gypsum Board (Walls): Provide 15.9 mm (5/8") thick with tapered edges unless otherwise specified.

- 2.2.17.2. Gypsum Board (Ceiling): Provide 15.9 mm (5/8") thick with tapered edges unless otherwise specified as follows:
- 2.2.17.2.1. Use anti sag sheets.
- 2.2.18. Fire Rated Gypsum Board having Testing Agency Fire Rating Identification Stamp on Each Sheet: ASTM C1396/C1396M, Type X, 12.7 mm (1/2") and/or 15.9 mm (5/8") thick gypsum board 1200 mm (4') wide, maximum practical length and tapered edge as required by each fire resistance assembly. "Gyproc Fireguard Type X or Type C" by Georgia-Pacific Canada LP, "CGC Sheetrock Firecode or Firecode C" by CGC Inc. or "CERTAINTEED® Type X or Type C" by CertainTeed Corporation.
- 2.2.19. Abuse Resistant Gypsum Board (GWB-5): Provide 1 of following:
- 2.2.19.1. Enhanced gypsum core encased in heavy duty paper facers on front and back, 16 mm (5/8"), conforming to ASTM C1396/C1396M and attaining a maximum of 0.014" as tested to ASTM D4060 (H-18 abrasion wheel, 500 grams, 200 cycles), a maximum of 0.123" indentation as tested to ASTM D5420 (72 in lbs) and a minimum of (133 ft lbs) as tested to ASTM E695 (50 lb bag) and ASTM C1629/C1629M Type X in fire rated assemblies, "EXTREME ABUSE" by CertainTeed Corporation or "CGC Sheetrock® Brand Mold Tough® AR Firecode Core" by CGC Inc.
- 2.2.19.2. Enhanced gypsum core encased in fiberglass facers on front and back, 15.9 mm (5/8"), conforming to ASTM C1396/C1396M and attaining a maximum of 0.014" as tested to ASTM D4060 (H-18 abrasion wheel, 500 grams, 200 cycles), a maximum of 0.123" indentation as tested to ASTM D5420 (72 in lbs) and a minimum of (133 ft lbs) as tested to ASTM E695 (50 lb bag) and ASTM C1629/C1629M Type X in fire rated assemblies, "DensAmor Plus® Abuse Guard" by Georgia-Pacific Canada LP.
- 2.2.20. Dust Barrier: Minimum 0.152 mm (6 mil) polyethylene in accordance with ASTM D4397.
- 2.2.21. Resilient Sponge Tape: Self-sticking adhesive on 1 side, closed cell neoprene sponge tape, "Rubatex®" by Rubatex Corp., "Foamflex # 1220" by Jacobs & Thompson Inc.; www.foamparts.com or "Backerseal™ (Greyflex)™" by Emseal; www.emseal.com.
- 2.2.22. Joint Tape: Conforming to ASTM C475/C475M, provide 1 of following:
- 2.2.22.1. Kraft paper joint tape with feathered edges and minute perforations 50 mm (2") wide.
- 2.2.22.2. Glass fibre tape, open weave, with pressure sensitive adhesive 1 side, "Durock Cement Board Tape" by CGC Inc.
- 2.2.23. Joint Fillers and Topping Compound: Either slow or fast setting, low shrinkage type free of asbestos fillers and as recommended by manufacturer. Use "Gyproc 90" by Georgia-Pacific Canada LP or "Durabond 90" by CGC Inc. at exterior soffits.
- 2.2.24. Sealant for Moisture Resistant Gypsum Board Edges: "Sheetrock Brand W/R Sealant" by CGC Inc., or similar type reviewed by Consultant.
- 2.2.25. Corner Bead: ASTM C1047, "Dur-A-Bead™ No. 103 Corner Bead" by CGC Inc. at corners, reveals, or similar. Provide custom shapes of similar materials and design as noted.
- 2.2.26. Metal Trim: CGC No.200-A or BMP D-4411 in lieu of "J" Mould. Do not provide "J" Mould (CGC No. 400-A) unless specifically noted on Drawings as 'Exposed "J" Mould'.
- 2.2.27. Attachment Clips: "Revoe Clips" by Revoe Manufacturing Ltd.; www.revoe-clips.com, type to suit design requirements complete with screws and other fastening system.
- 2.2.28. Control Joints: Prefabricated control joints prepared to suit site conditions; "No. 093" by CGC Inc. zinc alloy control joint.
- 2.2.29. Access Doors and Panels:
- 2.2.29.1. Supplied as part of Divisions 20, 21, 22, 23, 26, 27 and 28 for installation as part of this Section.
- 2.2.29.2. Access Panels for Items Other Than Mechanical and Electrical: Refer to Section 08 31 13 as applicable.

- 2.2.30. Sound Control Materials:
- 2.2.30.1. Sound Attenuation Batts (INS-1): CAN/ULC-S702.1, mineral (glass and stone wool) fibre, flame spread and smoke developed in conformance with OBC requirements and other authorities having jurisdiction in accordance with CAN/ULC-S102. Non-combustible in accordance with requirements of CAN/ULC-S114. Permitted Products: "EcoTouch™ QuietZone® PINK™ FIBERGLAS® Acoustic Insulation" by Owens Corning Canada LP; www.insulation.owenscorning.ca, "ROCKWOOL™ AFB - Acoustical Fire Batt Insulation" by ROCKWOOL™ International A/S; www.rockwool.com, "Sound-SHIELD® Formaldehyde-Free Fiber Glass Insulation" by Johns Manville Canada Inc.; www.jm.com, "NoiseReducer™ Sound Attenuation Batts" by CertainTeed Corporation or "Thermafiber® SAFB™ Mineral Wool Insulation" by Thermafiber, Inc. (Owens Corning Canada LP); www.thermafiber.com, of sufficient thickness to meet required STC rating for sound-rated partitions and of width to suit metal framing spacing and other miscellaneous spacings.
- 2.2.30.2. Strip Impalement Clips: 25 mm (1") wide strip of "Insul-Hold" by Insul-Hold Co., Inc.; www.insulhold.com, fabricated from 0.531 mm (25 ga) galvanized sheet metal in 30 m (100') rolls with punch-out insulation securement arrows. Alternatively, use special studs with punch-out impalement strips.
- 2.2.30.3. Pre-Formed Bottom Joints Track Materials: "(CFS-BTS) Bottom Track Seal " by Hilti (Canada) Corporation; www.hilti.ca for use with standard bottom of fire-rated and non-fire-rated gypsum board joints.
- 2.2.30.4. Pre-Formed Head-Joints Top Track Materials: "(CFS-TTS) Top Track Seal " by Hilti (Canada) Corporation for use with standard head-joints top track of fire-rated gypsum board and "(CS-TTS SA) Sound and Acoustic Track Seal " by Hilti (Canada) Corporation for use with standard head-joints top track of non-fire-rated gypsum board.
- 2.2.30.5. Acoustic Sealant: Single component, non-hardening, non-skinning synthetic rubber sealant; "CS-S SA LIGHT Smoke and Acoustic Sealant" by Hilti (Canada) Corporation.
- 2.2.30.6. Elastomeric Sealant: As recommended by manufacturer of fibre-reinforced gypsum sheathing board.
- 2.2.30.7. Gaskets: Closed cell neoprene, 3 mm (1/8") thick x 64 mm (2-1/2") wide.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Partition Types:
- 3.2.1.1. Refer to Drawings for partition types.
- 3.2.1.2. Provide partitions complete to underside of structure, unless otherwise indicated on Drawings.
- 3.2.2. Give minimum 48 hours notice for Consultant's inspection of internal wall insulation and services prior to concealing with gypsum board.
- 3.2.3. Provide adequate ventilation to eliminate excessive moisture before commencing and during work to ensure proper drying of joint filler and adhesive. Do not force dry adhesive and joint treatment.

- 3.2.4. Examine substrate for compliance with applicable requirements, installation tolerances and other conditions affecting installation of fibre-reinforced gypsum board or sheathing. Do not proceed until unsatisfactory conditions have been corrected. Beginning installation indicates acceptance of substrate conditions.
- 3.2.5. Carry out work using skilled tradesmen carefully supervised by competent foremen. Take measurements accurately.
- 3.2.6. Install framing, blocking and furring in accordance with ASTM C645, ASTM C1280 and ASTM C840.
- 3.2.7. Maintain wallboard panels minimum 6 mm (1/4") and maximum 13 mm (1/2") above floor to prevent moisture transfer. Unless otherwise shown, extend panels to minimum 100 mm (4") above finished ceiling and to underside of deck or structure where exposed and at fire rated and sound control partitions. Omit taping and filling of concealed surfaces above ceiling line, except at fire rated and sound control partitions and walls.
- 3.2.8. Erect plain wallboard vertically or horizontally, whichever results in fewer end joints. Keep end joints away from prominent locations and central portions of ceilings. Locate vertical joints at least 300 mm (12") from jamb lines of openings.
- 3.2.9. Do not secure gypsum board by installing screws into aluminum or steel window and door frames.
- 3.2.10. Install resilient sponge tape where gypsum board ceilings abut heads of door frames and where wallboard abuts heads or jambs of exterior door and window frames. Adhere tape to casing bead and compress during installation. Compressed thickness; 1.6 mm (1/16").
- 3.2.11. Apply 1 continuous 6 mm (1/4") bead of acoustical sealant to each side of partition where gypsum board meets dissimilar materials. Where 2 layers of gypsum board per face are required, apply bead of sealant at perimeter of base layer only.
- 3.2.12. Apply sealant beads at perimeter of other services and like objects which penetrate wallboard in accordance with manufacturer's directions.
- 3.2.13. Install access panels in locations to be determined by coordination with trades installing mechanical, electrical and other building services. Consultant reserves right to relocate access panels up to 3600 mm (12') from locations shown on Drawings due to site conditions, providing ample warning is given prior to installation.
- 3.2.14. Steel Framing for Partitions and Bulkheads:
 - 3.2.14.1. Comply with recommendations of CGC Drywall Steel-Framed Systems Folder 09250-SA 923 for steel stud partition, ceiling, column fireproofing and bulkhead detailing.
 - 3.2.14.2. Provide partition tracks at floor and underside of ceiling or structure above. Align accurately. Lay out to partition layout.
 - 3.2.14.3. Place studs vertically at 400 mm (16") oc unless otherwise specified and/or as required, not more than 50 mm (2") from abutting walls, and at each side of openings and corners. Position studs in tracks. Cross brace studs as required to provide rigid installation.
 - 3.2.14.4. Provide heavy duty double boxed studs at each side of openings to extend in 1 piece from floor to underside of structure above.
 - 3.2.14.5. Co-ordinate erection of studs and installation of service lines.
 - 3.2.14.6. Do not secure studs to exterior window framing, or to ceiling grid members.
 - 3.2.14.7. Provide continuous gasket between ceiling tracks and structure.
- 3.2.15. Provide continuous horizontal furring channels as backing to wall cabinets.
- 3.2.16. Metal Furring:
 - 3.2.16.1. Erect furring in accordance with manufacturer's directions and as specified herein.

- 3.2.16.2. Provide furring rigid, secure, square, level or plumb, framed and erected to maintain finish dimensions and contours indicated. Allow for thermal movement.
- 3.2.16.3. Furr around ducts, pipes and dropped beams occurring in finished areas and for vertical gypsum board breaks within or at termination of ceilings.
- 3.2.16.4. Provide metal furring channels fastened to masonry or concrete surfaces in parallel rows at 400 mm (16") oc unless gypsum board is indicated to be adhered directly to masonry or concrete surfaces. Shim metal furring channels to provide a level surface.
- 3.2.17. Gypsum Board Application:
 - 3.2.17.1. Provide gypsum board in accordance with manufacturer's written installation instructions and finish to requirements of ASTM C840.
 - 3.2.17.2. Provide metal trim casing bead at junctions with dissimilar materials. Provide reveals at junctions with dissimilar materials where indicated.
 - 3.2.17.3. Provide finished work plumb, level and true, free from perceptible waves or ridges and square with adjoining work.
 - 3.2.17.4. Cut and fit gypsum board to accommodate or fit around other parts of the Work. Provide work of this Section accurately and neatly.
 - 3.2.17.5. Butt gypsum board sheets together in moderate contact. Do not force into place. Place tapered or wrapped edges next to 1 another.
 - 3.2.17.6. Provide gypsum board perpendicular to framing and in lengths that will span ceilings and walls without creating end (butt) joints. If butt joints do occur stagger and locate them as far from centre of walls and ceilings as possible. Accurately fit exposed butt joints together and make edges smooth.
 - 3.2.17.7. Support ends and edges on framing.
 - 3.2.17.8. Fasten gypsum board to metal furring and steel studs with screws. Space screws at 200 mm (8") oc at board edges and 300 mm (12") oc on board field.
 - 3.2.17.9. Gypsum Board - Single Layer:
 - 3.2.17.9.1. Ceilings: Apply gypsum board to metal furring with screws. Erect board with long dimension parallel to supports. Locate end joints over supporting members. Space screws at 200 mm (8") oc.
 - 3.2.17.9.2. Partitions: Apply gypsum board to steel studs with screws. Erect board with long dimension parallel to supports. Locate end joints over supporting members. Locate vertical joints at least 300 mm (12") from jamb lines of openings. Space screws at 200 mm (8") oc at board edges and 300 mm (12") oc on board field.
 - 3.2.17.9.3. Ceiling and Partition Fasteners: Ensure perimeter screws are not less than 9 mm (3/8") nor more than 13 mm (1/2") from edges and ends are opposite screws on adjacent boards. Drive screws with power screw-gun and set with countersunk head slightly below surface of board.
 - 3.2.17.9.4. Joints: Finish all joints unless specified otherwise.
 - 3.2.17.10. Gypsum Board - Double Layer:
 - 3.2.17.10.1. Lay out work to minimize end joints on face layer; to offset parallel joints between face and base layers by at least 250 mm (10") and to apply face layer at right angles to base layer.
 - 3.2.17.10.2. Base Layer: Ensure base layer is same as face layer, or backing board, and applied at right angles to framing members. Secure base layer with screws spaced 300 mm (12") oc to each member. Ensure perimeter screws are not more than 13 mm (1/2") from edges and ends are opposite screws on adjacent boards. Ensure surface of erected base layer is straight, plumb or level and without protrusions before face layer is applied.
 - 3.2.17.10.3. Face Layer: Apply face layer at right angles to base layer with screws.

- 3.2.17.10.4. Joints: Finish joints in face layers only, unless otherwise required to achieve fire resistant ratings indicated, as hereinafter specified. Ensure setting compound for fire rated construction conforms to requirements of authorities having jurisdiction to obtain fire rating shown on Drawings.
- 3.2.18. Interior Ceilings:
- 3.2.18.1. Comply with recommendations of CGC Drywall Steel-Framed Systems Folder 09250-SA 923.
- 3.2.18.2. Provide hanger wires spaced at maximum 1200 mm (4') oc along carrying channels and within 150 mm (6") of ends of carrying channel runs. Secure hanger wires to inserts in structure above.
- 3.2.18.3. Provide carrying channels maximum 1200 mm (4') oc and within 150 mm (6") of walls. Secure with hanger wire saddle-tied along channels. Provide 25 mm (1") clearance between runners and walls. Provide splicers behind joints. Level channels to a maximum tolerance of 3 mm (1/8") over 3600 mm (12').
- 3.2.18.4. Provide metal furring channels at right angles to carrying channels at maximum 600 mm (24") oc and within 150 mm (6") of walls. Provide 25 mm (1") clearance between furring ends and abutting walls. Attach furring channels to carrying channels with saddle-tie of double strand tie wire.
- 3.2.18.5. Provide additional cross-reinforcing at bulkheads and other openings.
- 3.2.18.6. Seismic Bracing: Sway-brace suspension systems with seismic connections, supports and lateral-force bracings conforming to requirements of ASTM E580/E580M and as follows:
- 3.2.18.6.1. Install lateral-force bracing to ceilings where gypsum wallboard panels are attached by screws to metal suspension members and ceilings extend to walls.
- 3.2.18.6.2. Install hanger wires splayed 90° from each other at an angle not exceeding 45° from horizontal plane of ceiling to satisfy force-bracing requirements.
- 3.2.18.6.3. Attach wires to main runners and place within 50 mm (2") of intersection of cross tees. Ensure bracing points do not exceed 3660 mm (12') oc with first point of bracing within 1220 mm (4') of perimeter of suspended ceiling system.
- 3.2.18.6.4. Fasten vertical uplift strut to and extend from main runner near bracing points to structural support members above. Ensure design and installation of uplift strut is determined for each ceiling system to suit design requirements.
- 3.2.18.6.5. Partition Bracing: Brace non-bearing interior partitions to suspended ceilings by providing No. 12 gage galvanized, soft annealed mild steel suspension hanger wire laid at 45° maximum to horizontal plane of ceiling at 2440 mm (8') oc. Attach walls to metal suspension runners with a positive attachment designed by metal suspension system manufacturer.
- 3.2.18.6.6. Provide wider wall moulding on all sides to support individual panels around perimeter. Minimum size: 50 mm (2").
- 3.2.18.7. Premanufactured Grid Suspension Systems: Install in accordance with manufacturer's instructions. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- 3.2.19. Metal Trim and Accessories:
- 3.2.19.1. Provide metal trim casing beads at reveals; at ceiling-wall intersections and partition perimeters; and at intersection of dissimilar constructions such as gypsum board to concrete.
- 3.2.19.2. Provide metal trim casing beads where gypsum board abutts against a surface having no trim concealing junction.
- 3.2.19.3. Provide a 13 mm (1/2") separation gasket between metal trim casing beads and window frames or other cold surfaces or provide sponge tape between gypsum board partition or furring framing, where such framing abuts exterior door or window frame, sponge tape between floor and gypsum board partition track. Ensure tape is either full width or 1 strip 9 mm (3/8") wide on each side of framing member.

- 3.2.19.4. Provide casing bead and sponge tape where gypsum board abuts materials other than itself and acoustic tile ceilings including at exterior door and window frames, where juncture is not concealed with trim; or elsewhere where indicated on Drawings. Unless indicated otherwise, use tape 3 mm (1/8") narrower than casing bead to provide recess at exposed side. Compress tape by 25%.
- 3.2.19.5. Provide metal trim casing beads where indicated on Drawings.
- 3.2.19.6. Provide pre-finished metal angle trim supports and provide light pockets and eggcrate grilles and/or louvres in accordance with manufacturer's instructions. Install light pockets and eggcrate grilles and/or louvre units square, straight and in 1 piece where possible or with inconspicuous joints at long runs.
- 3.2.20. Control Joints:
- 3.2.20.1. Provide either manufactured control joint devices or field fabricated control joints from suitable materials to suit site conditions in accordance with manufacturer's instructions and/or ASTM C840.
- 3.2.20.2. Set in gypsum facing board, supporting control joints with studs or furring channels on both sides of joint. Ensure double studs with discontinuous tracks and double suspended ceiling furring channels have been installed prior to commencing board and bead application at control joints. Provide control joints as required to prevent cracks following locations:
- 3.2.20.2.1. where a partition, wall or ceiling traverses a construction joint (expansion, seismic or building control element) in base building structure.
- 3.2.20.2.2. where a wall or partition runs in an uninterrupted straight plane exceeding 9.1 m (30') (Note: A full height door frame may be considered a control joint).
- 3.2.20.2.3. interior ceiling with perimeter relief: installed so linear dimensions between control joints do not exceed 15 m (15') and total area between control joints does not exceed 230 m² (2,500 sq ft).
- 3.2.20.2.4. interior ceiling without perimeter relief: installed so linear dimensions between control joints do not exceed 9.1 m (30') and total area between control joints does not exceed 84 m² (900 sq ft).
- 3.2.20.2.5. at stress points (ie corners of openings or changes in direction of surfaces).
- 3.2.20.3. Provide additional control joints at long and narrow surfaces.
- 3.2.20.4. Provide control joints full height floor to ceiling or door header to ceiling in partitions and furring runs.
- 3.2.20.5. Provide control joints from wall to wall in ceiling areas.
- 3.2.20.6. Provide continuous polyethylene dust barrier behind and across control joints.
- 3.2.20.7. Ensure Consultant reviews exact locations of control joints.
- 3.2.21. Sound Control:
- 3.2.21.1. Where indicated on Drawings, provide sound rated partitions and ceiling in locations indicated to meet required minimum STC rating. Apply gypsum board on both sides of sound-proofed partitions. Follow manufacturer's details and recommendations.
- 3.2.21.2. Provide sound attenuation insulation to completely fill height of stud cavities. Tightly butt ends and sides of blankets within cavities to ensure a 90% capacity, do not overfill cavities. Cut blankets to fit small spaces. Carefully fit blankets behind electrical outlets, bracing, fixture attachments and mechanical and electrical services.
- 3.2.21.3. Mechanically fasten blankets to back of gypsum board as recommended by gypsum board manufacturer.
- 3.2.21.4. At sound attenuating suspended ceiling and enclosures having spring isolator hangers, terminate ceiling or enclosure at adjacent construction by providing continuous isolator strip and sealed joint.

- 3.2.22. Joint Treatment - Gypsum Board:
- 3.2.22.1. Verify board is firm against framing members and screw heads are properly depressed.
- 3.2.22.2. Mix joint compound or ready-to-use compounds according to manufacturer's directions. Use pure, unadulterated, clean water for mixing. Permit mixed material to stand 30 minutes before using. Do not mix more material than can be used within 1 hour. Do not use set or hardened compound. Clean tools and equipment after mixing each batch.
- 3.2.22.3. Tape and fill joints and corners in accordance with gypsum board manufacturer's printed instructions. Fill either manually, using hand tools of trade, or by a mechanical taping and filling machine of proven efficiency.
- 3.2.22.4. Remove plastic tape from control joints after finishing with joint compound.
- 3.2.22.5. After final coats of filler have dried at least 24 hours, sand surface lightly with No. 00 sandpaper to leave it smooth, ready for decoration.
- 3.2.22.6. Provide finished work smooth, seamless, plumb and true, flush and with square plumb neat corners.
- 3.2.22.7. Levels of Finish: Provide following levels of finish in accordance with ASTM C840:
- 3.2.22.7.1. Level 0: No taping, finishing or accessories required for temporary construction or areas where final decoration is not required.
- 3.2.22.7.2. Level 1: Use this level in plenum areas above ceilings, attics, areas where assembly would generally be concealed or in building service corridors and other areas.
- 3.2.22.7.3. Level 2: Use this level where water resistant gypsum backing board is used as substrate for tile; may be used in garages, warehouse storage, or other similar areas where surface appearance is not of primary concern.
- 3.2.22.7.4. Level 3: Use this level in appearance areas which are to receive heavy or medium texture spray or hand applied finishes before final painting or where heavy grade wall coverings are to be applied as final decoration.
- 3.2.22.7.5. Level 4: Use this level where flat paints, light textures or wall coverings are to be applied.
- 3.2.22.7.6. Level 5: Use this level to provide a uniform surface and minimize possibility of joint photographing and of fasteners showing through final decoration.
- 3.2.23. Fire Rated Partitions:
- 3.2.23.1. Ensure materials for fire rated construction conform to requirements of authorities having jurisdiction to obtain fire rating shown on Drawings. Where dissimilar components are built into fire rated assemblies ensure continuity of fire separation by boxing in elements with gypsum board and framing to suit authorities having jurisdiction. Work in cooperation with Section providing firestopping work.
- 3.2.23.2. Provide fire rated enclosures, separations and assemblies as indicated on Drawings conforming to requirements of authorities having jurisdiction.
- 3.2.23.3. Where required, secure sound attenuation blanket insulation between studs as specified in Article on Sound Control Partitions.
- 3.2.24. Cutting and Patching: Cooperate and coordinate with other Sections to obtain satisfactory gypsum board finish work. Do cutting, patching and Make Good as required by installation of work of other Sections.

3.3. SITE QUALITY CONTROL

3.3.1. Site Tests and Inspections:

3.3.1.1. Structural Inspection: Ensure a licensed engineer specified herein inspects work of this Section during erection/installation and submits sealed and signed Field Review Report within 5 Days of site visit.

3.3.2. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.4. CLEANING

3.4.1. Clean off beads, casings, joint cement droppings and similar items and remove surplus materials and rubbish on completion and as directed.

3.5. PROTECTION

3.5.1. Provide protection of materials and work of this Section from damage by weather and other causes. Perform work in areas closed and protected from damage due to weather. Protect work of other trades from damage resulting from work of this Section. Make Good such damage immediately.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide acoustical panel ceilings including but not limited to following:

1.2.1.1. ceiling suspension systems.

1.2.1.2. lay-in acoustical ceiling panels.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of suspended gypsum board ceilings: Section 09 21 16, Gypsum Board Assemblies.

1.2.2.2. Provision of sound-absorptive ceiling panels (ACP): Section 09 84 13, Fixed Sound-Absorptive Panels.

1.2.2.3. Provision of mechanical fixtures: Division 21, Fire Suppression, Division 22, Plumbing and Division 23, Heating, Ventilating and Air Conditioning.

1.2.2.4. Provision of electrical, communication and security fixtures: Division 26, Electrical, Division 27, Communications, Division 28, Electronic Safety and Security.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. ULC: Underwriters Laboratories of Canada; www.canada.ul.com.

1.3.1.2. cUL: Underwriters Laboratories Inc.; www.ul.com.

1.3.2. Reference Standards:

1.3.2.1. ASTM C635/C635M-22 - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

1.3.2.2. ASTM C636/C636M-19 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels

1.3.2.3. ASTM E1264-22 - Standard Classification for Acoustical Ceiling Products

1.3.2.4. CAN/ULC-S101-14 - Standard Methods of Fire Endurance Tests of Building Construction and Materials

1.4. SUBMITTALS

1.4.1. Product Data: Submit Product data on ceiling grid system, acoustical panels; clearly indicate specific items proposed for use if manufacturer's catalogues are submitted.

1.4.2. Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00. In addition to minimum requirements indicate following:

1.4.2.1. reflected plans of ceilings, joint pattern, position of suspension grids, seismic requirements, methods of suspension and termination at walls, partitions, bulkheads, lighting fixtures and mechanical fixtures.

1.4.2.2. Submit reflected ceiling plans detailed in measurement system (e.g. imperial or metric) to match Drawings.

- 1.4.2.3. Ensure a licensed engineer specified herein is responsible for:
 - 1.4.2.3.1. production and review of Shop Drawings.
 - 1.4.2.3.2. sealing and signing each Shop Drawing and any associated calculations performed.
- 1.4.3. Samples: Submit samples in accordance with Section 01 30 00. Submit following samples in sizes indicated:
 - 1.4.3.1. Submit 300 mm (12") long samples of suspension system parts, including trim and seismic items.
 - 1.4.3.2. Submit 300 mm x 300 mm (12" x 12") samples of acoustical panels.

1.5. CLOSEOUT SUBMITTALS

- 1.5.1. Operational and Maintenance Data: Submit maintenance instructions to Owner for recommended cleaning materials and methods for panels and trim. Include precautions for use of and composition of cleaning materials detrimental to acoustic materials and trim.

1.6. MAINTENANCE MATERIAL SUBMITTALS

- 1.6.1. Extra Stock Materials: Leave 1 carton per 93 m² (1000 sq ft) of each type of ceiling panel specified for Owner's future maintenance use. Supply spare panels from same production run as installed panels.

1.7. QUALITY ASSURANCE

- 1.7.1. Qualifications:
 - 1.7.1.1. Installers: Provide work of this Section executed by competent installers with minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
 - 1.7.1.2. Licensed Professionals: Employ a licensed engineer carrying professional liability insurance and is registered in the Province of Ontario.
- 1.7.2. Mock-Ups: Construct minimum 10 m² (100 sq ft) mock-up sample of complete system in correct measure unit (imperial or metric) at Project location designated by Consultant for review. Once reviewed with no objections recorded, sample remains part of finished work and used as a quality reference standard for balance of Project.

1.8. DELIVERY, STORAGE AND HANDLING

- 1.8.1. Delivery and Acceptance Requirements: Deliver materials in original packages, containers and bundles, bearing brand and manufacturer's name.
- 1.8.2. Storage and Handling Requirements:
 - 1.8.2.1. Store materials in a covered area, off ground, on flat, smooth, dry surfaces. Protect from moisture. Remove damaged or deteriorated materials from site.
 - 1.8.2.2. Comply with ceiling panel manufacturer's recommendations regarding temperature and humidity conditions before, during and after ceiling installation.

1.9. SITE CONDITIONS

- 1.9.1. Ambient Conditions: Continuously maintain rooms or areas scheduled to receive acoustical treatment at not less than 21 deg C (70 deg F) and at occupancy humidity, at least 3 Days prior to installation and 3 Days after work is completed. Schedule work to eliminate risk of damage to these materials due to adverse environmental conditions in rooms or areas when and after work is installed.

1.10. WARRANTY

- 1.10.1. Manufacturer Warranty: Warrant work of this Section for period of 3 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
- 2.1.1.1. Armstrong World Industries Canada Ltd.; www.armstrongceilings.com
- 2.1.1.2. Bailey Metal Products Ltd.: www.bmp-group.com
- 2.1.1.3. CertainTeed Ceilings; www.certainteed.com
- 2.1.1.4. CGC Inc.; www.cgcinc.com
- 2.1.1.5. ROCKFON; www.rockfon.com
- 2.1.2. Substitution Limitations: Comparable Products from manufacturers listed or not listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

- 2.2.1. Performance/Design Criteria:
- 2.2.1.1. Design suspension system to support safely and without distortion, superimposed loads of:
- 2.2.1.1.1. Lighting fixtures.
- 2.2.1.1.2. Air supply diffusers, boots, fire alarm grilles and exhaust and return air grilles.
- 2.2.1.2. Design suspension system to support lighting fixtures according to Ontario Hydro regulations and submit certification in accordance with Rule 30-302 (1).
- 2.2.1.3. Prepare panels for sprinkler head penetrations and suspension members of curtain tracks.
- 2.2.1.4. Coordinate installation and cooperate with Mechanical and Electrical Subcontractors, to accommodate mechanical and electrical items, or any other Work required to be incorporated in or coordinated with the ceiling system.
- 2.2.1.5. Structural Design: Employ a licensed engineer specified herein to:
- 2.2.1.5.1. design components for work of this Section requiring structural performance.
- 2.2.1.5.2. be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.
- 2.2.1.5.3. design acoustical ceiling system in compliance with seismic requirements for the Place of the Work as determined by authorities having jurisdiction and verified by an independent third party.
- 2.2.2. Unless otherwise indicated, manufacture ceiling suspension Products to minimum requirements of ASTM C635/C635M, for Medium Duty, modified as required to suit grid design shown.
- 2.2.3. Exposed Grid System for ACT-2: "DONN DX® Suspension System" by CGC Inc., "Prelude® XL 15/16" Exposed Tee System" by Armstrong World Industries, "Lance-Lock® System 900" by Bailey Metal Products Ltd., "Chicago Metallic 1200 Seismic 15/16" Exposed" by ROCKFON or "15/16" Classic Stab Systems" by CertainTeed Ceilings, factory finished satin white on hot dipped galvanized cold rolled steel. Ensure system provides lock joint intersections of cross and main tees.

- 2.2.4. Slotted Grid System for ACT-1: "DONN Fineline® 1/8 DXFF Suspension System" by CGC Inc., "Silhouette® XL 1/8" Reveal" by Armstrong World Industries or "Chicago Metallic Ultraline™ 4600 9/16" Exposed with 1/8" Reveal" by ROCKFON, factory finished satin white on hot dipped galvanized cold rolled steel.
- 2.2.5. Basic Steel Material and Finish: Commercial quality cold rolled steel 0.455 mm (26 ga) minimum thickness, galvanized to zinc coating designation Z90 (G30) for normal interior spaces, Z180 (G60) for high humidity spaces and Z275 (G90) for exterior spaces. Ensure exposed surfaces of metal products are factory finished in non-yellowing, low sheen satin white enamel to Consultant's review to match whiteness in panels. Provide paint formulation of grid system to lighting fixture, speaker grille, sprinkler and diffuser manufacturers to ensure consistency of colour, sheen and texture of all exposed metal components in the ceiling assemblies. Provide slip-on trim mouldings or metal mouldings with baked enamel finish, as standard with grid manufacturer, to trim around light fixtures.
- 2.2.6. Accessories for Suspension System: Complete with splices, clips and perimeter moulding of manufacturer's standard and aluminum types to suit the applicable conditions unless special conditions and access areas are shown or specified. In high humidity areas provide galvanized suspension system.
- 2.2.7. Hangers: Minimum 2.642 mm (12 ga) overall thickness galvanized steel wire to zinc coating designation Z275 (G90), meeting "Heavy-duty" classification of ASTM C635/C635M.
- 2.2.8. Main Tees: 3.66 m (12') long, 23.8 mm (15/16") face width double web design, rectangular bulb at top of web, 38 mm (1-1/2") web height. Expansion cut-outs in main tees controlling buckling caused by heat expansion.
- 2.2.9. Main Tee Splices: Designed to lock lengths of main tees together so joined lengths of tee function structurally as single unit with tee faces at joint perfectly aligned and presenting tight seam.
- 2.2.10. Cross Tees: 1220 mm (4') long, 25 mm (1") web height structural cross-section, design same as main tees, designed to connect at main tees forming positive lock without play, loss or gain in grid dimensions with offset over-ride of face flange over main tee flange to provide flush joint. Provide 38 mm (1-1/2") web height of cross-tee for fire rated assemblies.
- 2.2.11. Edge Moulding Around Ceiling Perimeters: Materials and finish to match tees.
- 2.2.12. Panel Hold-Down Clips: As recommended by lay-in panel manufacturer.
- 2.2.13. Inserts for Concrete Slabs: Certified type for setting in concrete or self drilling expansion inserts for placing afterwards. Tie wire anchors, Red Head TW-1614 by ITW Canada, Inc., or Parabolt Wire Anchor by Acrow Richmond, or T-14 Eyebolt by Ramset Ltd., "HHDCA" or "HLC-T" by Hilti (Canada) Corporation or Tire Wire Drive TW-932 by Isometric Ltd.
- 2.2.14. Fasteners: Galvanized and of size suited to loading conditions.
- 2.2.15. Metal Closures and Trim: Bonderized and with factory-applied white baked enamel finish. Provide anchors as standard with manufacturer.
- 2.2.16. Supplementary Steel Supports: Steel conforming to Section 05 50 00.
- 2.2.17. Acoustical Lay-in Panels: ASTM E1264, acoustical units, prefabricated, with white painted textured and/or smooth face, qualified for use in fire rated ceiling assembly; ULC or cUL labelled and meeting following performance criteria as determined by CAN/ULC-S101 and as specified:
- 2.2.17.1. Flame Spread Rating: 25 or under.
- 2.2.17.2. Smoke Developed: 50 or under.
- 2.2.17.3. Fuel Contributed: 25 or under.

2.2.17.4. Acoustical Lay-In Panels (ACT-1): 610 mm x 1220 mm x 25 mm (24" x 48" x 1") fibreglass, non-directional fissured, square tegular edge, white factory-painted exposed surface, "OPTIMA® Tegular Item No. 3252" by Armstrong World Industries, meeting following performance criteria:

2.2.17.4.1. NRC: 0.90.

2.2.17.4.2. LR: 0.88.

~~2.2.17.5. Acoustical Lay-In Panels (ACT-2): 610 mm x 1220 mm x 19 mm (24" x 48" x 3/4") panels, fibreglass, non-directional fissured, square edge, white factory-painted exposed surface, "OPTIMA® Item No. 3151" by Armstrong World Industries, meeting following performance criteria:~~

~~2.2.17.5.1. NRC: 0.95.~~

~~2.2.17.5.2. LR: 0.88.~~

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.

3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

3.2.1. Do not start installation until exterior glazing has been completed and exterior openings are closed in. Ensure wet work is completed and dried out to a degree acceptable to panel manufacturer before installation is commenced. Maintain uniform temperatures of at least 21 deg C (72 deg F) for 72 hours prior to commencement of work and maintain temperature until 72 hours after completion.

3.2.2. Install ceiling panels and metal suspension system in accordance with applicable requirements of ASTM C636/C636M, seismic design and manufacturer's directions. Where manufacturer's directions are at variance with Contract Documents, notify Consultant before proceeding with work.

3.2.3. Do not commence installation until all work above suspended ceiling has been completed, inspected and reviewed.

3.2.4. Install supporting inserts for hangers of suspended ceiling system into concrete slab above.

3.2.5. Install acoustical ceilings using tradesmen skilled in this class of work, in accordance with manufacturer's instructions and as specified herein.

3.2.6. Neatly and symmetrically install suspended ceiling to true lines, evenly balanced to pattern indicated on Drawings or as directed.

3.2.7. Centre ceiling system on room axis unless otherwise thereon or directed leaving equal border panels not less than 1/2 a full width.

3.2.8. Recessed items shall replace or be centred on acoustical panels, except where shown otherwise. Consult with Mechanical and Electrical to co-ordinate work. Provide additional supports where required.

3.2.9. Space hangers for suspended ceilings to support grillage independent of walls, columns, pipes and ducts at maximum 1220 mm (4') centres along support grillage and not more than 150 mm (6") from ends. Provide additional hangers at light fixtures and diffusers.

3.2.10. Attach hangers to inserts in overhead concrete slab. Bend top of hangers at right angles, turn down and securely fasten. Turn bottom of hangers upwards and securely wrap 3 times.

- 3.2.11. Suspension to Metal Deck: Punch lower part of metal deck with special puncher at required distances. Put hanger wire through holes, turn down, make a loop and securely wrap 3 times.
- 3.2.12. Provide written confirmations to Divisions 20, 21, 22, 23, 25, 26, 27 and 28, when requested by Consultant, that suspended ceiling is capable of supporting additional weight of mechanical and electrical fixtures specified in Divisions 20, 21, 22, 23, 25, 26, 27 and 28.
- 3.2.13. Run main tees at right angles to length of light fixtures.
- 3.2.14. Space main tees 1220 mm (4') oc in 1 direction and securely tie to hangers.
- 3.2.15. Space cross tees 610 mm (2') oc at right angles to main tees and properly lock at intersections.
- 3.2.16. Level suspended systems with a maximum tolerance of 3 mm (1/8") over 3.66 m (12').
- 3.2.17. Use longest practical lengths of tees, furring and running channels to minimize joints. Make joints square, tight, flush and reinforced with concealed splines. Assemble framework to form a rigid and interlocking system.
- 3.2.18. Design suspension system to accommodate movement caused by thermal expansion or contraction.
- 3.2.19. Design and space hangers and carrying members to support entire ceiling system, including lighting fixtures, diffusers and equipment openings in locations indicated on Drawings.
- 3.2.20. Use edge moulding where ceiling abutts vertical surface.
- 3.2.21. Use corner moulding along external edges at ceiling steps.
- 3.2.22. Exposed Grid Lay-in Panel Ceilings:
 - 3.2.22.1. Install direct-hung exposed grid lay-in acoustical panel ceilings where shown. Install main tees, cross tees and wall mouldings so bottom flanges are in flat, level plane at finish ceiling elevations. Arrange grid so opposite wall edge panels are of equal width but not less than 1/2 panel width and lay out and erect grid system to provide following panel pattern as shown:
 - 3.2.22.1.1. Pattern of 610 mm x 1220 mm (24" x 48"), with main beam tees spaced 1220 mm (48") oc and cross tees 610 mm (24") oc unless reviewed otherwise.
 - 3.2.22.2. Install exposed ceiling grid per ASTM C636/C636M, reviewed Shop Drawings and specified herein.
 - 3.2.22.3. Erect main beams parallel to main wall and to each other; space uniformly at centres specified. Stop ends of main beams 13 mm (1/2") from walls allowing for expansion. Supply main beams in as long lengths as possible to minimize number of joints in a run. Join lengths of main beams together at hangers only; use special splice pieces. In ceilings having recessed lighting fixtures, modify grid framing to provide main beams along and parallel to both long sides of lighting fixtures; at each 300 mm (12") wide fixture, provide an additional main beam along the long side of fixture. At other items recessed in ceiling and designed to be framed by main beams, provide additional main beams necessary. Rest ends of main beams on horizontal leg of wall mouldings.
 - 3.2.22.4. Support main beams with hangers along each run, spaced at not more than 1220 mm (48") centres; except in areas of steel framing, provide hangers at each intersection of main beam and framing. If ductwork or equipment located in ceiling plenum area interferes with hanger spacing, provide a trapeze or other arrangement reviewed by Consultant to support main beams at proper spacing. Do not secure hangers to metal roof deck, ductwork, conduit, piping, equipment or support system for any of these. Provide an additional hanger at each corner of each opening to receive a recessed lighting fixture and each opening that has been framed by main beam members. Provide additional hangers at each diffuser, grille and other points of extra loading. Secure hangers to main beams to develop full strength of hangers and per manufacturer's published directions. Secure hangers to construction above per ASTM C636/C636M and following requirements:
 - 3.2.22.4.1. Exposed Concrete Slab: Use anchors, cast-in hanger wires or inserts, specifically designed for hanger use.

- 3.2.22.4.2. Steel Beams: Use beam clips.
- 3.2.22.4.3. Steel Joists: Wrap hanger wire around lower chord member.
- 3.2.22.4.4. Permanent Metal Forms and Cellular Floor Deck: Tabs, holes or slots specifically provided for hanger attachment. Prevent hanger twisting or turning by cross tying.
- 3.2.22.5. Install primary cross tees at right angles to main beam tees and space uniformly at centres specified. Join ends of cross tees to web of main beams with a positive interlock; except at light fixtures, secure members together with concealed steel clips and bolts. Install tees to produce fine-line joints between flanges of abutting members.
- 3.2.22.6. At locations where ceilings abut walls, columns and other vertical surfaces, install continuous wall moulding to trim ceiling edges. Install moulding with bottom horizontal leg at elevation required to support acoustical panel and to be flush with bottom flange of grid members, and with vertical leg concealed. Bolt mouldings to supporting construction at 610 mm (24") on centres and within 150 mm (6") of end of each moulding piece. Provide tight, inconspicuous butt joints in moulding if several pieces are required in any 1 run.
- 3.2.22.7. Install acoustical panels with undamaged edges fitted accurately into suspension-system runners and edge mouldings. Scribe and cut panels at borders and penetrations to provide a precise fit. For circular penetrations through panels, provide edge mouldings fabricated to diameter required to fit penetration tightly. Fit panels moderately tight between upright legs of members. Cut panels neatly and accurately to fit closely around items piercing the finish ceiling plane ensuring no "light bleeding" is occurring at light fixtures. Secure each panel into grid opening with concealed hold-down clips.
- 3.2.22.8. Paint cut edges of panels remaining exposed after installation; match colour of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.3. SITE QUALITY CONTROL

- 3.3.1. Site Test and Inspection:
 - 3.3.1.1. After interior finishing work has been substantially completed, or when directed by Consultant, inspect acoustical treatment work.
 - 3.3.1.2. Structural Inspection: Ensure a licensed engineer specified herein inspects work of this Section during erection/installation and submits sealed and signed Field Review Report within 5 Days of site visit.
- 3.3.2. Non-Conforming Work: Replace broken, chipped or damaged work, reset loose units or units out of place and touch up marred surfaces with matching paint.

3.4. CLEANING

- 3.4.1. Clean exposed surfaces of acoustical panel ceilings, including trim and edge mouldings. Comply with manufacturer's written instructions for cleaning and touch-up of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned or repaired to permanently eliminate evidence of damage.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide interior tactile warning surfacing including but not limited to following:

1.2.1.1. cast-in-place tactile warning surfacing.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of homogeneous sheet vinyl flooring: Section 09 65 16, Resilient Sheet Vinyl Flooring.

1.2.2.2. Provision of homogeneous sheet safety flooring: Section 09 65 66, Resilient Athletic Impact Flooring.

1.2.2.3. Provision of carpet tile: Section 09 68 13, Carpet Tile.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. SDS: Safety Data Sheet.

1.4. ADMINISTRATIVE REQUIREMENTS

1.4.1. Preinstallation Meetings: Arrange preinstallation meeting 1 week before commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.5. SUBMITTALS

1.5.1. Product Data: Submit Product data on tactile warning surfacing; clearly indicate specific items proposed for use if manufacturer's catalogues are submitted.

1.5.2. Samples: Submit samples in accordance with Section 01 30 00. Submit following samples in sizes indicated:

1.5.2.1. cast-in-place tactile surfacing 300 mm (12") square.

1.6. CLOSEOUT SUBMITTALS

1.6.1. Operational and Maintenance Data: Submit 3 copies of Product maintenance manual to Consultant prior to completion of the Work. Ensure manual contains specific maintenance recommendations and gives specific warning of any maintenance practice or materials which may damage or disfigure tactile warning surfacing.

1.7. MAINTENANCE MATERIAL SUBMITTALS

1.7.1. Extra Stock Materials: Leave 2 extra tiles of each type of tactile warning surfacing specified for Owner's future maintenance use. Supply tactile warning surfacing from same production run as installed.

1.8. QUALITY ASSURANCE

1.8.1. Qualifications:

1.8.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

1.8.2. Mock-Ups: Construct minimum 10 m² (100 sq ft) mock-up sample at Project location designated by Consultant for review. Once reviewed with no objection recorded, sample remains part of finished work and used as a quality reference standard for balance of Project.

1.9. DELIVERY, STORAGE AND HANDLING

1.9.1. Delivery and Acceptance Requirements:

1.9.1.1. Deliver materials in good condition to site in manufacturer's original unopened containers that bears name and brand of manufacturer, Project identification, shipping and handling instructions.

1.9.1.2. Deliver flooring material in a manner to avoid deterioration, staining or any other damage.

1.9.1.3. Deliver packaged floor preparation and adhesive materials in their original bags or containers clearly identified; keep containers sealed and labels intact until time of use. Prevent damage or contamination to materials by water, moisture, freezing, excessive heat, foreign matter or other causes.

1.9.1.4. Deliver materials on site at least 24 hours before work begins.

1.9.2. Storage and Handling Requirements:

1.9.2.1. Store and handle flooring material in a manner to avoid deterioration, staining or any other damage.

1.9.2.2. Store packaged floor preparation and adhesive materials in their original bags or containers clearly identified; keep containers sealed and labels intact until time of use. Prevent damage or contamination to materials by water, moisture, freezing, excessive heat, foreign matter or other causes. If materials are frozen, do not stir any such liquids or adhesives until they are completely thawed.

1.9.2.3. Provide secure heated and dry storage facilities on site. Maintain temperature in storage area between 18 deg C (65 deg F) and 38 deg C (100 deg F).

1.9.2.4. Store materials on site at least 24 hours before work begins.

1.10. SITE CONDITIONS

1.10.1. Ambient Conditions:

1.10.1.1. Maintain appropriate environmental conditions and protect work during and after installation. Comply with trade standards and manufacturer's Product instructions. Follow Product SDS and label instructions concerning safety, health and other related precautionary and environmental protection. Comply with applicable federal, provincial, local and statutory regulations.

1.10.1.2. Close doors and windows. Turn off radiant floor heating systems and protect work area from direct draft, sun and heat exposure during installation and for at least 72 hours after completion.

1.10.1.3. When necessary, build a temporary shelter and use indirect auxiliary heaters to maintain an adequate temperature level in work environment.

1.10.1.4. Exhaust temporary heaters to building exterior to prevent health hazards and damage to work from toxic fumes and emanations.

1.10.1.5. Maintain temperature of floor covering areas at not less than 18 deg C (65 deg F) or more than 38 deg C (100 deg F) 48 hours before, during installation and for 48 hours after application unless otherwise required in Product instructions.

1.11. WARRANTY

- 1.11.1. Manufacturer Warranty: Warrant work of this Section for period of 5 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner. Defects include but are not limited to; buckling, opening of seams, bond failure and extensive colour fading.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
- 2.1.1.1. AccessTile; www.accesstile.com
- 2.1.1.2. Engineered Plastics Inc.; www.armor-tile.com
- 2.1.1.3. Kinesik Engineered Products Incorporated; www.kinesik.ca
- 2.1.2. Substitution Limitations: Comparable Products from other manufacturers not listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

- 2.2.1. Cast-in-Place Tactile Warning Surfacing: Provide 1 of following:
- 2.2.1.1. Ceramic Tile Type: Provide 10 mm thick porcelain tactile walking surface indicator with 4 mm high truncated domes in colour selected later by Consultant. Permitted Product: "Elan® Tile" by Kinesik Engineering Products Incorporated.
- 2.2.1.2. Polymer Type:
- 2.2.1.2.1. Provide 3 mm thick polymer based tactile walking surface indicator with 5 mm high truncated domes in colour selected later by Consultant. Permitted Products: "Eon® Tile" by Kinesik Engineering Products Incorporated or "Intelligent Design™ Cast In Place Replacement" by AccessTile.
- 2.2.1.2.2. Provide vitrified polymer composite based tactile walking surface indicator with raised truncated domes in colour selected later by Consultant. Permitted Product: "Armor-Tile™ Cast in Place" by Engineered Plastics Inc.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- 3.2.2. Place tactile warning surfacing units in dimensions and orientation indicated on Drawings.

3.3. SITE QUALITY CONTROL

- 3.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.4. CLEANING

- 3.4.1. Remove protective plastic sheeting from detectable warning tiles within 24 hours of installation.
- 3.4.2. Clean tiles not more than 4 Days prior to date scheduled for inspection intended to establish Date of Substantial Performance in each area of the Project.

3.5. PROTECTION

- 3.5.1. Protect detectable warning tiles against damage during construction period to comply with tile manufacturer's specifications.
- 3.5.2. During and after detectable warning tile's installation and concrete curing stage, it is imperative no walking, leaning, or external forces are placed on tile to rock tile, causing a void between underside of tile and concrete substrate.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide resilient sheet vinyl flooring including but not limited to following:

1.2.1.1. preparing substrate.

1.2.1.2. resilient sheet vinyl flooring.

1.2.1.3. resilient base.

1.2.1.4. reducing strips and thresholds at junction with adjacent architectural finishes.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Removal of existing flooring and architectural finishes: Section 02 41 00, Demolition and Salvage.

1.2.2.2. Provision of wood base: Section 06 40 00, Architectural Woodwork.

1.2.2.3. Sealant between sheet flooring and penetrating components: Section 07 92 00, Joint Sealants.

1.2.2.4. Provision of carpet tiles: Section 09 68 13, Carpet Tile.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. MRSA: Methicillin Resistant Staphylococcus Aureus.

1.3.1.2. PVC: Polyvinyl Chloride.

1.3.1.3. RH: Relative Humidity.

1.3.1.4. SCOF: Static Coefficient of Friction.

1.3.1.5. SDS: Safety Data Sheet.

1.3.2. Reference Standards:

1.3.2.1. ASTM D2047-25 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine

1.3.2.2. ASTM D4259-24 - Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application

1.3.2.3. ASTM E648-25 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

1.3.2.4. ASTM E662-21ae1 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials

1.3.2.5. ASTM F710-22 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

1.3.2.6. ASTM F1861-21(25) - Standard Specification for Resilient Wall Base

1.3.2.7. ASTM F1869-23 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

- 1.3.2.8. ASTM F1913-19(25) - Standard Specification for Vinyl Sheet Floor Covering Without Backing
- 1.3.2.9. ASTM F2170-19a - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

1.4. ADMINISTRATIVE REQUIREMENTS

- 1.4.1. Preinstallation Meeting:
 - 1.4.1.1. Prior to start of work, arrange for Project site meeting of all parties associated with work of this Section, including Contractor, resilient sheet vinyl flooring installer, trade of substrates to which flooring is applied and manufacturer's representative.
 - 1.4.1.2. Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of resilient sheet vinyl flooring installation and other matters affecting construction, to permit compliance with intent of this Section. In particular ensure Division 3 requirements for concrete are compatible with requirements of this Section; floor flatness and floor levelness requirements for various floor finishes and their acceptability by flooring manufacturer; surface texture of finished floor required for various floor finishes; permitted approaches to remediation of high moisture and high pH floors; adhesive application and floor covering installation.

1.5. SUBMITTALS

- 1.5.1. Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00. Submit Shop Drawings for all areas showing seam layout for major seams between rolls, coving details, treatment at walls, floor drains, treatment where flooring meets dissimilar materials and other special conditions.
- 1.5.2. Samples: Submit samples in accordance with Section 01 30 00. Submit following samples:
 - 1.5.2.1. duplicate 300 mm x 300 mm (12" x 12") sample pieces of sheet material.
 - 1.5.2.2. 300 mm (12") samples for welding rod, each type of seam specified, to indicate quality of joint treatment and each type of flooring accessory.
 - 1.5.2.3. resilient base 300 mm (12") long.
- 1.5.3. Test and Evaluation Reports: If requested, submit test reports from recognized independent testing laboratory for following requirements:
 - 1.5.3.1. calcium chloride test results in accordance with requirements specified herein.
 - 1.5.3.2. pH test results and verify their acceptability to resilient sheet vinyl flooring manufacturer in accordance with requirements specified herein.
 - 1.5.3.3. Critical Radian Flux of 0.45 watts per cm² or greater, Class I in accordance with ASTM E648.
 - 1.5.3.4. Smoke Generation, Maximum Specific Optical Density of 450 or less in accordance with ASTM E662.
 - 1.5.3.5. SCOF of minimum 0.6 on level surface in accordance with ASTM D2047.

1.6. CLOSEOUT SUBMITTALS

- 1.6.1. Operating and Maintenance Data: Provide maintenance data for resilient sheet vinyl flooring for incorporation into maintenance manual specified in Section 01 70 00.

1.7. MAINTENANCE MATERIAL SUBMITTALS

- 1.7.1. Extra Stock Materials: Supply to Owner at completion of job, 3% gross area as spare flooring of each colour, packaged in original cartons. Ensure maintenance materials are from same production run as installed materials.

1.8. QUALITY ASSURANCE

1.8.1. Qualifications:

1.8.1.1. Installers: Provide work of this Section executed by competent installers with minimum of 5 years' experience in application of Products, systems and assemblies specified, including 2 years in heat welding of seams and with approval and training of Product manufacturers. Upon request, provide proof of manufacturer's certificate to Consultant prior to commencement of installation.

1.8.2. Mock-Ups:

1.8.2.1. In coordination with Consultant, Owner, Contractor, Subcontractor, flooring manufacturer and adhesive manufacturer, meet to select and block-off a floor area of approximately 9 m² (100 sq ft). Clean and properly prepare for building a mock-up of resilient sheet vinyl flooring using specified adhesive and floor finish materials in accordance with Specifications, Product instructions and discussions from preinstallation meeting. Ensure finish lighting scheme is replicated in area where mock-up is installed. During mock-up area installation, ensure participants are present to observe substrate preparation, installation and cleaning procedures.

1.8.2.2. After mock-up installation and inspection, discuss pertinent remarks, observations and recommendations are discussed in presence of participants.

1.8.2.3. Once reviewed, mock-up including recorded observations and recommendations remains part of finished work and used as quality reference standard for balance of resilient sheet vinyl flooring work. Protect mock-up area from dirt, dust, damage and abuse until Substantial Performance of the Work.

1.9. DELIVERY, STORAGE AND HANDLING

1.9.1. Delivery and Acceptance Requirements:

1.9.1.1. Deliver materials in good condition to site in manufacturer's original unopened containers that bears name and brand of manufacturer, Project identification, shipping and handling instructions.

1.9.1.2. Deliver flooring material in a manner to avoid deterioration, staining or any other damage.

1.9.1.3. Deliver packaged floor preparation and adhesive materials in their original bags or containers clearly identified; keep containers sealed and labels intact until time of use. Prevent damage or contamination to materials by water, moisture, freezing, excessive heat, foreign matter or other causes.

1.9.1.4. Deliver materials on site at least 24 hours before work begins.

1.9.2. Storage and Handling Requirements:

1.9.2.1. Store and handle flooring material in a manner to avoid deterioration, staining or any other damage.

1.9.2.2. Store packaged floor preparation and adhesive materials in their original bags or containers clearly identified; keep containers sealed and labels intact until time of use. Prevent damage or contamination to materials by water, moisture, freezing, excessive heat, foreign matter or other causes. If materials are frozen, do not stir any such liquids or adhesives until they are completely thawed.

1.9.2.3. Provide secure heated and dry storage facilities on site. Maintain temperature in storage area between 18 deg C (65 deg F) and 38 deg C (100 deg F).

1.9.2.4. Store materials on site at least 24 hours before work begins.

1.10. SITE CONDITIONS

1.10.1. Ambient Conditions:

- 1.10.1.1. Maintain appropriate environmental conditions and protect work during and after installation. Comply with trade standards and manufacturer's Product instructions. Follow Product SDS and label instructions concerning safety, health and other related precautionary and environmental protection. Comply with applicable federal, provincial, local and statutory regulations.
- 1.10.1.2. Close doors and windows. Turn off radiant floor heating systems and protect work area from direct draft, sun and heat exposure during installation and for at least 72 hours after completion.
- 1.10.1.3. When necessary, build a temporary shelter and use indirect auxiliary heaters to maintain an adequate temperature level in work environment.
- 1.10.1.4. Exhaust temporary heaters to building exterior to prevent health hazards and damage to work from toxic fumes and emanations.
- 1.10.1.5. Maintain temperature of floor covering areas at not less than 18 deg C (65 deg F) or more than 38 deg C (100 deg F) 48 hours before, during installation and for 48 hours after application unless otherwise required in Product instructions.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
 - 2.1.1.1. Armstrong World Industries Canada Ltd.; www.armstrongflooring.com
 - 2.1.1.2. Flexco; www.flexcofloors.com
 - 2.1.1.3. Mannington Commercial; www.manningtoncommercial.com
 - 2.1.1.4. MAPEI Inc.; www.mapei.ca
 - 2.1.1.5. R&D Technical Solutions Ltd.; www.kelmar.com
 - 2.1.1.6. Roppe Corporation, USA; www.roppe.com
 - 2.1.1.7. Schluter Systems (Canada) Inc.; www.schluter.com
 - 2.1.1.8. Sika Canada Inc.; www.sika.ca
 - 2.1.1.9. Tarkett; www.commercial.tarkett.com

2.2. MATERIALS

- 2.2.1. Performance/Design Criteria:
 - 2.2.1.1. Carbon Impact Design: Preference will be given to those manufacturers who have provided EPDs outlining their programs for reducing their Operational and Embodied Carbon footprints as specified herein.
 - 2.2.1.2. Material Ingredient Disclosure: Preference will be given to those manufacturers who have provided HPDs or similar documentation identifying their Product chemical content as specified herein.
- 2.2.2. Concrete Moisture Emission Reducer: Provide 1 of following:
 - 2.2.2.1. "Planiseal™ VS" by MAPEI Inc.
 - 2.2.2.2. "Kelmar® MVB" by R&D Technical Solutions Ltd.
 - 2.2.2.3. "Sikafloor® 81 EpoCem^{CA}" by Sika Canada Inc.

- 2.2.3. Ensure homogenous sheet vinyl flooring is treated with bacteria growth inhibitor to inhibit growth of bacteria including MRSA commonly known as 'staph' to avoid skin infection.
- 2.2.4. Homogeneous Sheet Vinyl Flooring (RFL-1):
 - 2.2.4.1. ASTM F1913, non-backed, non-layered, homogenous vinyl composition composed of polyvinyl chloride resin, stabilizers, fillers and pigments for use on slab on grade and suspended floors. Colour: To be selected later by Consultant.
 - 2.2.4.2. Permitted Product: 2.00 mm (0.080") thick, 1.98 m (6' - 6") wide up to 25 m (82' - 0") in length; "iQ Eminent" by Tarkett.
- 2.2.5. Resilient Base (B2): 9.5 mm (3/8") thick x 64 mm (2-1/2") high in accordance with ASTM F1861, Type TP, Group 1, Style A, PVC-free vulcanized rubber, in coil lengths, colour selected from manufacturer's standard range. Provide "Wallflowers® Rubber Wall Base" by Flexco, "BurkeBase Premium TS Molded Wall Base" by Mannington Commercial, "Pinnacle Rubber Wall Base" by Roppe Corporation, USA or "Johnsonite Baseworks® Thermoset Rubber Wall Base - Mandalay" by Tarkett. Colour: "Snow White" plus 2 additional colours to be selected later by Consultant.
- 2.2.6. Primers and Adhesives: Water-resistant reactive adhesives or of types recommended by resilient sheet vinyl flooring manufacturer for specific material on applicable substrate, above, on or below grade.
- 2.2.7. High Moisture Tolerant Adhesive: "S-543 Commercial Sheet Flooring & LVT Adhesive" by Armstrong World Industries Canada Ltd. or "Planiseal™ VS" by MAPEI Inc.
- 2.2.8. Sub-Floor Filler: Fast setting, polymer-modified Portland cement based patching compound mixed with either a latex additive or water only depending on substrate conditions and Product instructions.
- 2.2.9. Edge-Protection and Transition Profiles for Floors:
 - 2.2.9.1. Type TH2: Provide sloped-shaped profile with minimum 13 mm (1/2") wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg and integrated grout joint spacer. Material and Finish: E - Stainless Steel Type 304 = V2A. Height as required. Permitted Product: "Schluter®-RENO-U" by Schluter Systems (Canada) Inc.
 - 2.2.9.2. Type TH1 and TH3: Provide T-shaped profile with 25 mm (1") wide top section and 9 mm (11/32") vertical section that wedges between flooring types. Material and Finish: E - Stainless Steel Type 304 = V2A. Height as required. Permitted Product: "Schluter®-RENO-T" by Schluter Systems (Canada) Inc.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions:
 - 3.1.1.1. Ensure concrete substrates are dry after performing tests as specified herein before using methods recommended by resilient sheet vinyl flooring and adhesive manufacturers and that they exhibit no alkalinity, carbonization, dusting and scaling.
 - 3.1.1.2. Ensure concrete floor to receive resilient sheet vinyl flooring has been prepared in accordance with ASTM F710.
 - 3.1.1.3. Examine substrates for curing compounds, sealers, hardeners and other substances not compatible with adhesive.
 - 3.1.1.4. Apply resilient sheet vinyl flooring in respective areas during final stages of building completion when ceilings and permanent partitions are finished, paint prime coats are applied and substrate conditions are suitable.

- 3.1.2. Preinstallation Testing:
- 3.1.2.1. Perform calcium chloride test no earlier than 28 Days after concrete has been placed in accordance with requirements of ASTM F1869 and/or RH testing in accordance with ASTM F2170 immediately prior to installation of resilient sheet vinyl flooring for moisture on concrete floors around perimeter of areas, at columns and where moisture may be anticipated. Conduct 3 tests for first 93 m² (1000 sq ft) and 1 additional test for every 93 m² (1000 sq ft) of flooring. Ensure moisture emission from concrete floor does not exceed 2.27 kg/93 m² (5 lbs/1000 sq ft) in 24 hours or has a maximum RH of 85%. Do not proceed with installation until moisture problem has been corrected. Provide results to Consultant prior to commencement of installation including diagram of area tested showing location of each moisture test.
- 3.1.2.2. When concrete moisture emission rate is between 2.27 kg/93 m² (5 lbs/1000 sq ft) and 4.53 kg/93 m² (10 lbs/1000 sq ft) in 24 hours use either a concrete moisture emission reducer or a high moisture tolerant adhesive.
- 3.1.2.3. When concrete moisture emission rate is between 4.53 kg/93 m² (10 lbs/1000 sq ft) and 6.79 kg/93 m² (15 lbs/1000 sq ft) in 24 hours use a concrete moisture emission reducer.
- 3.1.2.4. Conduct pH test no earlier than 28 Days after concrete has been placed to ensure alkali salt residue is within limitation acceptable to resilient sheet vinyl flooring manufacturer and to avoid adhesive failure, discolouration, shrinkage and softening of floor covering. If pH results are higher than 10, report to Consultant, Contractor or Owner for investigation and remedial. Also refer to manufacturer for ways to neutralize floor prior to beginning of installation. Neutralize by sanding, vacuuming and/or by water plus mild muriatic acid application as recommended by manufacturer. Retest to assure pH has been neutralized.
- 3.1.3. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. PREPARATION

- 3.2.1. Surface Preparation:
- 3.2.1.1. Prepare concrete floors to receive resilient sheet vinyl flooring in accordance with requirements of ASTM F710. Consult individual manufacturer for their specific recommendations and follow them as required.
- 3.2.1.2. For existing floors conduct non-chemical methods of removal such as abrasive cleaning or blast cleaning, including methods described in ASTM D4259 on existing concrete slabs with deleterious residues.
- 3.2.1.3. Clean floor free of paint, oil, dirt or any other foreign matter detrimental to resilient sheet vinyl flooring application.
- 3.2.1.4. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler. Mix and apply concrete filler mix in accordance with manufacturer's directions.
- 3.2.1.5. Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler has cured.
- 3.2.1.6. Vacuum and clean substrate to resilient sheet vinyl flooring manufacturer's recommendations.

3.3. INSTALLATION

- 3.3.1. Do not commence resilient sheet vinyl flooring installation prior to 28 Days of placing concrete.
- 3.3.2. Install resilient sheet vinyl flooring in accordance with manufacturer's written installation procedures and as specified herein. Mix and apply adhesives to manufacturer's written installation procedures.
- 3.3.3. Install resilient sheet vinyl flooring wall to wall before installation of floor set cabinets, casework, furniture, equipment and fixed partitions.

- 3.3.4. Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by resilient sheet vinyl flooring before initial set takes place.
- 3.3.5. Lay resilient sheet vinyl flooring using heat seam and welding rod process. Prepare heat welded seams with special tool for this purpose and heat weld with vinyl welding rod in seams. Use method and sequence of work in conformance with reviewed Shop Drawings and in conformance with manufacturer's recommendations. Finish seams flush and free from voids, recesses and raised areas. Lay flooring (with seams parallel to building lines) to produce a minimum number of seams. Border widths minimum 1/3 width of full material. Lay resilient sheet vinyl flooring true, level and with even tight joints. Fit borders accurately as required.
- 3.3.6. Run sheets parallel to length or width of room as reviewed. Double cut sheet joints and continuously seal.
- 3.3.7. As installation progresses, roll resilient sheet vinyl flooring with 45 kg (100 lb) roller or per resilient sheet vinyl flooring manufacturer's written recommendations to ensure full adhesion. Keep edges of resilient sheet vinyl flooring at seams devoid of extra adhesive.
- 3.3.8. Where resilient sheet vinyl flooring terminates at exterior doors with thresholds or transition trim, feather flooring as required to achieve maximum allowable distance of 13 mm (1/2") between flooring and top of threshold or transition trim. Extend resilient sheet vinyl flooring a minimum of 13 mm (1/2") under threshold and apply sealant to perimeter of threshold.
- 3.3.9. Cut resilient sheet vinyl flooring neatly around fixed objects. Provide borders around permanent fixtures.
- 3.3.10. Fit joints tightly.
- 3.3.11. Continue resilient sheet vinyl flooring over areas which will be under built-in furniture.
- 3.3.12. Continue resilient sheet vinyl flooring through areas to receive movable type partitions without interrupting floor pattern.
- 3.3.13. Terminate resilient sheet vinyl flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar, unless indicated otherwise on Drawings.
- 3.3.14. Install metal edge strips at unprotected or exposed edges where flooring terminates.
- 3.3.15. Resilient Base:
 - 3.3.15.1. Provide resilient base to substrate surfaces in accordance with manufacturer's recommendations.
 - 3.3.15.2. Apply adhesive evenly and continuously for full base adhesion and contact. Do not apply adhesive in a manner which promotes induced waviness in resilient base.
 - 3.3.15.3. Provide base in longest lengths possible with top and bottom edges installed straight and true. Provide preformed inside and outside corners.
 - 3.3.15.4. Provide resilient bases to walls, partitions, columns and items of Architectural Woodwork.

3.4. SITE QUALITY CONTROL

- 3.4.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.
- 3.4.2. Manufacturer Services:
 - 3.4.2.1. To ensure proprietary materials are used in accordance with manufacturer's instructions, ensure manufacturers and/or suppliers furnishing appropriate directions make regular site visits prior to and during construction.
 - 3.4.2.2. Determine number and frequency of such visits through prior agreement between Consultant, Contractor, Subcontractor, resilient sheet vinyl flooring and adhesive manufacturers.
 - 3.4.2.3. Ensure easy access to site by above representatives at all times.

- 3.4.2.4. Ensure after each visit, manufacturer reports in writing current observations concerning work conditions and progress to Contractor for inclusion into minutes of construction work.
- 3.4.2.5. Following these observations, ensure any condition or work reported as objectionable or in non-conformity to trade standard requirements is rectified or removed and replaced at Subcontractor's sole expense and responsibility.

3.5. CLEANING

- 3.5.1. Remove excess adhesive from floor, base and wall surfaces without damage.
- 3.5.2. Clean flooring and base surface to flooring manufacturer's instructions.

3.6. PROTECTION

- 3.6.1. In laboratories protect installed flooring with minimum 1 layer of kraft paper, joints taped, covered with minimum 3 mm (1/8") thick masonite board, joints taped.
- 3.6.2. Protect installed resilient sheet vinyl flooring as recommended by flooring manufacturer against damage from rolling loads, other trades or placement of fixtures and equipment.
- 3.6.3. Prohibit traffic on floor for 48 hours after installation.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide resilient athletic flooring including but not limited to following:

1.2.1.1. resilient sheet athletic flooring on acoustic sub-floor.

1.2.1.2. adhesive and accessories required for installation and maintenance.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of carpet tiling: Section 09 68 13, Carpet Tile.

1.2.2.2. Provision of acoustic sub-floor: Section 13 48 00, Acoustic Isolated Floating Floors.

1.3. REFERENCES

1.3.1. Reference Standards:

1.3.1.1. ASTM F2772-24 - Standard Specification for Athletic Performance Properties of Indoor Sports Floor Systems

1.4. ADMINISTRATIVE REQUIREMENTS

1.4.1. Preinstallation Meetings: Arrange preinstallation meeting 1 week before commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.5. SUBMITTALS

1.5.1. Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00.

1.5.2. Samples: Submit samples in accordance with Section 01 30 00. Submit following samples in sizes indicated:

1.5.2.1. resilient sheet rubber impact flooring 300 mm (12") square.

1.5.2.2. resilient base 300 mm (12") long.

1.5.2.3. reducing strips 300 mm (12") long.

1.6. CLOSEOUT SUBMITTALS

1.6.1. Operational and Maintenance Data: Submit 3 copies of Product maintenance manual to Consultant prior to completion of the Work. Ensure manual contains specific maintenance recommendations and gives specific warning of any maintenance practice or materials which may damage or disfigure resilient sheet rubber impact flooring and bases.

1.7. MAINTENANCE MATERIAL SUBMITTALS

- 1.7.1. Extra Stock Materials: Leave approximately 2% of each type of resilient sheet athletic flooring specified for Owner's future maintenance use. Supply resilient sheet athletic flooring from same production run as installed resilient sheet athletic flooring.

1.8. QUALITY ASSURANCE

- 1.8.1. Qualifications:
- 1.8.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
- 1.8.2. Mock-Ups: Construct minimum 10 m² (100 sq ft) mock-up sample at Project location designated by Consultant for review. Once reviewed and no objections recorded, sample remains part of finished work and used as a quality reference standard for balance of Project.

1.9. DELIVERY, STORAGE AND HANDLING

- 1.9.1. Delivery and Acceptance Requirements: Deliver materials undamaged in original wrappings or containers, with manufacturer's labels and seals intact.
- 1.9.2. Storage and Handling Requirements:
- 1.9.2.1. Store materials undamaged in original wrappings or containers, with manufacturer's labels and seals intact. Store materials in a warm, dry area.
- 1.9.2.2. Prevent damage to materials during handling and storage. Do not stack material, nor in excess of allowable floor loading. Store materials on smooth surfaces only, in an area designated by Consultant.

1.10. SITE CONDITIONS

- 1.10.1. Ambient Conditions:
- 1.10.1.1. Maintain appropriate environmental conditions and protect work during and after installation. Comply with trade standards and manufacturer's Product instructions. Follow Product instructions concerning safety, health and other related precautionary and environmental protection. Comply with applicable federal, provincial, local and statutory regulations.
- 1.10.1.2. Close doors and windows. Turn off radiant floor heating systems and protect work area from direct draft, sun and heat exposure during installation and for at least 72 hours after completion.
- 1.10.1.3. When necessary, build a temporary shelter and use indirect auxiliary heaters to maintain an adequate temperature level in work environment.
- 1.10.1.4. Exhaust temporary heaters to building exterior to prevent health hazards and damage to work from toxic fumes and emanations.
- 1.10.1.5. Maintain temperature of floor covering areas at not less than 16 deg C (60 deg F) or more than 30 deg C (86 deg F) 48 hours before, during installation and for 48 hours after application unless otherwise required in Product instructions.

1.11. WARRANTY

- 1.11.1. Manufacturer Warranty: Warrant work of this Section for period of 3 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner. Defects include but are not limited to; buckling, opening of seams, bond failure and extensive colour fading.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
 - 2.1.1.1. Advantage Sport; www.avantagesport.com
- 2.1.2. Substitution Limitations: This Specification is based on Advantage Sport's "Omnisports Multiflex Synthetic Flooring" Product. Comparable Products from other manufacturers not listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

- 2.2.1. Provide Products free from blisters, cracks, chipped edges and corners, embedded foreign matter or other defects.
- 2.2.2. Resilient Sheet Athletic Flooring (RFL-2):
 - 2.2.2.1. ASTM F2772, Class 2; prefabricated resilient athletic flooring, layered with synthetic vinyl, stabilizing agents and pigmentation; permitted Product: "Omnisports MultiFlex" by Advantage Sport with following characteristics:
 - 2.2.2.1.1. Total Thickness: 7 mm (9/32").
 - 2.2.2.1.2. Colour: To be selected later by Consultant.
 - 2.2.2.1.3. Finish: Smooth Texture.
- 2.2.3. Provide adhesive certified by manufacturer.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions:
 - 3.1.1.1. Ensure wood substrate is dry and clean.
 - 3.1.1.2. Apply resilient sheet athletic flooring in respective areas during final stages of building completion when ceilings and permanent partitions are finished, paint prime coats are applied and substrate conditions are suitable.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. PREPARATION

- 3.2.1. Surface Preparation:
 - 3.2.1.1. Clean resilient sheet athletic flooring substrates free of loose and adhered material perfectly clean and in accordance with resilient sheet athletic flooring manufacturer's instructions.
 - 3.2.1.2. Perform bond test over floors where paint, varnish and other foreign agents are removed.
 - 3.2.1.3. Remove subfloor ridges and bumps to flush with adjacent subfloor.

3.3. INSTALLATION

- 3.3.1. Review manufacturer's printed instructions prior to installation.
- 3.3.2. Install resilient sheet athletic flooring in accordance with manufacturer's Installation Instructions.
- 3.3.3. Unroll sheet and allow relaxation.
- 3.3.4. Inspect sheet for any damages or defects.

- 3.3.5. Always install resilient sheet athletic rubber impact flooring in same direction.
- 3.3.6. Cut and adjust flooring prior to installation.
- 3.3.7. All edges must be straight-edged before adjusting seams.
- 3.3.8. Mix adhesive in accordance with manufacturer's instructions.
- 3.3.9. Apply adhesive and lay sheets in accordance with manufacturer's instructions.
- 3.3.10. Roll flooring in both directions with a 45 dg (100 lbs) sectional floor roller.
- 3.3.11. Check for air bubbles and continue rolling if needed.
- 3.3.12. Roll seam with a hand roller and remove any excess adhesive that may have come through the seam.
- 3.3.12.1. Hold seams in place with suitable weights (concrete utility bricks 50 mm x 100 mm x 200 mm (2" x 4" x 8")) for a minimum of 24 hrs.
- 3.3.13. Repeat same procedure for rest of the installation.
- 3.3.14. Terminate resilient sheet athletic flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar, unless indicated otherwise on Drawings.
- 3.3.15. Promptly remove and replace flooring showing bumps from underlying dirt, discolouration, excessive wear, shrinkage or adhesion failure. Remove and replace base showing shrinkage or adhesion failure.

3.4. SITE QUALITY CONTROL

- 3.4.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.5. CLEANING

- 3.5.1. Remove adhesive from surface of flooring as work progresses.
- 3.5.2. Do not mechanically wash newly laid floor covering for minimum 14 Days after installation to allow adhesive to set and dry.

3.6. PROTECTION

- 3.6.1. Protect this work and work of other trades at all times.
- 3.6.2. Protect newly laid flooring from construction traffic for a period of 7 Days to allow flooring to bond firmly. Then thoroughly clean surfaces in accordance to manufacturer's directions using cleaners as recommended by material manufacturer.
- 3.6.3. Provide and maintain necessary protection of finished rubber impact flooring and bases. Replace damaged resilient sheet rubber impact flooring and bases with new materials without cost to Owner.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide carpet tile including but not limited to following:

1.2.1.1. carpet tile.

1.2.1.2. resilient base.

1.2.1.3. metal edge strips.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of resilient sheet flooring: Section 09 65 16, Resilient Sheet Vinyl Flooring.

1.2.2.2. Provision of resilient sheet athletic flooring: Section 09 65 66, Resilient Athletic Flooring.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. ISO: International Organization for Standardization; www.iso.org.

1.3.1.2. ULC: Underwriters Laboratories of Canada; www.canada.ul.com.

1.3.1.3. VOC: Volatile Organic Compound.

1.3.1.4. WHI: Warnock Hersey (Intertek); www.intertek-eltsemko.com.

1.3.2. Reference Standards:

1.3.2.1. ASTM F1861-21(25) - Standard Specification for Resilient Wall Base

1.3.2.2. CAN/ULC-S101-14 - Standard Methods of Fire Endurance Tests of Building Construction and Materials

1.3.2.3. CAN/ULC-S102.2-18 - Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

1.4. SUBMITTALS

1.4.1. Shop Drawings: Submit carpet tile layout drawings in accordance with Section 01 30 00. Do not install carpet tile until layout drawings have been reviewed with no objections recorded.

1.4.2. Samples:

1.4.2.1. Prior to ordering carpet tile, submit samples of carpet tile and accessories to Consultant for review, minimum 450 mm x 450 mm (18" x 18"), for each type and colour of carpet to be used.

1.4.2.2. Consultant may take random samples of carpet tiles as installation progresses for comparison with reviewed samples. If, in opinion of Consultant, such samples fail to meet standard of reviewed samples, remove tiles and replace with permitted tiles as required at no cost to Owner.

1.4.3. Test and Evaluation Reports: Owner may request carpet mill to provide independent testing in accordance with ISO Classification and/or industry accepted standards confirming submitted carpet tile meets performance levels specified herein.

1.5. CLOSEOUT SUBMITTALS

- 1.5.1. Operational and Maintenance Data: Submit maintenance instructions in triplicate for insertion in maintenance manuals in accordance with Section 01 70 00. Ensure instructions give specific warning of maintenance or cleaning practices or materials which may damage carpeting.

1.6. MAINTENANCE MATERIAL SUBMITTALS

- 1.6.1. Extra Stock Materials: Deliver to Consultant and store where directed 3% of each colours selected suitably labelled in boxes. Identify Product name, colour, quantity and locations where used in Project (Room Name and Nos).

1.7. QUALITY ASSURANCE

- 1.7.1. Qualifications:

- 1.7.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

- 1.7.2. Mock-Ups: In area designated by Consultant, provide sample installation of each colour of at least 9 m² (100 sq ft) showing colour matching. Make changes as required until reviewed with no objections recorded. When reviewed with no objections recorded, sample area represents minimum standard for work. Remove sample installation when directed unless sample area can be satisfactorily incorporated into Work.

1.8. DELIVERY, STORAGE AND HANDLING

- 1.8.1. Delivery and Acceptance Requirements: Deliver cartons of carpet tile to site clearly tagged to show installation location.

- 1.8.2. Storage and Handling Requirements:

- 1.8.2.1. Store adhesive, carpet tapes and similar items in heated area maintained at minimum temperature of 10 deg C (50 deg F) or at such temperature as recommended by Product manufacturer.

- 1.8.2.2. Comply with adhesive and carpet tile manufacturer's directions for use of adhesive. Observe open time limits for adhesives and place lids on open cans when not being used. Under no circumstances contaminate or thin adhesives with water or solvents, unless specifically directed by manufacturer in writing.

1.9. SITE CONDITIONS

- 1.9.1. Ambient Conditions: Provide ventilation system in area to be carpeted to ensure adequate (min 1 air change each hour) extraction of VOC's or other contaminants. In occupied buildings, existing ventilation system may not be used for this purpose.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:

- 2.1.1.1. Flexco; www.flexcofloors.com

- 2.1.1.2. Mannington Commercial; www.manningtoncommercial.com

- 2.1.1.3. Patcraft Chroma; www.chroma.patcraft.com

- 2.1.1.4. Roppe Corporation, USA; www.roppe.com

- 2.1.1.5. Schluter Systems (Canada) Inc.; www.schluter.com

2.1.1.6. Tarkett; www.commercial.tarkett.com

2.2. MATERIALS

2.2.1. Carpet Tile (CPT-1): Provide tiles uniform in colour and texture, supplied from same dye batch, conforming to CAN/ULC-S101, having flame spread rating and smoke developed classification tested in accordance with CAN/ULC-S102.2 for floor surface covering and certified by ULC or WHI. Provide "Simplify I0692" by Patcraft, colour: Evaluate 00570 24"x24".

2.2.2. Adhesive: Non-toxic, providing total VOC emission not exceeding 0.5 mg/m²/hr. Vinyl-compatible, quick release adhesive recommended by carpet manufacturer.

2.2.3. Resilient Base (B2): 9.5 mm (3/8") thick x 64 mm (2-1/2") high in accordance with ASTM F1861, Type TP, Group 1, Style A, PVC-free vulcanized rubber, in coil lengths, colour selected from manufacturer's standard range. Provide "Wallflowers® Rubber Wall Base" by Flexco, "BurkeBase Premium TS Molded Wall Base" by Mannington Commercial, "Pinnacle Rubber Wall Base" by Roppe Corporation, USA or "Johnsonite Baseworks® Thermoset Rubber Wall Base - Mandalay" by Tarkett.

2.2.4. Tools: Paint roller and tray, seam roller, steel measuring tape, chalk line (use white chalk) and carpet knife.

2.2.5. Edge-Protection and Transition Profiles for Floors:

2.2.5.1. Type TH2: Provide sloped-shaped profile with minimum 13 mm (1/2") wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg and integrated grout joint spacer. Material and Finish: E - Stainless Steel Type 304 = V2A. Height as required. Permitted Product: "Schluter®-RENO-U" by Schluter Systems (Canada) Inc.

2.2.5.2. Type TH3: Provide T-shaped profile with 25 mm (1") wide top section and 9 mm (11/32") vertical section that wedges between flooring types. Material and Finish: E - Stainless Steel Type 304 = V2A. Height as required. Permitted Product: "Schluter®-RENO-T" by Schluter Systems (Canada) Inc.

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.

3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. PREPARATION

3.2.1. Surface Preparation:

3.2.1.1. Ensure floor is clean and free of cracks and protrusions. Remove dirt, paint, debris, grease, oil and loose toppings or finishes.

3.2.1.2. Fill gaps or cracks more than 1.5 mm (1/16") wide and minor depressions with Latex compound. Grind protrusions smooth.

3.2.1.3. Vacuum clean floors prior to installation.

3.3. INSTALLATION

3.3.1. Commencement of Work: Refer to Drawings and Room Finish Schedule for areas where carpet tile is to be installed. Install work of this Section after all trades have completed their work and just prior to completion of work, unless otherwise instructed by Consultant.

- 3.3.2. Measuring: Determine centre of room using standard tile-laying methods. Resulting quadrants should meet at right angles. Offsetting centre chalk line may become necessary to insure perimeter tiles will be at least half-size or larger.
- 3.3.3. Laying Out: To prevent movement of tiles during initial stages and to insure straight lines and square corners, create an anchor line by laying strips of adhesive alongside each centre chalk line. Lay tiles accurately and firmly along centre lines in selected quadrant. Additional tiles within quadrant should be installed by "stair-step" technique. In some cases, due to partitions, "starting" point is centre of the room. Install carpet tiles up to partitions, not under partitions.
- 3.3.4. Checking Tightness: Measure areas to insure tight installation. Measure over 11 tiles to attain cumulative space "gained" over 10 joints. Gain must not be greater than 6 mm (1/4"). Utilize this method in continual check of installation.
- 3.3.5. Alignment: As tiles are butted against each other, frequently check at joints with your fingers to see they are properly aligned. Do not install tiles that seem out of true more than 0.8 mm (1/32").
- 3.3.6. Control Grid: To prevent tiles from shifting in larger areas, about every 6 m (20') to 9 m (30') both in length and width directions, anchor row of tiles. Use texturing paint roller to apply narrow strip of adhesive under "control" tiles.
- 3.3.7. Joints: Take care when butting 1 tile against another. Avoid too much pressure on joining tiles, as it will cause tiles to "peak" or "buckle". Face pile should be brushed back and tile "tipped" into place, to avoid any pile being caught in joint.
- 3.3.8. Perimeter Tiles: Adhere to floor unless noted on Drawings. Lay last whole tile closest to wall and perimeter cuts on adhesive. Perimeter cuts must then be accurately cut and tightly fitted against vertical fixed surface such as wall. In event of an open perimeter design, a fixed reducer strip anchored to floor is necessary to lock tile area in place.
- 3.3.9. Cutting: Cuts are best made from back, whether using template for fitting around columns or at room perimeter. Activation of electrical floor outlets will follow carpet installation. Affected tiles must be surface-marked with tape.
- 3.3.10. Trimming and Gluing: Whenever tile is cut or trimmed, it must always be adhered to floor.
- 3.3.11. Resilient Base:
- 3.3.11.1. Provide resilient base to substrate surfaces in accordance with manufacturer's recommendations.
- 3.3.11.2. Apply adhesive evenly and continuously for full base adhesion and contact. Do not apply adhesive in a manner which promotes induced waviness in resilient base.
- 3.3.11.3. Provide base in longest lengths possible with top and bottom edges installed straight and true. Provide preformed inside and outside corners.
- 3.3.11.4. Provide resilient bases to walls, partitions, columns and items of Architectural Woodwork.

3.4. SITE QUALITY CONTROL

- 3.4.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.5. CLEANING

- 3.5.1. Immediately following installation, inspection and review of work by Consultant, vacuum clean carpet using pile lifter and remove debris.

3.6. PROTECTION

- 3.6.1. Restriction of Traffic: Restrict traffic during installation. Upon completion of installation, do not allow traffic or movement of furniture onto carpet surface until installed area has been anchored at perimeter.

- 3.6.2. Cover entire carpeted area with plastic covering held in place by masking tape at seams and stay-tacking around perimeter, if required by Consultant.
- 3.6.3. Do not remove carpet protection until directed by Consultant.
- 3.6.4. Hand over work to Owner free of blemishes and in perfect condition.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide fixed sound-absorptive panels including but not limited to following:

1.2.1.1. cementitious wood fibre plank acoustical wall panels.

1.2.1.2. cementitious wood fibre plank acoustical ceiling panels.

1.2.1.3. framework mounting extrusions.

1.2.1.4. fasteners.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of gypsum board assemblies: Section 09 21 16, Gypsum Board Assemblies.

1.2.2.2. Provision of acoustical ceiling systems: Section 09 51 13, Acoustical Panel Ceilings.

1.2.2.3. Provision of finish painting: Section 09 91 00, Painting.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. CISCA: Ceilings & Interior Systems Construction Association; www.cisca.org.

1.3.1.2. HVAC: Heating, Ventilating and Air Conditioning.

1.3.1.3. NRC: Noise Reduction Coefficient.

1.3.2. Reference Standards:

1.3.2.1. ASTM E84-25 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.4. ADMINISTRATIVE REQUIREMENTS

1.4.1. Preinstallation Meetings: Arrange preinstallation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.4.2. Scheduling: Schedule installation of fixed sound-absorptive panels as late as possible in sequence of construction schedule to reduce damage and as follows:

1.4.2.1. Do not install fixed sound-absorptive panels until space is enclosed, weather tight and conditioned.

1.4.2.2. Do not install prior to completion of abutting grid ceiling installation.

1.4.2.3. Ensure no wet work remains with exception of touch-up.

1.5. SUBMITTALS

- 1.5.1. Product Data: Submit manufacturer's literature describing system to be provided.
- 1.5.2. Shop Drawings:
 - 1.5.2.1. Submit Shop Drawings showing general layout, jointing, anchoring sizes and types, shapes, thickness and other similar detailed information necessary to fully describe installation.
 - 1.5.2.2. Ensure elevations indicate arrangement of joints. Clearly indicate locations of seams, methods of joining seams, direction of panels and notations occur.
 - 1.5.2.3. Ensure Shop Drawings include key plans, elevations, plan sections and details.
- 1.5.3. Samples: Submit samples in accordance with Section 01 30 00. Submit following samples in sizes indicated:
 - 1.5.3.1. Submit 300 mm (12") long samples of suspension system parts, including trim.
 - 1.5.3.2. Submit 300 mm x 300 mm (12" x 12") samples of fixed sound-absorptive panels showing full range of exposed texture expected on completed work.
- 1.5.4. Certificates:
 - 1.5.4.1. Provide certification from manufacturer of fixed sound-absorptive panels attesting to their Product's compliance with specified requirements including mandatory fire performance characteristics under ASTM E84.
 - 1.5.4.2. Provide certification stating technicians utilized for installation have been trained or qualified by manufacturer.
- 1.5.5. Test and Evaluation Reports: Submit complete test reports for fixed sound-absorptive panels prepared by an independent testing laboratory IAS Certified indicating full compliance with both acoustical and fire resistance performance requirements under ASTM E84 and as follows:
 - 1.5.5.1. Ensure systems are certified under ASTM E84 and Class is compliant with placement in building as follows:
 - 1.5.5.1.1. Class A - Flame Spread Index (0-25).
 - 1.5.5.1.2. Smoke Developed Index (0-450) for all Classes A, B or C.
- 1.5.6. Manufacturers' Instructions: Submit manufacturer's summary of installation procedures which will be basis for reviewing or rejecting actual installation procedures.

1.6. MAINTENANCE MATERIAL SUBMITTALS

- 1.6.1. Extra Stock Materials: Leave manufacturer's recommended percentage of each type of panel specified for Owner's future maintenance use. Supply panels from same production run as installed panels.

1.7. QUALITY ASSURANCE

- 1.7.1. Qualifications:
 - 1.7.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
- 1.7.2. Mock-Ups: Construct minimum 10 m² (100 sq ft) mock-up sample at Project location designated by Consultant for review. Once reviewed with no objections recorded, sample remains part of finished work and used as a quality reference standard for balance of Project.

1.8. DELIVERY, STORAGE AND HANDLING

1.8.1. Delivery and Acceptance Requirements:

- 1.8.1.1. Deliver materials in manufacturer's original unopened packaging.
- 1.8.1.2. Remove carton type wrappings and inter-leavings that are wet.
- 1.8.1.3. Unwrap and inspect panels upon arrival for flaws and defects. Notify Consultant at least 24 hours in advance of inspection.
- 1.8.1.4. Reject panels that are flawed by poor colour match with goods specified, water damage or other unsatisfactory conditions.

1.8.2. Storage and Handling Requirements:

- 1.8.2.1. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.
- 1.8.2.2. Prevent soiling, physical damage or wetting.
- 1.8.2.3. Store cartons open at each end to stabilize moisture content and temperature.

1.9. SITE CONDITIONS

1.9.1. Ambient Conditions:

- 1.9.1.1. Do not install acoustical panels until building is closed in and HVAC system is operational.
- 1.9.1.2. Locate materials onsite at least 24 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.
- 1.9.1.3. Maintain following conditions in areas where acoustical materials are to be installed 24 hours before, during and after installation:
 - 1.9.1.3.1. Relative Humidity: 65 - 75%.
 - 1.9.1.3.2. Uniform Temperature: 13 deg C - 21 deg C (55 deg F - 70 deg F).

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
 - 2.1.1.1. Tectum Inc.; www.tectum.com
- 2.1.2. Substitution Limitations: Comparable Products from other manufacturers not listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

2.2.1. Performance/Design Criteria:

- 2.2.1.1. Provide fixed sound-absorptive panel assembly designed and tested to provide surface burning characteristics in accordance with ASTM E84 as follows:
 - 2.2.1.1.1. Flamespread: 5.
 - 2.2.1.1.2. Smoke Developed: 15.
- 2.2.1.2. Provide fixed sound-absorptive panel system which has been manufactured, fabricated and installed to provide a sufficient NRC rating.

- 2.2.2. Fixed Sound-Absorptive Panel System (AWP-1): Provide following panels:
 - 2.2.2.1. Tectum Finalé Panels:
 - 2.2.2.1.1. Material: Aspen wood fibers bonded with inorganic hydraulic cement.
 - 2.2.2.1.2. Thickness: 38 mm (1-1/2") + 22 mm (7/8") Tectum furring with SoniCor fiber core between furring.
 - 2.2.2.1.3. Edge: Long edges beveled.
 - 2.2.2.1.4. Width: 603 mm (23-3/4").
 - 2.2.2.1.5. Length: 1220 mm (48").
 - 2.2.2.1.6. Colour: Natural.
 - 2.2.2.1.7. Mounting Style: "C-40". Provide fasteners, furring strips and OCF 703 fibreglass insulation for a complete single source installation.
 - 2.2.3. Fixed Sound-Absorptive Panel System (ACP-1): Provide following panels:
 - 2.2.3.1. Tectum Finalé Panels:
 - 2.2.3.1.1. Material: Aspen wood fibers bonded with inorganic hydraulic cement.
 - 2.2.3.1.2. Thickness: 38 mm (1-1/2") + 22 mm (7/8") Tectum furring with SoniCor fiber core between furring.
 - 2.2.3.1.3. Edge: Long edges beveled.
 - 2.2.3.1.4. Width: 603 mm (23-3/4").
 - 2.2.3.1.5. Length: 1220 mm (48").
 - 2.2.3.1.6. Colour: White.
 - 2.2.3.1.7. Mounting Style: "C-40". Provide fasteners, furring strips and OCF 703 fibreglass insulation for a complete single source installation.
 - 2.2.4. Painted Head Drywall Screws:
 - 2.2.4.1. Material: Steel.
 - 2.2.4.2. Length: As required.
 - 2.2.4.3. Colour: To match panel colour.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Comply with instructions and recommendations of sound-absorptive panel system manufacturer.
- 3.2.2. Install materials in accordance with governing regulations, fire resistance rating requirements and industry standards applicable to work including CISCA's "Custom Acoustical Glass Fiber Wall & Ceiling Panels".
- 3.2.3. Ensure screw head is flush with panel surface.

- 3.2.4. Securely affix sound-absorptive panels by means of splines attached vertically to smooth wall or furring strips. Engage vertical kerfs on the edges of the wall panels with splines. Apply adhesive or use Velcro hook and loop fastening where necessary.
- 3.2.5. Cover field cut edges by means of trim or other mouldings.
- 3.2.6. Site Tolerances:
 - 3.2.6.1. Maximum variation of panels from true location is +/-3 mm (+/-1/8").
 - 3.2.6.2. Maximum variation of surfaces intended to be flush is +/-1.6 mm (+/-1/16").
 - 3.2.6.3. Maximum variation of reveal width is +/-1.6 mm (+/-1/16").

3.3. SITE QUALITY CONTROL

- 3.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.4. CLEANING

- 3.4.1. Clean exposed surfaces of sound-absorptive panel, trim, mouldings and suspension members complying with manufacturer's instructions for cleaning.
- 3.4.2. Touch up any minor finish damage.
- 3.4.3. Remove surplus materials, rubbish and debris, leaving area in a neat and clean condition.

3.5. PROTECTION

- 3.5.1. Protect installed work from damage due to subsequent construction activity, including temperature and humidity limitations and dust control, so work will be without damage and deterioration at time of acceptance by Owner.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

- 1.1.1. Read and conform to:
 - 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
 - 1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

- 1.2.1. Section Includes: Provide painting including but not limited to following:
 - 1.2.1.1. surface preparation of substrate: abrasive blasting, cleaning and preparation of surfaces for application of paint systems.
 - 1.2.1.2. interior priming and painting of:
 - 1.2.1.2.1. exposed building surfaces indicated on Room Finish Schedule or on Drawings.
 - 1.2.1.2.2. hollow metal doors, frames and transom panels.
 - 1.2.1.2.3. edges of plastic laminated wood doors and trim of lites in same doors.
 - 1.2.1.2.4. borrowed lite frames.
 - 1.2.1.2.5. exposed miscellaneous metal and steel items for work of other trades, including hangers, screws, supports, etc.
 - 1.2.1.2.6. gypsum board walls, ceilings, bulkheads and other enclosures.
 - 1.2.1.2.7. wood fitments unless plastic laminated as noted.
 - 1.2.1.2.8. conduit, piping, ductwork, light panels, etc. exposed to view in areas listed in Room Finish Schedule or on Drawings.
 - 1.2.1.2.9. natural gas piping.
 - 1.2.1.2.10. shop primed materials of other Sections.
 - 1.2.1.2.11. exposed surfaces of open ceilings including, structure, ducts, mechanical and electrical items, hangers, screws, miscellaneous metals, etc.
 - 1.2.1.2.12. pipes, conduits, ducts and thermal insulation covers on ducts in rooms where walls and/or exposed ceilings are painted except mechanical/ electrical plant rooms.
 - 1.2.1.3. provision of materials, labour and equipment required to complete painting work and ancillary work described and implied herein to full intent of Drawings and Schedules.
 - 1.2.1.4. waste management and disposal of paint, stain and wood preservatives and other related hazardous materials.
- 1.2.2. Section Excludes: Painting of:
 - 1.2.2.1. chrome, stainless steel, vinyl, plastic laminate and aluminum surfaces throughout unless specified otherwise.
 - 1.2.2.2. wallcoverings unless otherwise noted.
 - 1.2.2.3. primed and finish painted equipment supplied by manufacturer unless required to be field painted in 1 common corporate colour as identified in Room Finish Schedule or on Drawings.
 - 1.2.2.4. areas indicated as "unfinished" or "exposed" on Room Finish Schedule or on Drawings.
 - 1.2.2.5. sealers over concrete.
 - 1.2.2.6. shop priming of steel including structural steel, joists and steel decking, metal fabrications and custom metal work.

- 1.2.2.7. shop priming and finishing of finish woodwork.
- 1.2.2.8. electrostatic painting (powder coating).
- 1.2.2.9. fluoropolymer thermal setting enamels or other organic coatings.
- 1.2.3. Related Sections: Following description of work is included for reference only and shall not be presumed complete:
 - 1.2.3.1. Surface preparation and shop priming of miscellaneous metal work: Section 05 50 00, Metal Fabrications.
 - 1.2.3.2. Wood preservative or fire retardant treatment for rough carpentry: Section 06 10 00, Rough Carpentry.
 - 1.2.3.3. Shop priming of steel doors, frames and screens: Section 08 11 13, Hollow Metal Doors and Frames.
 - 1.2.3.4. Coordination of paint for application on suspended acoustic ceilings: Section 09 51 13, Acoustical Panel Ceilings.
 - 1.2.3.5. Instructions on painting, stenciling and banding of mechanical and electrical work: Division 20, Mechanical General Requirements, Division 22, Plumbing, Division 23, Heating, Ventilating and Air Conditioning and Division 26, Electrical.
 - 1.2.3.6. Prime and finish coats applied by other Sections. Read carefully other Sections of Specifications to determine extent thereof.

1.3. REFERENCES

- 1.3.1. Abbreviations and Acronyms:
 - 1.3.1.1. DFT: Dry Film Thickness.
 - 1.3.1.2. MPI: The Master Painters Institute; www.mpi.net.
 - 1.3.1.3. OPCA: Ontario Painting Contractors Association; www.ontariopainting.contractors.
 - 1.3.1.4. PCA: Painting Contractors of America; www.pcaped.org.
 - 1.3.1.5. SDS: Safety Data Sheets.
 - 1.3.1.6. SSPC: The Society for Protective Coatings (formerly known as Steel Structures Painting Council); www.sspc.org.
 - 1.3.1.7. TSP: Tri-sodium Phosphate.
 - 1.3.1.8. VOC: Volatile Organic Compound.
- 1.3.2. Definitions:
 - 1.3.2.1. Exposed: Visible in completed work. In case of closets, cabinets and drawers, it includes their interiors. Exposed surfaces in underground parking areas are considered "Exterior" for purpose of this Specification. Exposed surfaces in aboveground parking areas are considered "Interior" for the purpose of this Specification.
 - 1.3.2.2. Gloss or Sheen: Capacity of a finish on a surface to reflect light at specific angles as tested in accordance with ASTM D523.
 - 1.3.2.3. Hazardous Waste: Construction and demolition materials that are regulated for disposal by local, city, county, province or federal authorities having jurisdiction.
 - 1.3.2.4. Painting: In this Section refers to application of various types of paint, stain, varnishes and lacquers, etc.

- 1.3.2.5. Surface Preparation: Cleaning or treating of surface to be painted to ensure best possible bond between surface and painting to be applied to surface; remove surface contaminants that will affect performance of painting, without limitations such as oil, grease, salts, dust, dirt, rust, rust scale, mill scale and old coatings where applicable; remove surface imperfections without limitation including but not limited to such as weld spatter, sharp edges, burrs, slivers, laminations, pits, porosities and crevices; prepare surfaces to provide anchor profile or surface profile which improve mechanical bonding of coating to prepared surface by increasing surface area.
- 1.3.3. Reference Standards:
- 1.3.3.1. ASTM D523-25 - Standard Test Method for Specular Gloss
- 1.3.3.2. MPI Approved - The Master Painters Institute – Approved Products List October 2024
- 1.3.3.3. SSPC-SP 1-16 - Solvent Cleaning
- 1.3.3.4. SSPC-SP 2-18 - Hand Tool Cleaning
- 1.3.3.5. SSPC-SP 3-18 - Power Tool Cleaning
- 1.3.3.6. SSPC SP-6/NACE No. 3-06 - Commercial Blast Cleaning

1.4. ADMINISTRATIVE REQUIREMENTS

- 1.4.1. Preinstallation Meetings:
- 1.4.1.1. Review Drawings, details and Schedules, determine intent, extent, materials, types of surfaces, locations and be fully cognizant of intent of Work. Review Product literature, SDS, related safety data, proper disposal requirements and inform those involved in work of this Section.
- 1.4.1.2. Review Specifications and Drawings for work of other Sections regarding provisions for prime and finish coats and ensure compatibility with each other and substrate prior to application.
- 1.4.1.3. Prior to start of work, arrange for Project site meeting of parties associated with Work of this Section. Presided over by Contractor, include Consultant, Subcontractor, manufacturer's representative, any sub-trades whose work will be painted (including Mechanical and Electrical trades) or whose work is adjacent to, or whose work or schedule may be affected by work of this Section.
- 1.4.1.4. Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas requiring painting and other matters affecting construction, to permit compliance with intent of this Section.
- 1.4.2. Scheduling: Schedule painting operations to prevent disruption of and by other trades. Ensure painting is completed for locations requiring application of finishes by other trades in a timely fashion to prevent delays.

1.5. SUBMITTALS

- 1.5.1. Product Data:
- 1.5.1.1. Submit Product data conforming to Section 01 70 00 and submit a Schedule of Finishes listing manufacturer's Product name, colour, textures, SDS and test reports requested for each paint system. Submit test reports for odourless, low or zero VOC Products when specified.
- 1.5.1.2. Painting Subcontractor to receive written confirmation of specific surface preparation procedures and primers used for fabricated steel items from fabricator/supplier to ensure appropriate and manufacturer compatible finish coat materials prior to commencement of painting.

- 1.5.2. Samples: Submit samples 30 Days before materials are required in accordance with Section 01 30 00. Submit following samples in sizes indicated:
- 1.5.2.1. 3 copies of brushouts minimum 200 mm x 250 mm (8" x 10") of each finish including colour, sheen and texture required at least 20 Days prior to commencement of application. Identify each sample with job, finish, colour name, number, sheen and gloss values, substrate to be applied to, date and name of Subcontractor.
- | | Substrate | Sample, Base Material |
|------------|------------------|------------------------------|
| 1.5.2.1.1. | Gypsum Board | Face of typical unit |
| 1.5.2.1.2. | Metal | Steel Plate |
| 1.5.2.1.3. | Woodwork | Wood |
- 1.5.2.2. sample panels of stain, varnish, lacquer or other wood finish on each species of wood specified, minimum 300 mm (12") square and of specified thickness.
- 1.5.3. Certificates: Surface Preparation: Submit manufacturer's representative's written approval of surface preparation methods and any specific recommendations for alternative methods.
- 1.5.4. Site Quality Control Submittals:
- 1.5.4.1. Submit site instruction reports in accordance with Section 01 30 00 containing information required by this Section.
- 1.5.4.2. Progress Reports: Submit in accordance with Section 01 30 00. Arrange to have paint manufacturer's representative inspect work of this Section on a regular basis and prepare weekly job progress reports. Submit copy of reports to Consultant.

1.6. CLOSEOUT SUBMITTALS

- 1.6.1. Operation and Maintenance Data: Upon completion of Project, submit a coating maintenance manual. Ensure manual includes an 'Area Summary' with finish schedule, 'Area Detail' designating where each Product/colour/finish was used, Product data pages, SDS, care and cleaning instructions, touch-up procedures and colour samples of each colour and finish used.

1.7. MAINTENANCE MATERIAL SUBMITTALS

- 1.7.1. Extra Stock Materials: Submit to Owner 3% but not less than 1 - 4 ℓ (1 gal) can of each different type and colour and degree of gloss of paint used (batch mix) on this Project for touch-ups. Ensure paint is boxed and in sealed, unopened cans in undamaged condition, with name of manufacturer, contents, type and colour clearly indicated on a label securely adhered to can. Give to Consultant at time of final inspection.

1.8. QUALITY ASSURANCE

- 1.8.1. Qualifications:
- 1.8.1.1. Applicators:
- 1.8.1.1.1. Execute work of this Section by a firm which has adequate plant, equipment and skilled workers to perform work expeditiously and which is known to have been responsible, during immediate past 5 years, for installations similar to work contained herein. Ensure firm is fully conversant with applicable laws, bylaws, codes, fire, health and safety regulations and other regulations which govern.
- 1.8.1.1.2. Provide work of this Section executed by competent applicators with membership in good standing in OPCA and/or PCA and have a minimum of 5 years' experience in application of Products, systems, coatings and assemblies specified and with approval and training of Product manufacturers.
- 1.8.1.1.3. Ensure materials, preparation and workmanship conforms to requirements of MPI's "Architectural Painting Specification Manual".

- 1.8.2. Certifications: Ensure paint manufacturers and Products used are listed under MPI's Approved Product List.
- 1.8.3. Mock-Ups:
 - 1.8.3.1. Provide mock-up at location established by Consultant, complete with required lighting. Mock-up to establish standard of workmanship, texture, gloss and coverage.
 - 1.8.3.2. Apply minimum 300 mm x 300 mm (12" x 12"), or where required, full size mock-up of each finish on each type of surface to be coated with correct material, number of coats, colour, texture and degree of gloss required.
 - 1.8.3.3. Provide additional mock-ups of each finish in modified colour, texture or degree of gloss when required, to obtain no objections.
 - 1.8.3.4. Prepare surfaces and apply treatment to galvanized or other components as required for Consultant's review. Do no painting until mock-ups have been reviewed with no objections recorded.
 - 1.8.3.5. Reviewed mock-up to become standard of comparison for painting work on site. Correct and refinish work which does not compare with reviewed finishes at no expense to Owner.
 - 1.8.3.6. Reviewed full size mock-up may become integral part of finished work if permitted by Consultant.

1.9. DELIVERY, STORAGE AND HANDLING

- 1.9.1. Delivery and Acceptance Requirements:
 - 1.9.1.1. Deliver to site, materials manufacturer's original, sealed and labeled containers bearing manufacturer's name, brand name, type of paint or coating and colour designation, degree of gloss, batch number, standard compliance, materials content as well as mixing, reducing and application requirements.
 - 1.9.1.2. Manufacturer to certify, materials delivered to site conform to approved list.
- 1.9.2. Storage and Handling Requirements:
 - 1.9.2.1. Store on site, materials in manufacturer's sealed and labeled containers.
 - 1.9.2.2. Comply with applicable local fire and building code requirements during storage and application.
 - 1.9.2.3. Store containers of paint, thinner and other volatile materials in secure, well ventilated location, heated to minimum 10 deg C (50 deg F), where they will not be exposed to excessive heat or direct solar radiation. Keep tightly closed when not in actual use.
 - 1.9.2.4. Presence of any unauthorized materials or containers on site is sufficient cause for rejection of paint materials on site at that time.
 - 1.9.2.5. Protect floor and wall surfaces in storage areas from paint drips and splatters.
 - 1.9.2.6. Be totally responsible for prevention of fire or explosion caused by improper storage of paints, solvents, rags and similar items. Store fire hazardous materials in location and in manner approved by local fire authority. Post "No Smoking" signs in areas of storage and mixing and strictly enforce this requirement. Provide and maintain CO₂ fire extinguishers of minimum 9 kg (20 lb) capacity. Repair damage to storage area or surrounding area at no cost to Owner.
 - 1.9.2.7. Where toxic, volatile, explosive, flammable materials are used, provide adequate fireproof storage lockers and take necessary precautions and post adequate warnings (eg "No Smoking" signs) as required.

1.10. SITE CONDITIONS

- 1.10.1. Ambient Conditions:
 - 1.10.1.1. Paint and finish in clean, dust-free, properly ventilated and adequately lit areas minimum 323 Lx (30 ft candles) on surfaces to be painted or decorated.

- 1.10.1.2. Provide each paint materials in accordance with manufacturer's recommended tolerances for:
- 1.10.1.2.1. Substrate Moisture Content: Perform tests with a properly calibrated electronic moisture meter to ensure compliance with manufacturer's recommendations. Without limitation, maximum moisture content as follows:
 - 1.10.1.2.1.1. Gypsum Based Board and Plaster: Maximum 12 - 14%.
 - 1.10.1.2.1.2. Wood: Maximum 15%.
- 1.10.1.3. Temperature and Ventilation:
 - 1.10.1.3.1. Do not provide paint under ambient and surface temperatures less those required below in any instance for 24 hours before, during and 7 Days after installation.
 - 1.10.1.3.2. Provide ventilation to remove odours, evaporating solvents and moisture. Maintain adequate ventilation at all times to control excessive humidity.
 - 1.10.1.3.3. Interior Paint:
 - 1.10.1.3.3.1. Water Based Paints: Maintain minimum interior surface and ambient air temperature of between 18 deg C (65 deg F) and 32 deg C (90 deg F) during application and drying of paint and maintain until building occupancy occurs.
 - 1.10.1.3.3.2. Do not undertake interior painting on surfaces where condensation has or will form due to presence of high humidity and lack of proper ventilation.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
 - 2.1.1.1. Benjamin-Moore & Co., Limited; www.benjaminmoore.com
 - 2.1.1.2. Dulux Paints; www.dulux.ca
 - 2.1.1.3. Para Paints; www.para.com
 - 2.1.1.4. Pittsburgh Paints; www.pittsburghpaints.com
 - 2.1.1.5. The Sherwin-Williams Company; www.sherwin-williams.com
- 2.1.2. Substitution Limitations: Comparable Products from other manufacturers not listed herein may be reviewed provided they meet requirements of "MPI's Approved Products List" and this Specification.
- 2.1.3. Source Limitations: Provide primers for each coating system from same manufacturer as finish coats.

2.2. MATERIALS

- 2.2.1. Description:
 - 2.2.1.1. Regulatory Requirements:
 - 2.2.1.1.1. Conform to latest edition of Industrial Health and Safety Regulations issued by applicable authorities having jurisdiction in regard to site safety (ladders, scaffolding, ventilation, etc.).
 - 2.2.1.1.2. Comply with more stringent of applicable laws, bylaws, codes, fire regulations, health and safety regulations of authorities having jurisdiction or requirements of this Specification. Ensure standards used for work of this Section are considered a minimum.
 - 2.2.1.1.3. Where required, ensure paints and coatings meet flame spread and smoke developed ratings designated by local code requirements and/or authorities having jurisdiction.
 - 2.2.1.1.4. Comply with toxic trace limitations stipulated by authorities having jurisdiction.

- 2.2.1.1.5. Conform to requirements of local authorities having jurisdiction in regard to storage, mixing, application and disposal of paint and related waste materials.
- 2.2.2. Performance/Design Criteria:
 - 2.2.2.1. Provide best practices specified or recommended in MPI's "Architectural Painting Specification Manual".
 - 2.2.2.2. Consultant reserves right to refuse any paint or finishing material if in its opinion it is not suitable or adequate for proposed use.
 - 2.2.2.3. Paint material containers not displaying manufacturer's Product identification will not be permitted. Ensure paint is not diluted.
 - 2.2.2.4. Use brand of paint chosen throughout work of this Section, except where specified otherwise. As far as practical, factory mix paint for immediate application without thinning or alteration at site.
 - 2.2.2.5. Provide primers in recommended DFT/coat.
 - 2.2.2.6. Only materials (primers, paints, coatings, varnishes, stains, lacquers, etc.) listed in MPI Approved Product List are permitted for use on this Project.
 - 2.2.2.7. Provide other materials such as linseed oil, shellac, thinners, solvents, etc. of highest quality Product of an MPI listed manufacturer and be compatible with paint materials being used as required.
 - 2.2.2.8. Ensure materials used are lead and mercury free and have low VOC content where possible.
 - 2.2.2.9. Provide paint materials with good flowing and brushing properties and dry or cure free of blemishes, sags, air entrapment, etc.
 - 2.2.2.10. Paint materials which from time to time will become hot, such as convector covers and similar item, a paint type approved by paint manufacturer for particular condition.
 - 2.2.2.11. EPFL-1: Epoxy Floor Coating, broadcast system, silica sand filled 100% epoxy binder, minimum 3mm thick, with one coat of 100% solid chemical free resistant epoxy topcoat. Colour NCS S 1000N (Light Grey) to match existing.
- 2.2.3. Finishes:
 - 2.2.3.1. Colours:
 - 2.2.3.1.1. PT-1A: Benjamin-Moore, OC-17, eggshell finish.
 - 2.2.3.1.2. PT-1B: Benjamin-Moore, OC-17, matte finish.
 - 2.2.3.1.3. PT-2: Beige P5223-44, eggshell finish.
 - 2.2.3.1.4. PT-3: Dry-fall paint, Benjamin-Moore, OC-17, matte finish.
 - 2.2.3.1.5. PT-4: DLX10006-7, Stone's Throw, eggshell finish.
 - 2.2.3.1.6. PT-5: SW9176 Dress Blues, eggshell finish.
 - 2.2.3.1.7. PT-6: SW9149 Inky Blue, eggshell finish.
 - 2.2.3.1.8. PT-7: Epoxy for concrete floor, colour and finish to match existing red area of refuge.
 - 2.2.3.1.9. PT-8: Allow for accent colour.
 - 2.2.3.1.10. PT-9: Allow for accent colour.
 - 2.2.3.2. Gloss Values:
 - 2.2.3.2.1. Walls: Satin (G4) or Semi-gloss (G5)
 - 2.2.3.2.2. Ceilings: Flat or Matte (G1)
 - 2.2.3.2.3. Trim and Doors: Semi-gloss (G5) or Gloss (G6)

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions:
- 3.1.1.1. Do work only when surfaces and conditions are satisfactory for production of quality work. Report to Consultant in writing any surfaces which are found to be unsatisfactory.
- 3.1.1.2. Ensure surfaces are dry and free of dirt, grease or other contaminants that may affect applied finish.
- 3.1.1.3. Verify moisture content of surfaces with electronic moisture meter. Do not proceed without written directions if moisture reading is higher than as required for application. Refer to "Ambient Conditions" article specified herein for substrate moisture content requirements.
- 3.1.1.4. If substrate is steel, do not apply coatings over moisture or when surface temperature is within 3 deg C (5 deg F) of dew point.
- 3.1.1.5. If substrate is wood, do not stain or paint if moisture reading is higher than 15%. Inspect work to assure surfaces are smooth, free from machine marks and nail heads have been countersunk.
- 3.1.1.6. If substrate is gypsum board, inspect to ensure joints are completely filled and sanded smooth. Inspect surfaces for "nail popping", screw heads not recessed and taped, breaks in surface or other imperfections and have repaired as required.
- 3.1.1.7. Verify each substrate is dry and not frozen and free from tool and sandpaper marks, dust, rust, insects, grease and other foreign matter liable to impair finished work.
- 3.1.2. Evaluation and Assessment:
- 3.1.2.1. Prior to commencement of work of this Section, thoroughly examine (and test as required) conditions and surfaces scheduled to be painted and report in writing to Contractor and Consultant any conditions or surfaces that will adversely affect work of this Section.
- 3.1.2.2. Do not commence painting work until adverse conditions and defects have been corrected and surfaces and conditions are acceptable to this Subcontractor.
- 3.1.2.3. Commencement of work does not imply acceptance of surfaces except as qualified herein. Surfaces such as concrete, masonry, structural steel and miscellaneous metal, wood, gypsum board and plaster, is not responsibility of this Subcontractor. Commencement of work implies acceptance of previously completed work.

3.2. PREPARATION

- 3.2.1. Protection of In-Place Conditions:
- 3.2.1.1. Provide scaffolding, staging, platforms and ladders, as required for execution of work. Erect scaffolding to avoid interference with work of other trades. Comply with Occupational Health and Safety Act.
- 3.2.1.2. During work of this Section, provide drop cloths, plastic, plywood or metal sheets to protect floors in areas assigned for storage and mixing of paints. Cover finished floors, walls, ceilings and other work in vicinity and protect from paint and damage.
- 3.2.1.3. Protect work of other trades against paint splattering and Make Good at own expense any such damage.

- 3.2.1.4. Remove and securely store miscellaneous and finish hardware and surface fittings, electrical switch and outlet covers, receptacle plates, louvres, fittings and fastenings, to protect from paint splatter. Mask items not removable. Use sufficient drop cloths and protective coverings for full protection of floors, furnishings, mechanical, electrical and special equipment, other components of building which do not require painting or to be removed, from paint spotting and other soiling. Carefully clean and re-install items when paint is dry. Clean any components that are paint spotted or soiled. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (e.g. lacquer finishes).
- 3.2.1.5. Prohibit traffic, where possible, from areas where painting is being carried out and until paint is cured. Post "wet paint" or other warning signage during and on completion of work. Provide also warning signs at points of entry to areas where painting is applied and drying.
- 3.2.2. Surface Preparation:
 - 3.2.2.1. Prepare defective surfaces to obtain a satisfactory substrate and in accordance with paint manufacturer's instructions.
 - 3.2.2.2. Prior to painting, sweep areas dust-free.
 - 3.2.2.3. Clean soiled surfaces to be painted.
 - 3.2.2.4. Remove mildew by scrubbing affected area with solution of 150 g (5.3 oz) TSP and 125 g (4.4 oz) bleach in 3.5 ℓ (0.92 gal) water. Rinse well with clean water and allow to dry. If condition is serious, source out finishes with extra mildew resistance.
 - 3.2.2.5. Be responsible for surface preparation to suit surface condition and conform to level of cleaning based on SSPC, recommended metal cleaning procedures most commonly used to suit site conditions.
 - 3.2.2.6. Metals:
 - 3.2.2.6.1. Ensure application of paint and coatings occurs within appropriate time frame after cleaning when environmental conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications.
 - 3.2.2.6.2. Ferrous Metal: Clean to SSPC-SP 1/2/3, to suit site conditions. Remove loose rust and prime bare metal with rust inhibitive steel primer. Touch-up damaged shop applied primer using compatible Product. Provide full coat primer only if damage is extensive. Treat weld areas with phosphoric acid (5% solution).
 - 3.2.2.6.3. Miscellaneous Steel (previously painted and exposed by alterations work): Remove oil, grease, dirt, rust scale, loose mill scale, loose paint or coating by abrasive blasting in accordance with SSPC SP-6/NACE No. 3.
 - 3.2.2.6.4. Galvanized Steel (Pre-Treated) (Non-Crystal Appearance): Follow manufacturer's recommendations for preparation, priming and coating of pre-treated galvanized steel.
 - 3.2.2.6.5. Light Zinc Coated or Satin Coated Products (ZF075) mostly found in environmentally controlled areas. Follow manufacturer's recommendations for preparation, priming and coating.
 - 3.2.2.6.6. Heavy Coated Zinc Z275 (G90) for high humidity areas and as specified. Follow manufacturer's recommendations for preparation, priming and coating.
 - 3.2.2.6.7. Metal Doors: Remove doors before painting to paint bottom and top edges and re-hang once dry. Do not paint stainless steel or bronze door butts. Paint or finish top and bottom edges of doors. Touch-up or refinish tops and edges after fitting. Exterior doors to have tops, bottoms and side edges finished same as exterior faces to these doors.
 - 3.2.2.7. Woodwork:
 - 3.2.2.7.1. Verify and determine wood species, grain direction and structure, properties of finish, application method and exposure to elements. Check moisture content to avoid movement of wood caused by expansion and contraction due to changes in moisture content. Verify grain cut as it may interfere with adhesion of paint.

- 3.2.2.7.2. Apply wood finishing Product in following order and as needed for specific appearance and application specified herein. Sanding sealer to control penetration of subsequent coats to create more uniform finish. Stain to colour wood and highlight grain for final finish. Filler to fill pores of wood and control penetration of subsequent coats. Apply filler across grain forcing it into pores followed with rubbing and sanding when dried. For staining requirements mix stain with filler before applying for uniform finish. Finish coats to provide protection to wood.
- 3.2.2.7.3. Wood work for Opaque Coating: Seal knots and sapwood in surfaces to receive paint with alcohol-based primer-sealer. Seal door edges. Sand smooth rough surfaces of woodwork to be finished using No. 150 grit paper followed by a second sanding using No. 220 grit paper. Sand in direction of grain. Clean surfaces free of dust before applying first coat using brush, compressed air or tack rags. Fill nail holes, splits and scratches with non-shrinking filler after first coat is dry.
- 3.2.2.7.4. Prepare plywood surface by removing dirt and debris. Fill screw and nail holes or minor imperfections with recommended filler and sand properly to receive finish coating. Ensure plywood requiring stained or painted finish is primed with top quality alkyd primer. Use only penetrating quality stain over plywood.
- 3.2.2.7.5. Woodwork for Clear Finish or Stain: Sand smooth woodwork to be finished using No. 150 grit paper followed by a second sanding using No. 220 grit paper and clean surfaces free of dust using brush, compressed air or tack rags before applying first coat. Abrade surfaces with stiff brush to remove loose fibres and splinters. Fill nail holes, splits and scratches with non-shrinking filler tinted to match local grain condition after first coat is dry. Sand lightly between coats with No. 220 grit sandpaper and remove dust.
- 3.2.2.7.6. Remove salt deposits that may appear on wood surfaces treated with fire retarder.
- 3.2.2.8. Previously Finished Surfaces: Clean existing interior surfaces to be repainted or varnished to provide bond. Remove rust, scale, oil, grease, mildew, chemicals and other foreign matter. Remove loose paint and fill flush with suitable patching material. Clean off bubbled, cracked, peeling or otherwise defective paint by stripping with suitable environmental strippers or by burning. Do not burn off paints suspected of having lead content. Treat residue from stripping as Hazardous Waste. Flatten gloss paint and varnish with sandpaper and wipe off dust. If previous coatings have failed so as to affect proper performance or appearance of coatings to be applied, remove previous coatings completely and prepare substrates properly and refinish as specified for new work. Leave entire surface suitable to receive designated finishes and in accordance with finish manufacturer's instructions.
- 3.2.2.9. Gypsum Board:
- 3.2.2.9.1. Examine and ensure gypsum board surfaces are without defects or deficiencies and suit able to receive painting applications. Commencement implies acceptance of gypsum board work. Examine surfaces after for imperfections showing through and fill small nicks or holes with patching compound and sand smooth. Examine surfaces after priming for imperfections showing through.
- 3.2.2.9.2. Clean surfaces dry, free of dust, dirt, powdery residue, grease, oil, wax or any other contaminants. Sand and dust as necessary prior to painting and between coats to provide an anchor for next coat and to remove defects visible from a distance up to 1 m (39").

3.3. APPLICATION

- 3.3.1. Material Compatibility: Provide primers and finish coat materials compatible with each other and substrate including fillers.
- 3.3.2. Mixing and Tinting:
- 3.3.2.1. Unless otherwise specified herein, paint to be ready and factory tinted. Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment and colour and gloss uniformity.

- 3.3.2.2. Mix and prepare paint materials including paste, powder or catalyzed paint mixes in accordance with manufacturer's directions for particular material and coat to be applied to produce a mixture of uniform density. If reducing is required, do so in accordance with recommendations of manufacturer for particular material and coat.
- 3.3.2.3. Where thinner is used, addition is not to exceed manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- 3.3.2.4. Mix primer-sealer with a certain amount of colour coat in proportions recommended by manufacturer of material actually used. Tint undercoats and each finish coat with correct type colours, for identification of each succeeding coat.
- 3.3.2.5. Thoroughly mix materials before application. Apply materials evenly, under adequate illumination, free from sags, runs and other defects. Do cutting-in neatly.
- 3.3.3. Obtain colour chart giving colour schemes and gloss value for various areas from Consultant. Ensure colour chart gives final selection of colours and surface textures of finishes and whether finishes are transparent (natural) or opaque (paint).
- 3.3.4. Provide finish uniform in sheen, colour and texture, free from streaks, shiners and brush or roller marks or other defects.
- 3.3.5. Apply materials in accordance with manufacturer's directions and specifications paying particular attention to appropriate time frame after cleaning when environmental conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications. Do not use adulterants. Do any reduction of coating's viscosity in accordance with manufacturer's directions.
- 3.3.6. Use up paints within period of shelf life recommended by paint manufacturer.
- 3.3.7. Ensure successive coatings are harmonious chemical compositions and materials of same manufacturer.
- 3.3.8. Sand and dust between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1 m (39").
- 3.3.9. Ensure each coat is dry and hard before a following coat is applied.
- 3.3.10. Continue through paint finish behind wall-mounted items (e.g. chalk and tack boards).
- 3.3.11. Finish listed surfaces indicated on Room Finish Schedule(s) and/or noted on Drawing(s) and as specified. Refer to Room Finish Schedule for type, location and extent of finishes required and include touch-ups and field painting necessary to complete work shown, scheduled or specified.
- 3.3.12. Finishes and number of coats specified herein are intended as minimum requirements guide only. Refer to manufacturer's recommendations for exact instructions for thickness of coating to obtain optimum coverage and appearance. Some materials and colours may require additional coats and deeper colours may require use of manufacturers' special tinted primers. Unless otherwise specified, provide Premium Grade finish as defined by MPI as minimum finish.
- 3.3.13. Paint entire plane of areas exhibiting incomplete or unsatisfactory coverage and of areas which have been cut and patched. Patching is not permitted. Vary each coat slightly in successively darker tones to permit supervision identity.
- 3.3.14. Do not paint baked paint surface, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory. Finish paint primed surfaces.
- 3.3.15. Advise Consultant when each applied paint coat can be inspected. Do not recoat without inspection. Tint each coat slightly to differentiate between applied coats.
- 3.3.16. Apply additional paint coats, beyond number of coats specified for any surface, to completely cover and hide substrate and to produce a solid, uniform appearance.
- 3.3.17. Apply primer coat soon after surface preparation is completed to prevent contamination of substrate.

- 3.3.18. Primer/Sealers: Apply primer-sealer coats by brush or roller. Permit to dry in accordance with manufacturer's recommendations before applying succeeding coats. Touch up suction spots and sand between coats with No. 120 sandpaper.
- 3.3.19. Metals: Apply primer coat to unprimed ferrous metal surfaces. Where sandblast preparation is specified, apply specified primer immediately after blast cleaning.
- 3.3.20. Woodwork:
 - 3.3.20.1. Fill open grain woods with filler tinted to match wood and work well into grain. Wipe excess from surface before filler sets.
 - 3.3.20.2. Sand smooth paint and varnish undercoats prior to recoating.
 - 3.3.20.3. Prime woodwork designated for painting as soon as possible after delivery to site and before installation. Prime cut surfaces, whether exposed or not, i.e. 6 edges of wood doors, before installation. Prime cut surfaces of woodwork to receive transparent finish with 1 coat of transparent finish reduced 25% or as directed by manufacturer.
 - 3.3.20.4. Apply final coats on smooth surfaces by roller or brush. Hand brush wood trim surfaces.
- 3.3.21. Allow each coat of paint to cure and become dry and hard before application of succeeding coats (unless manufacturer's directions require otherwise).
- 3.3.22. Before finishing paint coats are applied, inspect and touch-up shop coats of primers previously applied by other trades or fabricators.
- 3.3.23. Provide paint coating thicknesses indicated, measured as minimum DFT.
- 3.3.24. Apply a minimum of 4 coats of paint where deep or bright colours are used to achieve satisfactory results.
- 3.3.25. Ledges: Finish projecting ledges, both above and below sight lines, as specified for adjacent surfaces.
- 3.3.26. Existing Spaces:
 - 3.3.26.1. Refinish existing surfaces of rooms or areas which have been damaged, altered or otherwise affected by work. Also finish "new" work occurring thereon unless otherwise specified. Use same procedure as for new work but primer (or filler, stain and sealer in case of varnish finish) may be omitted. Prepare existing surfaces as specified herein. Ensure finish matches previous finish.
 - 3.3.26.2. Paint or repaint rooms or areas where noted on Room Finish Schedule and/or as indicated on Drawings.
 - 3.3.26.3. Repaint surfaces entirely between changes of plane.
 - 3.3.26.4. Use finish coat of respective new surface paint system for minor repair of existing finishes. Use system primer where existing finishes are damaged down to bare surface.
 - 3.3.26.5. Extend painting to a suitable boundary to avoid a "patched" effect. Sand, wire-brush, or scrape such existing finished surfaces to remove loose paint and to reduce gloss. Also clean existing films of dirt, grease or wax. If metallic surfaces are rusted, remove loose scale to provide a firm surface. Patch and sand cracks and other imperfections.
 - 3.3.26.6. Provide paint to interior existing spaces effected by alterations [and shelled-in spaces] in accordance with following:
 - 3.3.26.6.1. Paint walls to nearest inside and outside corners for full wall height.
 - 3.3.26.6.2. Paint columns floor to ceiling.
 - 3.3.26.6.3. Paint full ceilings to nearest wall or bulkhead.
 - 3.3.26.6.4. Unless indicated otherwise match existing colour.

3.3.26.6.5. Where Room Finish Schedule indicates existing and/or new wall finishes to be painted, existing surfaces such as, existing door and frames, mechanical supply and return air grilles (both on walls and ceilings), access doors and electrical panels which have been previously painted to be painted for a complete finish room. If Room Finish Schedule indicates "-" it denotes entire room need not be painted, paint only patched area.

3.3.26.7. Example Locations:

3.3.26.7.1. pressed steel frames.

3.3.26.7.2. hollow metal doors.

3.3.26.7.3. access doors and frames.

3.3.26.7.4. hose cabinets.

3.3.26.7.5. miscellaneous exposed interior metal work.

3.4. SITE QUALITY CONTROL

3.4.1. Site Tests and Inspections:

3.4.1.1. Provide and coordinate site inspection service by manufacturer's representative in advance of work commencing and during progress of work to ensure correct use and application of each specified material. Manufacturer's representative to review and submit approval of surface preparation methods in Specifications or obtain specific recommendations for alternative methods. Report such conditions to Consultant.

3.4.1.2. As work progresses and upon completion of work, submit written reports and manufacturers' confirmation that materials and application methods conform to manufacturers' requirements.

3.4.1.3. Inspect surfaces, preparation and paint applications.

3.4.2. Non-Conforming Work:

3.4.2.1. Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction to Consultant at no cost to Owner. Touch up small affected areas, repaint large affected areas or areas without sufficient DFT of paint. Remove runs, sags of damaged paint by scraper or by sanding prior to application of paint.

3.4.2.2. Following are considered non-conforming qualities:

3.4.2.2.1. Lack of Uniformity:

3.4.2.2.1.1. brush/roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas and foreign materials in paint coatings.

3.4.2.2.1.2. evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.

3.4.2.2.1.3. damage due to touching before paint is sufficiently dry or any other contributory cause.

3.4.2.2.1.4. damage due to application on moist surfaces or caused by inadequate protection from weather.

3.4.2.2.1.5. damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

3.4.2.2.2. Aesthetic Problems: If following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces:

3.4.2.2.2.1. visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 1 m (39").

3.4.2.2.2.2. visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1 m (39").

3.4.2.2.2.3. visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.

- 3.4.2.2.4. when final coat on any surface exhibits a lack of uniformity of colour, sheen, texture and hiding across full surface area.
- 3.4.3. Manufacturer Services: Arrange for manufacturer's representative to visit site at intervals during surface preparation and paint coating application to ensure proper specified surface preparation is being performed, specified Product are being used, appropriate number of coats are being applied and specified finishing procedures are being carried out.

3.5. CLEANING

- 3.5.1. Keep waste rags in covered metal drums containing water and remove from building at end of each Day. Remove other combustible rubbish materials and empty paint cans each Day from site and safely dispose of same in accordance with requirements of authorities having jurisdiction.
- 3.5.2. Clean equipment and dispose of wash water/solvents as well as other cleaning and protective materials (e.g. rags, drop cloths, masking papers, etc.), paints, thinners, paint removers/strippers in accordance with safety requirements of authorities having jurisdiction.
- 3.5.3. Clean containers used for storage, mixing and application of materials free of foreign materials and residue.
- 3.5.4. Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.
- 3.5.5. Clean adjacent surfaces which have been painted, soiled or otherwise marred. Remove spilled, splashed, splattered or sprayed paint as work progresses using means and materials that are not detrimental to affected surfaces.
- 3.5.6. Remove masking and other protection provided under this Section.
- 3.5.7. Remove temporary protective wrappings provided by others for protection of work after completion of painting operations unless instructed otherwise.
- 3.5.8. Painting work will not be considered complete until spatters, drippings, smears and overspray have been cleaned and removed to satisfaction of Consultant.
- 3.5.9. Make Good any damage to structure building surfaces or furnishings resulting from painting operations at no cost to Owner.
- 3.5.10. Waste Management:
- 3.5.10.1. Dispose paint waste in accordance with local regulations.
- 3.5.10.2. Set aside and protect surplus and uncontaminated finish materials not required by Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

3.6. ATTACHMENTS

- 3.6.1. INTERIOR FINISH SCHEDULE:
- 3.6.1.1. INT 3.1 - Concrete Vertical Surfaces: (including ceilings and undersides of mezzanines, stairs, etc.):
- 3.6.1.1.1. Latex (over alkali-resistant primer) (INT 3.1A-G3):
- 3.6.1.1.1.1. 1 coat primer alkali resistant W.B.: MPI #3
- 3.6.1.1.1.2. 2 coats latex: MPI #52
- 3.6.1.1.1.3. Finish: Eggshell.
- 3.6.1.2. INT 5.1 - Structural Steel and Metal Fabrications: (columns, beams, joists, etc.):
- 3.6.1.2.1. Steel and Metal Fabrications (with existing shop coat primer) - Unexposed: No further finishing required except for touch-up of damaged surfaces.

- 3.6.1.2.2. Latex (over Q.D. shop primer) (INT 5.1X-G5):
- 3.6.1.2.2.1. 1 coat Q.D. shop applied primer: MPI #275
- 3.6.1.2.2.2. 2 coats latex: MPI #54
- 3.6.1.2.2.3. Finish: Semi-Gloss.
- 3.6.1.3. INT 5.3 - Galvanized Metal (Not Chromate Passivated): (High contact/high traffic areas (doors, frames, railings, pipes, etc.) low contactor low traffic areas (overhead decking, pipes, ducts, etc.):
- 3.6.1.3.1. Latex (over w.b. galvanized primer) (INT 5.3J-G5):
- 3.6.1.3.1.1. 1 coat waterborne primer: MPI #134
- 3.6.1.3.1.2. 2 coats latex: MPI #54
- 3.6.1.3.1.3. Finish: Semi-Gloss.
- 3.6.1.4. INT 6.3 - Dressed Lumber: (including doors, door and window frames, moldings, etc.):
- 3.6.1.4.1. High Performance Architectural Latex (over latex primer) (INT 6.3A-G5):
- 3.6.1.4.1.1. 1 coat latex primer: MPI #39
- 3.6.1.4.1.2. 2 coats HIPAC latex: MPI #141
- 3.6.1.4.1.3. Finish: Semi-Gloss.
- 3.6.1.5. INT 9.2 - Plaster and Gypsum Board: (gypsum wallboard, drywall, "Sheet Rock" type material, & texture finishes, etc.):
- 3.6.1.5.1. Latex (over latex primer sealer) (INT 9.2A-G3):
- 3.6.1.5.1.1. 1 coat latex primer sealer: MPI #50
- 3.6.1.5.1.2. 2 coats latex: MPI #52
- 3.6.1.5.1.3. Finish: Eggshell.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide visual display surfaces including but not limited to following:

1.2.1.1. whiteboards.

1.3. SUBMITTALS

1.3.1. Product Data: Submit Product data or catalogue sheets in accordance with Section 01 30 00 to fully illustrate work of this Section. Ensure Product data sheets or manufacturer's catalogue sheets contain detailed description and bear item numbers, marked to show quantity, colour, model numbers, fabrication details and installation instructions.

1.4. QUALITY ASSURANCE

1.4.1. Qualifications:

1.4.1.1. Installers: Provide work of this Section executed by competent installers with minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

1.5. DELIVERY, STORAGE AND HANDLING

1.5.1. Delivery and Acceptance Requirements: Deliver packaged materials in original, undamaged containers with manufacturer's labels and seals intact. Handle and store materials in accordance with manufacturer's and Supplier's recommendations to prevent damage thereto.

1.5.2. Storage and Handling Requirements: Protect work of this Section from damage of any kind. Protect other work from damage resulting from work of this Section. Replace damaged work which cannot be repaired, cleaned or restored.

PART 2 - PRODUCTS

2.1. MANUFACTURED UNITS

2.1.1. Whiteboards:

2.1.1.1. Dual-purpose board consisting of white porcelain enameled steel on particleboard core, frameless complete with hanging brackets. Permitted Products: "Porcelain Surfaces" by ASI Visual Display Products; www.asi-visualdisplayproducts.com, "Dimension 13 Wall Mounted Whiteboard" by Egan Visual Inc.; www.egan.com or "Porcelain Enameled Steel Panels" by Polyvision; www.polyvision.com size(s) as shown on Drawings.

2.1.1.2. Supply with each unit, 12 dry pens (4 colours) and a brush.

PART 3 - EXECUTION

3.1. EXAMINATION

3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.

- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Install visual display boards perfectly rigid in accordance with manufacturer's printed directions.

3.3. SITE QUALITY CONTROL

- 3.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide plastic-laminate-clad lockers including but not limited to following:

1.2.1.1. single-tier plastic-laminate-clad flat top lockers to match existing.

1.2.1.2. plastic laminate trims, end gables, filler panels.

1.2.1.3. bases.

1.2.1.4. screws, bolts and other items to bolt lockers together and to secure same to structure.

1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:

1.2.2.1. Provision of wood blocking: Section 06 10 00, Rough Carpentry.

1.3. REFERENCES

1.3.1. Abbreviations and Acronyms:

1.3.1.1. AWMAC/WI: Architectural Woodwork Manufacturers Association of Canada/Woodwork Institute; www.awmac.com.

1.3.1.2. NAAWS: North American Architectural Woodwork Standards – 4.0, 2021, as amended.

1.3.1.3. NEMA: National Electrical Manufacturers Association; www.nema.org.

1.3.2. Reference Standards:

1.3.2.1. ANSI/NEMA LD 3-05 - High-Pressure Decorative Laminates

1.4. SUBMITTALS

1.4.1. Shop Drawings:

1.4.1.1. Submit Shop Drawings for work of this Section in accordance with Section 01 30 00.

1.4.1.2. Prepare Shop Drawings for fabrication and erection of lockers and accessories. Show fabrication details, including exact sizes and description of anchorage and hardware, trim, nature of component parts and interface conditions with other work.

1.4.1.3. Clearly cross-reference components on Shop Drawings to Drawings indicating location, number required and name of unit.

1.4.2. Locker Drawings: Submit 3 copies of drawings of each locker room showing arrangement, numbering system and number of lockers in room, for Owner's control purposes. Ensure Drawings are on 215 mm x 280 mm (8-1/2" x 11") sheets.

1.5. QUALITY ASSURANCE

1.5.1. Qualifications:

1.5.1.1. Installers: Provide work of this Section executed by competent installers with minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

1.6. DELIVERY, STORAGE AND HANDLING

- 1.6.1. Delivery and Acceptance Requirements:
 - 1.6.1.1. Deliver materials in sequence to meet installation schedule. Provide protection from marring or other damage.
 - 1.6.1.2. Carefully unload materials in a manner to prevent damage.
- 1.6.2. Storage and Handling Requirements: Carefully handle and store in a manner to prevent damage.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedule and Specifications:
 - 2.1.1.1. BRC Group; www.brc.group
- 2.1.2. Substitution Limitations: Comparable Products from other manufacturers not listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

- 2.2.1. High Pressure, Paper Base, Decorative Laminates (P.LAM):
 - 2.2.1.1. Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
 - 2.2.1.1.1. Arborite; www.arborite.com
 - 2.2.1.1.2. Formica Inc.; www.formica.com
 - 2.2.1.1.3. Industrial Laminates/Norplex, Inc.; www.micarta.com
 - 2.2.1.1.4. Nevamar Company, LLC; www.nevamar.com
 - 2.2.1.1.5. Pionite Decorative Laminates; www.pionite.com
 - 2.2.1.1.6. Wilsonart Canada; www.wilsonart.com
 - 2.2.1.2. Provide types and thicknesses conforming to ANSI/NEMA LD 3 and Section 04, "Table: 04-009 – HPL TYPES and MINIMUM PERFORMANCE REQUIREMENTS" of NAAWS.
 - 2.2.1.3. Colours and Finishes: To match existing.
- 2.2.2. Plastic Laminate Adhesive: Provide in accordance with Section 04, 04.5.5.2 and "Adhesive Usage Guide" in "Appendix" of NAAWS.
- 2.2.3. Hooks: Stainless steel.
- 2.2.4. Fasteners: Stainless steel in accordance with locker manufacturers written recommendations.
- 2.2.5. Fabrication:
 - 2.2.5.1. Fabricate lockers to sizes and to profiles required from following:
 - 2.2.5.1.1. Lockers (LKR-1): Double-tier type, 375 mm wide x 457 mm deep x 1524 mm total height (15" x 18" x 60"), flat top and with base.
 - 2.2.5.2. Composition: Unitized with common intermediate uprights separating units as follows:
 - 2.2.5.2.1. Doors: 19 mm (3/4") nominal thickness. Incorporate a nickel plated lock pocket recess with matching pull and padlock locking system; padlock by Owner on exterior face. Ensure doors have number plates incorporating non-removable numerals, 1 number designated for each locker.

- 2.2.5.2.2. Hang doors on continuous 1 piece stainless steel piano hinge. Securely fasten hinges to frame and door. Provide hinges of type which maximize security, resistance to abuse and vandalism. Hold doors in closed position with friction catch.
- 2.2.5.2.3. Side Panels: 19 mm (3/4") nominal thickness.
- 2.2.5.2.4. Tops, Bottoms and Shelves: 13 mm (1/2") nominal thickness.
- 2.2.5.2.5. End Cover Panels: 19 mm (3/4") nominal thickness.
- 2.2.5.2.6. Filler Kits and Trim Kits: 19 mm (3/4") nominal thickness.
- 2.2.5.2.7. Hinges: Continuous full length 16 ga stainless steel, piano hinge.
- 2.2.5.2.8. Do not put manufacturer's names on front of lockers.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Install plastic-laminate-clad lockers and accessories at locations shown in accordance with manufacturer's written recommendations.
- 3.2.2. Install lockers level and plumb with flush surfaces and rigid attachment to anchoring surfaces.
- 3.2.3. Anchor lockers to floor and wall at 1220 mm (48") maximum spacing as recommended by manufacturer's written instructions.
- 3.2.4. Bolt adjoining locker units together to ensure rigid installation.
- 3.2.5. Attached locker number plates as indicated.

3.3. ADJUSTING

- 3.3.1. Upon completion, test doors and adjust for ease of operation.

3.4. SITE QUALITY CONTROL

- 3.4.1. Non-Conforming Work: Remove unsatisfactory materials and replace to Consultant's satisfaction at no cost to Owner.

3.5. CLEANING

- 3.5.1. Clean and Make Good surfaces soiled or damages. Clean units before final review by Consultant.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

- 1.1.1. Read and conform to:
 - 1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.
 - 1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

- 1.2.1. Section Includes: Provide draperies including but not limited to following:
 - 1.2.1.1. drapery track and accessories.
 - 1.2.1.2. drapery material.
- 1.2.2. Related Sections: Following description of work is included for reference only and shall not be presumed complete:
 - 1.2.2.1. Provision of wood blocking: Section 06 10 00, Rough Carpentry.
 - 1.2.2.2. Provision of gypsum wall walls: Section 09 21 16, Gypsum Board Assemblies.

1.3. REFERENCES

- 1.3.1. Reference Standards:
 - 1.3.1.1. NFPA 701-19 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

1.4. ADMINISTRATIVE REQUIREMENTS

- 1.4.1. Preinstallation Meetings: Arrange preinstallation meeting 1 week before commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.
- 1.4.2. Scheduling: Schedule installation of draperies as late as possible in sequence of construction schedule to reduce damage and as follows:
 - 1.4.2.1. Do not install draperies until space is enclosed, weather tight and conditioned.
 - 1.4.2.2. Do not install prior to completion of abutting grid ceiling installation.
 - 1.4.2.3. Ensure no wet work remains with exception of touch-up.

1.5. SUBMITTALS

- 1.5.1. Product Data: Submit manufacturer's literature describing system to be provided.
- 1.5.2. Shop Drawings:
 - 1.5.2.1. Submit Shop Drawings showing general layout, jointing, anchoring sizes and types, shapes, thickness and other similar detailed information necessary to fully describe installation.
 - 1.5.2.2. Ensure elevations indicate arrangement of joints. Clearly indicate locations of seams, methods of joining seams, direction of fabric and notations as to where dye lot changes occur.

- 1.5.2.3. Ensure Shop Drawings include key plans, elevations, plan sections and details.
- 1.5.3. Samples: Submit 2 samples as follows:
 - 1.5.3.1. each type mounting track.
 - 1.5.3.2. each type fabric facing.
 - 1.5.3.3. Sample Size: 100 mm x 100 mm (4" x 4") or 100 mm (4") in length as appropriate to material.

1.6. CLOSEOUT SUBMITTALS

- 1.6.1. Operation and Maintenance Data: Submit procedures to be followed in cleaning and maintaining drapery fabric. Include a copy of instruction in Operation and Maintenance Manual.

1.7. MAINTENANCE MATERIAL SUBMITTALS

- 1.7.1. Extra Stock Materials: Leave 10% of each type of drapery fabric specified for Owner's future maintenance use. Supply drapery fabric from same production run as installed drapery fabric.

1.8. QUALITY ASSURANCE

- 1.8.1. Qualifications:
 - 1.8.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
- 1.8.2. Source Limitations: For draperies, obtain each colour and pattern of fabric and trim from 1 dye lot.
- 1.8.3. Fire-Test-Response Characteristics: For fabrics treated with fire retardants, provide Products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.
- 1.8.4. Mock-Ups: Construct minimum 10 m² (100 sq ft) mock-up sample at Project location designated by Consultant for review. Once reviewed with no objections recorded, sample remains part of finished work and used as a quality reference standard for balance of Project.

1.9. DELIVERY, STORAGE AND HANDLING

- 1.9.1. Delivery and Acceptance Requirements:
 - 1.9.1.1. Deliver materials in manufacturer's original unopened packaging.
 - 1.9.1.2. Remove paper type wrappings and inter-leavings that are wet.
 - 1.9.1.3. Unwrap and inspect fabric facings upon arrival for flaws and defects. Notify Consultant at least 24 hours in advance of inspection.
 - 1.9.1.4. Reject drapery fabric that is flawed by inclusion of excessive mis-weaves, poor colour match with goods specified, water damage, inadequate continuous drops without seaming, or other unacceptable conditions.
- 1.9.2. Storage and Handling Requirements:
 - 1.9.2.1. Store materials in a clean area, free from dust and damage from construction activities.
 - 1.9.2.2. Do not store drapery fabric in bolts in an upright position, or beneath other materials.
 - 1.9.2.3. Cover materials with plastic in a manner to provide air circulation.
 - 1.9.2.4. Remove damaged, defective, or rejected materials from site.

1.10. SITE CONDITIONS

- 1.10.1. Ambient Conditions: Maintain ambient temperature and humidity within spaces to receive draperies at levels indicated for final review. Continuously maintain levels from at least 48 hours prior to installation until space is turned over to Owner.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
- 2.1.1.1. Prestige Decor; www.prestigedecor.ca
- 2.1.2. Substitution Limitations: Comparable Products from manufacturers not listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

- 2.2.1. Drapery Track:
- 2.2.1.1. Provide extruded aluminum track, clear anodized finish, minimum size 36.5 mm wide x 23.8 mm high (1-7/16" wide x 15/16" high), surface ceiling mounted track, fixed through exposed tee grid system faces for acoustic tile ceilings or through reinforcing in gypsum board ceilings.
- 2.2.1.2. Provide track complete with accessories including end sleeves, stops and nylon carriers at 150 mm (6") oc. Factory form curved sections to radius indicated on Drawings and supply in 1 piece without joints up to 7200 mm (24' - 0").
- 2.2.2. Drapery Fabric: Provide "Groundwork Linen" by Prestige Decor with following characteristics:
- 2.2.2.1. Height: As indicated.
- 2.2.2.2. Flame Code: NFPA 701 with treatment.
- 2.2.2.3. Colour: To be selected later by Consultant.
- 2.2.3. Fabrication:
- 2.2.3.1. Fabricate draperies in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than a full width of fabric is required to produce panel of specified fullness, use equal widths of not less than 1/2 width of fabric located at ends of panel.
- 2.2.3.2. One-Way-Stacking Draperies: Add 125 mm (5") to overall width for returns.
- 2.2.3.3. Center-Opening Draperies: Add 250 mm (10") to overall width for overlap.
- 2.2.3.4. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and overlapped. Join widths so patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are not permitted.
- 2.2.3.5. Side Hems: Double-turned, 38 mm (1-1/2") wide hems consisting of 3 layers of fabric and blind stitched so stitches are not visible on face of drapery.
- 2.2.3.6. Bottom Hems: Double-turned, 100 mm (4") wide hems consisting of 3 layers of fabric and weighted and blind stitched so weights and stitches are not visible on face of drapery.
- 2.2.3.7. Interlinings: Extend from top of drapery to within 13 mm (1/2") of lining's bottom hem and to leading edge of side hems to produce full-shadowed appearance.
- 2.2.3.8. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam and hand stitched at side hems and shadowed with 38 mm (1-1/2") return of face fabric.
- 2.2.3.9. Bottom Hem: Blind stitch to drapery fabric.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Drapery Track:
 - 3.2.1.1. Install track systems according to manufacturer's written instructions, level and plumb and at height and location in relation to adjoining openings as indicated on Drawings.
 - 3.2.1.2. Isolate metal parts of tracks and brackets from concrete, masonry and mortar to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.
- 3.2.2. Drapery:
 - 3.2.2.1. Where draperies abut overhead construction, hang draperies so clearance between headings and overhead construction is 6 mm (1/4").
 - 3.2.2.2. Where draperies extend to floor, install so bottom hems clear finished floor by not more than 25 mm (1") and not less than 13 mm (1/2").
 - 3.2.2.3. Where draperies extend to windowsill, install so bottom hems hang above sill line and clear sill line by not more than 13 mm (1/2").

3.3. SITE QUALITY CONTROL

- 3.3.1. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.4. ADJUSTING

- 3.4.1. After hanging draperies, test and adjust each track to produce unencumbered, smooth operation.
- 3.4.2. Steam and dress down draperies as required to produce crease- and wrinkle-free installation.
- 3.4.3. Remove and replace stained or soiled draperies.

END OF SECTION

PART 1 - GENERAL

1.1. GENERAL INSTRUCTIONS

1.1.1. Read and conform to:

1.1.1.1. CCDC 2 - 2020, Stipulated Price Contract with Supplementary Conditions as amended in the Contract Documents.

1.1.1.2. Division 1 requirements and documents referred to therein.

1.2. SUMMARY

1.2.1. Section Includes: Provide acoustic isolated floating floors including but not limited to following:

1.2.1.1. acoustic isolated floating floors (ASF-1).

1.3. REFERENCES

1.3.1. Reference Standards:

1.3.1.1. CSA O121-17 - Douglas fir plywood

1.4. ADMINISTRATIVE REQUIREMENTS

1.4.1. Preinstallation Meetings: Arrange preinstallation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Consultant. Presided over by Contractor, include Consultant who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.5. SUBMITTALS

1.5.1. Product Data: Submit manufacturer's Product data and installation instructions for each material and Product used.

1.5.2. Shop Drawings:

1.5.2.1. Submit Shop Drawings in accordance with Section 01 30 00. Ensure Shop Drawings indicate material characteristics, details of construction, connections and relationship with adjacent construction.

1.5.2.2. Ensure a licensed engineer specified herein is responsible for:

1.5.2.2.1. production and review of Shop Drawings.

1.5.2.2.2. sealing and signing each Shop Drawing and any associated calculations performed.

1.6. QUALITY ASSURANCE

1.6.1. Qualifications:

1.6.1.1. Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

1.6.1.2. Licensed Professionals: Employ a licensed engineer carrying professional liability insurance and is registered in the Province of Ontario.

1.6.2. Mock-Ups: Construct minimum 10 m² (100 sq ft) mock-up sample at Project location designated by Consultant for review. Once reviewed with no objections recorded, sample remains part of finished work and used as a quality reference standard for balance of Project.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications:
- 2.1.1.1. AcoustiGuard - WILREP Ltd.; www.acoustiguard.com
- 2.1.2. Substitution Limitations: This Specification is based on AcoustiGuard - WIREP Ltd.'s "Freedom Step™ Layout System". Comparable systems from other manufacturers not listed herein may be reviewed provided they meet requirements of this Specification.

2.2. MATERIALS

- 2.2.1. Performance/Design Criteria:
- 2.2.1.1. Ascertain loads and characteristics of supported structure affected by isolation system.
- 2.2.1.2. Ensure floating floor is free from any rigid connections to any part of building structure and designed to reduce transmission of airborne and structure-borne sound from mechanical equipment spaces and other acoustically active areas to rest of building.
- 2.2.1.3. Base normal design load calculation on weight of floating slab plus weight of walls, equipment and fixtures supported by floating floor isolation system plus 25% of specified live load.
- 2.2.1.4. Base maximum design load calculation on weight of floating slab plus weight of walls, equipment and fixtures supported by floating floor isolation system plus 100% of specified live load.
- 2.2.1.5. Ensure dynamic frequency of floating floor system does not exceed 10 Hz excluding affects of air cavity below floating floor.
- 2.2.1.6. Overload Capacity: Ensure assemblies are capable of supporting minimum 6 times normal design load without any visible damage, buckling or permanent set and remain totally functional when overload is removed.
- 2.2.1.7. Design for minimum height of 50 mm (2") of elastomeric material. Ensure in all cases static deflection under maximum design load does not exceed 15% of total thickness of elastomeric material.
- 2.2.1.8. Structural Design: Employ a licensed engineer specified herein to:
- 2.2.1.8.1. design components for work of this Section requiring structural performance.
- 2.2.1.8.2. be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.
- 2.2.2. Isolation Materials: Provide 610 mm (24") x 1220 mm (48") x 38 mm (1-1/2") thick Ecobatt insulation pre-punched 50 mm (2") thick moulded rubber pyramid isolators approximately 100 mm x 100 mm (4" x4"). Permitted Product: "Freedom Step Pyramid Layout - PRO" by AcoustiGuard - WIREP Ltd.
- 2.2.3. Plywood Panels:
- 2.2.3.1. 1st Layer Plywood: 19 mm (3/4") thick, waterproof, grade stamped exterior grade Pine plywood, select grade, unsanded conforming to CSA O121.
- 2.2.3.2. 2nd Layer Plywood: 19 mm (3/4") thick, waterproof, grade stamped exterior grade Pine plywood, select grade, sanded conforming to CSA O121.
- 2.2.4. Plywood Adhesive: Provide "LePage PL PREMIUM MAX" by LePage; www.lepage.ca.

PART 3 - EXECUTION

3.1. EXAMINATION

- 3.1.1. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2. INSTALLATION

- 3.2.1. Install acoustic isolated floating floor system in accordance with manufacturer's written instructions.

3.3. SITE QUALITY CONTROL

- 3.3.1. Site Tests and Inspections:
 - 3.3.1.1. Structural Inspection: Ensure a licensed engineer specified herein inspects work of this Section during erection/installation and submits sealed and signed Field Review Report within 5 Days of site visit.
- 3.3.2. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

3.4. CLEANING

- 3.4.1. Upon completion of work, check concrete is not in threaded holes and ensure their cleanliness and proper function and remove debris, equipment and excess material from site.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. These Specifications are an integral part of the Contract Documents. Tendering and Contract Requirements and Division 01 00 00, General Requirements apply to all Specification Sections.
- 1.1.2. All equipment and materials provided under Division 20 shall be new, unused, and of current manufacture at the time of delivery to site. Equipment shall be manufactured no more than 18 months prior to installation unless otherwise approved by the Consultant in writing.
- 1.1.3. Ensure that all mechanical and electrical services are arranged so that "layering" of services is minimized. Offset as required to maximize ceiling space.
- 1.1.4. Install all sprinkler mains and branches in joist space where joists exist or tight to underside of structure.
- 1.1.5. Maintain the specified ceiling height while allowing {200 mm}[8"] for lighting below all mechanical services.
- 1.1.6. Work in the Specifications is divided into descriptive Sections which are not intended to delegate functions or work to any specific Subcontractor or identify absolute contractual limits between Subcontractors or between the Contractor and his Subcontractor. The requirements of any one Section apply to all Sections. Refer to other Sections to ensure a complete operational product and fully coordinated standard of work.
- 1.1.7. Refer to architectural drawings for finish required for mechanical systems. Where a discrepancy exists between finish listed in mechanical and architectural specifications, the more expensive specifications will be enforced.
- 1.1.8. The responsibility for determining which Subcontractor or supplier shall provide labour, material, products, equipment, and services to complete the work rests solely with the Contractor.
- 1.1.9. The direction to 'provide' equipment, materials, products, labour and services shall be interpreted to 'supply, install and test' the Division 20 00 00 work indicated on the Drawings and specified. All products and equipment shall be new.
- 1.1.10. Provide mechanical components and normal system accessories not shown on the Drawings or stipulated in the Specifications but required to ensure complete operational systems acceptable to the Consultant and all authorities having jurisdiction.
- 1.1.11. Obtain and pay for all permits required by Authorities Having Jurisdiction, testing agencies, regulatory agencies and for other permits required to complete the work of this Division.
- 1.1.12. Participate in commissioning activities. Provide technical assistance, labour, and technicians as appropriate for the specific activities as directed by the commissioning agent or party otherwise in charge of the planning and implementation of the commissioning activities (i.e. the Integrated Testing Coordinator). This includes systems performance and verification commissioning and Integrated Life Safety Systems testing procedures per CAN/ULC-S1001.

1.2. INTENT/PHASING

- 1.2.1. Mention in the Specifications or the indication on the Drawings of equipment, materials, operation and methods, requirements of the quality noted, the quantity required, and that the systems are complete in every respect.

- 1.2.2. Consider the Specifications as an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.
- 1.2.3. Be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective materials, equipment and parts of equipment and repair related damages.
- 1.2.4. Phasing shall be scheduled with the Owner.

1.3. CONTRADICTION AND AMBIGUITY

- 1.3.1. Where there is apparent contradiction or ambiguity in the documents, or where there are apparent discrepancies in or omissions from the documents, or if there is any doubt as to the intent of the documents, the bidder shall request and obtain written clarification(s) from the Consultant prior to submitting a tender.
- 1.3.2. Consideration will not be granted for misunderstanding of the intent of the documents or the extent of the work to be performed.

1.4. LEED REQUIREMENTS

- 1.4.1. The building will be certified under the Canadian Green Buildings Council, Leadership in Energy and Environmental Design. This requires the contractor to adhere to certain requirements with respect to cleanliness, recycling, materials reuse and other practices which are part of the contract requirements under Division 01 00 00 and the Supplementary General Conditions, in addition to the following:
 - 1.4.1.1. Smoking shall not be permitted inside.
 - 1.4.1.2. Open ended ductwork shall be protected with plastic sheeting and temporary filters.
 - 1.4.1.3. Open ended piping shall be capped to limit ingress of debris.
 - 1.4.1.4. All trades shall practice recycling of waste, under direction of the Construction Manager.
- 1.4.2. Mechanical initiatives selected to be designed into the project includes the following:
 - 1.4.2.1. Use of storm water to flush some toilets and urinal.
 - 1.4.2.2. Use of stored storm water for landscape irrigation.
 - 1.4.2.3. Use of ultra-low flow plumbing fixtures throughout the project.
 - 1.4.2.4. Energy efficient cooling and heating systems through the use of internal energy reclaim, condensing gas boilers, variable speed drives on multiple pumps, etc.
 - 1.4.2.5. Use of CO₂ sensors and air flow measurement to monitor and control air quality on each floor.
 - 1.4.2.6. Use of high efficiency building envelope and glazing systems.
 - 1.4.2.7. Commissioning of all mechanical building systems, including verification by a third party.
 - 1.4.2.8. Use of non CFC refrigerants in all equipment.

1.5. METRIC PRACTICE

- 1.5.1. Conform to Canadian Metric Practice Guide CSA CAN3-Z234.1-89.
- 1.5.2. Provide adapters between metric and imperial installations.
- 1.5.3. Metric descriptions in this Division are nominal equivalents of Imperial values.

1.6. COORDINATION

- 1.6.1. Coordinate and schedule the work of this Division with other work to facilitate mutual progress.
- 1.6.2. Identify and resolve interference problems prior to prefabrication and installation of equipment. Submit interference drawings for review prior to installing anything on site. Do not proceed until drawings have been reviewed.
- 1.6.3. Examine the site and all Contract Documents prior to bid submission. No allowance will be made for any difficulties encountered due to any features of the building, methods of construction, site or surrounding public and private property which existed up to the bid close.

1.7. REFERENCE STANDARDS

- 1.7.1. Provide new materials and equipment of design and quality defined in Section 20 25 00. Provide current models of equipment manufactured in North America, unless specified otherwise, with published ratings certified by recognized North American testing and standards agencies.
- 1.7.2. Workmanship and installation methods shall conform to best practice. Employ tradesmen to perform work under the direct supervision of qualified personnel.
- 1.7.3. Install equipment in accordance with manufacturer's recommendations.
- 1.7.4. Meet ASHRAE/IES 90.1, 2013 (or most recent edition) Standards for the supply and installation of all equipment.
- 1.7.5. Meet the additional selection, sizing and performance criteria specified in this Specification.
- 1.7.6. Be responsible for all aspects of your work including any damage resulting.

1.8. DRAWINGS AND MEASUREMENTS

- 1.8.1. Read the mechanical work drawings in conjunction with all other structural, architectural, sprinkler, electrical, etc., drawings and, where applicable, the Code Consultant's report.
- 1.8.2. The mechanical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building is to be taken on site. Do not scale the drawings, and do not use the drawings for prefabrication work.
- 1.8.3. The drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details but not shown on the drawings.

- 1.8.4. The locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of the equipment and/or materials, other equipment systems being installed, and of the building, all at the responsibility of the contractor and at their cost.
- 1.8.5. Sections of the mechanical specification are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.
- 1.8.6. The mechanical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.
- 1.8.7. The mechanical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.
- 1.8.8. The mechanical drawings and specifications have been prepared solely for the use by the party with whom the Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any other party.
- 1.8.9. When a discrepancy exists within the drawings or specification, the most costly arrangement will take precedence.
- 1.8.10. Drawings do not indicate exact new or existing architectural, structural or electrical features. Coordinate with other contractors prior to commencement of work. Site measure all existing architectural, structural and electrical systems as required.
- 1.8.11. Do not scale Drawings. Take field measurements before ordering and fabricating materials.
- 1.8.12. Obtain 'roughing-in' requirements of equipment which is not part of Division 20 00 00 work before proceeding.
- 1.8.13. Leave areas clear for future equipment and maintenance including coil/fan removal.

1.9. REGULATORY REQUIREMENTS

- 1.9.1. Meet the requirements of Section 01 41 00.
- 1.9.2. Meet the requirements and recommendations of all Municipal, Provincial and Federal Bylaws and Ordinances.
- 1.9.3. In general, the physical and chemical properties and characteristics of Division 20 00 00 work shall meet the requirements of recognized agencies which shall include:

AMCA	-	Air Moving & Conditioning Association
ADC	-	Air Diffusion Council
ANSI	-	American National Standards Institute
AHRI	-	Air Conditioning & Refrigeration Institute
ASHRAE	-	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWWA	-	American Water Works Association
CGA	-	Canadian Gas Association
CGSB	-	Canadian General Standards Board
CIRI	-	Canadian Industrial Risk Insurers

CSA	-	Canadian Standards Association
CTI	-	Cooling Tower Institute
EGC	-	Enbridge Gas Company
FCC	-	Federal Communication Commission
FM	-	Factory Mutual
IAO	-	Insurers Advisory Organization
LEED	-	Canadian Green Buildings Council
MMC	-	Marsh McLennan Insurance Protection Consultants
MTC	-	Ministry of Transportation and Communication
NBCC	-	National Building Code of Canada
NFPA	-	National Fire Protection Association
OBC	-	Provincial Ontario Building Code
OFM	-	Local Fire Codes or Standards Ontario Fire Marshall
OH	-	Ontario Hydro Special Inspection Department
OME	-	Ontario Ministry of Environment
OML	-	Ministry of Labour and Workmen's Compensation Requirements
OWRA	-	Ontario Plumbing Code
TBD	-	Local Building Codes City of Toronto, Buildings Department
TSSA	-	Technical Standards & Safety Authority
UL	-	Underwriter's Laboratories Inc.
ULC	-	Underwriter's Laboratories of Canada

1.9.4. Give all necessary notices, obtain all permits and pay for fees, taxes and other costs in connection with the work. File all necessary forms, Contract Documents and prepare submissions and obtain approvals of regulatory bodies having jurisdiction.

1.9.5. Comply with the requirements of the Model National Energy Code for Buildings or ASHRAE 90.1-2013 in the selection, application and installation of all mechanical equipment and systems.

1.10. CHANGES TO CONTRACT WORK

1.10.1. Do not proceed with changes to Work without written authority from the Owner.

1.10.2. Follow procedures outlined in Tendering and Contract Requirements for administration and execution of Contract revisions.

1.10.3. Quotations for changes to work shall be determined by one of the following methods as selected by the Owner (Construction Manager) (Consultant).

1.10.3.1. By estimate and acceptance of a lump sum ("Lump Sum method");

1.10.3.2. Where unit prices, discounts and allowances are set out in the Contract documents or subsequently agreed upon, in accordance with such unit prices ("Unit Price method");

1.10.3.3. By actual time and material costs and a fixed or percentage fee for overhead and profit ("Time and Material method").

1.10.4. Changes in the work evaluated using the lump sum method shall be based on the following factors:

1.10.4.1. For Base Labour Units - The most recent edition of the Mechanical Contractors Association Labour Calculator and SMACNA published Labour Units, latest edition. If required/applicable, factors affecting productivity as outlined in the document "Change Order Protocol" shall include the following additional factors when evaluating change pricing:

- 1.10.4.1.1. Site Conditions
 - 1.10.4.1.2. Clean Up
 - 1.10.4.1.3. Material Handling
 - 1.10.4.1.4. Scheduling
 - 1.10.4.1.5. Time Keeping
 - 1.10.4.1.6. Mobilization and Demobilization
 - 1.10.4.1.7. Labour Warranties (not included in Labour Rate)
 - 1.10.4.1.8. Estimating
 - 1.10.4.1.9. Fabrication Drafting
 - 1.10.4.1.10. Measuring
 - 1.10.4.1.11. Printing
 - 1.10.4.1.12. Record Drawings and As-Built Drawings
 - 1.10.4.1.13. Interference Drawings
 - 1.10.4.1.14. LEED Requirements (if certification pursued)
 - 1.10.4.1.15. Garbage Sorting, Tagging, Disposal
 - 1.10.4.1.16. Installation Height (applies to work 10 feet [3m] or more above working surface)
 - 1.10.4.1.17. Multi-storey - lost productivity factor
 - 1.10.4.1.18. Environmental conditions - lost productivity factor
 - 1.10.4.1.19. Availability of personnel - lost productivity factor
 - 1.10.4.1.20. Stacking of trades - lost productivity factor
 - 1.10.4.1.21. Abnormal work schedule - lost productivity and increased supervision factor(s)
 - 1.10.4.1.22. Crew size inefficiency – use of larger than planned workforce
- Under no circumstances shall the cumulative total of additional factors exceed 20% of the hours established using Base Labour units.
- 1.10.5. Where changes are evaluated using either the Lump Sum method, or the Time and Material method use Labour Rates defined on the Bid Form in effect at the time of bid submission and adjusted from time to time by changes to applicable legislation and/or Union Contract. The Labour Rate shall include:
 - 1.10.5.1. Base Rate
 - 1.10.5.2. Vacation/Stat Pay
 - 1.10.5.3. Union Deductions and Charges

- 1.10.5.4. Legislated Burdens
- 1.10.5.5. Expendable Small Tools
- 1.10.5.6. Finance Payroll
- 1.10.5.7. Rest Breaks
- 1.10.5.8. Idle Time
- 1.10.5.9. Safety
- 1.10.5.10. Labour Warranties
- 1.10.5.11. Parking
- 1.10.6. Where changes are evaluated using either the lump sum method, or the time and material method, the cost to the Owner shall be the actual cost of credits and, where additional work is required, the cost to the Owner shall be the actual cost plus a percentage covering overhead and profit, after all credits included in the change have been deducted.
- 1.10.7. Where "credit" changes are estimated, the overall factors used to establish the value of the change shall not be less than 80% of equivalent factors used for "add" changes.
- 1.10.8. Where changes are evaluated using either the lump sum method, or time and material method, the markup for overhead and profit shall be limited to and be calculated as follows:
 - 1.10.8.1. Work carried out by the Trade Contractor or Trade Subcontractor: 10% overhead and profit combined.
 - 1.10.8.2. Trade Contractor's overhead and profit on Trade Subcontractor's work: 5% overhead and profit combined.
 - 1.10.8.3. Credits to Owner's account: For changes involving deletions only, overhead and profit shall not be deducted.
 - 1.10.8.4. Trade Contractor and trade Subcontractor's overhead and profit shall be calculated on net additional work only.
 - 1.10.8.5. The cumulative total percentage for overhead and profit charged by the Trade Contractor, Trade Subcontractor and others shall not exceed 20% of the cumulative total value of such change in the work, net of overhead and profit.
- 1.10.9. Where changes are evaluated using the Unit Price method, the value of the change shall be based on the net difference in quantities with the appropriate unit rate applied.
- 1.10.10. Where changes are extensive, or where requested by the Consultant, material and labour take-off shall be organized on a drawing by drawing basis or area by area basis to more readily facilitate verification of quantities and labour hours.
- 1.11. PREPURCHASED EQUIPMENT**
 - 1.11.1. Where equipment has been prepurchased by the Owner, assume complete responsibility for acceptance, delivery schedule, off-loading, storage, rigging, installation, protection, startup and warranty of this equipment, as if the equipment was provided by this Division.

- 1.11.2. Responsibilities of the equipment supplier are delineated in the pre-purchase documents which are available for Contractor review during the bid period.
- 1.11.3. The following equipment has been pre-tendered in order to ensure equipment delivery in time to meet the building construction schedule.
- 1.11.4. Include in Contract Price, the cost of the following prepurchased equipment.
- 1.11.5. Exclude the cost of other prepurchased mechanical equipment from the Contract Price.
- 1.11.6. Request from the Supplier, full details of the equipment and the manufacturer's Shop Drawings. Include related information in the Operating and Maintenance Manual.
- 1.11.7. Assume extensions of warranties to meet specified times.

1.12. WARRANTY

- 1.12.1. Meet the requirements of Tendering and Contract Requirements.
- 1.12.2. Warranty all equipment, material and workmanship for not less than one year from date of Substantial Performance of the Work, or for longer periods when stated elsewhere in the Specifications.
- 1.12.3. If any equipment or material does not match the manufacturer's published data or rating schedules during performance tests, replace without delay. Bear all associated costs of replacement. Adjust all components to achieve the specified ratings.
- 1.12.4. The Owner will give notice of observed defects promptly in writing.
- 1.12.5. Promptly correct defects and deficiencies which originate during the warranty period. Pay for resulting damage.

1.13. INSTRUCTIONS TO BIDDERS

- 1.13.1. Submit Supplementary Mechanical Bid Form. Failure to comply with the stated requirements of the Bid Form may nullify the bid.
- 1.13.2. Pay attention to "Basis of Design", "Alternative" and "Alternate" manufacturers and supplier defined in Section 20 25 00.
- 1.13.3. The Bidder is invited to submit additional alternate prices not specifically requested with the Bid.
- 1.13.4. Alternate prices may be used to establish the lowest Contract Price.
- 1.13.5. The lowest or any Bid will not necessarily be accepted.

1.14. SEPARATE AND IDENTIFIED PRICES

- 1.14.1. Submit separate and identified prices on the Bid Form and express as a credit or an extra to the Stipulated Bid Sum. Do not include Separate prices in the Stipulated Bid Sum. Include Identified Prices in the Stipulated Sum.
- 1.14.2. Calculation of the Contract Price will include separate prices consistent with their acceptance or rejection by the Owner.

1.15. ITEMIZED PRICES

- 1.15.1. Itemized prices shown in Section 20 20 00 shall be included in the Stipulated Bid Sum.
- 1.15.2. Itemized prices are requested for accounting purposes only, or to delegate certain costs to third parties.

1.16. QUALITY ASSURANCE

- 1.16.1. All mechanical work is to be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on-site supervision of an experienced journeyman tradesman. The use of apprentice tradesmen is to be limited and the journeyman/apprentice ratio is subject to the Consultant's approval.
- 1.16.2. All journeyman tradesmen are to have valid trade certificates available at the site for review by the Consultant at any time.
- 1.16.3. An experienced and qualified superintendent is to be onsite at all times when mechanical work is being performed.

1.17. WORKPLACE SAFETY

- 1.17.1. Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required and maintain one copy at the site in a visible and accessible location available to all personnel.
- 1.17.2. Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations.
- 1.17.3. If at any time during the course of the work asbestos containing materials, black mould, lead paint, or any other such materials are encountered or suspected, immediately report the discovery to the Consultant and cease all work in the area in question. Do not resume work in affected areas until the situation has been properly corrected and without written approval from Owner.

PART 2 - SUBMITTALS

2.1. SHOP DRAWINGS

- 2.1.1. Submit shop drawings via email in pdf format only. Provide hard copy reproduction of all shop drawings for manuals, authorities having jurisdiction, the Owner and for coordination among other Trades. Identify Shop Drawing by Specification index reference and project name.
- 2.1.2. Review all Shop Drawings prior to submittal and clearly certify as 'Correct for Review by Consultant'. Show company name, date and sign all Shop Drawings.
- 2.1.3. Consultant review of Shop Drawings does not relieve the Contractor of full responsibility for errors, necessity to check Shop Drawings, furnish materials and equipment and perform work required by the Contract Documents.
- 2.1.4. Clearly identify all components, accessories, including options to be supplied with each item.
- 2.1.5. Division 20 shall coordinate and identify any electrical deviations for equipment as identified in the contract documents with Division 26 trades prior to submitting a shop drawing for review.

This shall include coordination and assignment of any potential cost impacts for deviations. Any revisions required to electrical services to suit equipment power requirements shall be at no cost to the owner and shall be borne by Division 20. Shop drawings shall clearly indicate and identify all electrical deviations.

- 2.1.6. Submitted product data shall include sufficient detail to allow a reasonable assessment of the equipment being provided. The data shall include, but not be limited to:
 - 2.1.6.1. dimensions, including service clearance requirements
 - 2.1.6.2. design and working pressure ratings of pressure vessels and line components
 - 2.1.6.3. shipping and operating weight including accessories and working fluids, together with point loadings
 - 2.1.6.4. performance specifications including pump and fan curves/charts
 - 2.1.6.5. part load operational capabilities and limitations
 - 2.1.6.6. sound power levels
 - 2.1.6.7. materials of construction including exterior and internal finishes
 - 2.1.6.8. factory test standards rating conformance to recognized and applicable industry standards
 - 2.1.6.9. extended warranty coverage
 - 2.1.6.10. electrical requirements, including complete wiring diagrams clearly defining field, internal and factory wiring scope
 - 2.1.6.11. motor, power or control wiring requirements including rated voltage, phase and cycle, rated power draw, full load current, motor size and speed, motor frame size, type of enclosure and maximum rated temperature rise
 - 2.1.6.12. product installation, startup and operation manuals
 - 2.1.6.13. statement of compliance with the Model National Energy Code of Canada, as applicable
- 2.1.7. Incomplete submissions will be returned as unacceptable.
- 2.1.8. Bind one set of reviewed Shop Drawings in each Operating and Maintenance Manual.
- 2.1.9. Provide shop drawings for specified items as follows:

Section	Title	Equipment
20 05 48	Sound and Vibration Controls	Silencers Vibration Isolators
21 12 00	Standpipe and Hose Stations	Fire Valves Cabinets and Accessories
21 13 00	Sprinkler Systems	Sprinkler Layouts Sprinkler Hydraulic Calculations Sprinkler Heads - Data Sheets and Samples

Section	Title	Equipment
22 15 00	Compressed Air Systems	Valves Outlet Reducing Stations Air Compressors
22 30 00	Plumbing Specialties	Drainage Products Backflow Preventers Domestic Water Recirculation Pumps Water Meters
22 33 00	Domestic Water Heaters	Instant Hot Water Dispensers
22 40 00	Plumbing Fixtures	Plumbing Fixtures Plumbing Trim Emergency Equipment
22 63 00	Medical Gas Piping Systems	Medical Compressed Air System Medical Vacuum System
23 05 93	Balancing	Air Balancing Reports Water Balancing Reports
23 31 00	Sheet Metal	Access Doors Fire Dampers Smoke Dampers Exhaust Hoods
23 33 13	Positive Seal Motorized Dampers	Dampers
23 34 00	Fans	Fans
23 36 30	Air Terminal Control Units - Digital	Air Terminal Control Units
23 37 13	Air Terminals	Grilles and Diffusers Light Troffers Air Boots Factory Test Reports
23 39 00	Louvres	Louvres
23 55 23	Radiant Heaters	Radiant Heaters
23 60 00	Condensers	Condensing Units
23 76 00	Direct Expansion Air Conditioners	A.C. Units
23 82 00	Hydronic Terminal Units	Wallfin Custom Enclosure Radiators Convactor Radiators Cabinet Unit Heaters Forced Convection Radiation Units Unit Heaters

Section	Title	Equipment
23 82 16	Air Coils	Water Coils DX Coils
23 82 19	Fan Coil Units	Fan Coil Units
23 82 50	Electric Heating	Heating Cable Convectors Unit Heaters Baseboards Insert Heaters Reheat Coils Infrared Heaters
25 50 00	Electronic Controls and Monitoring	Control Systems Description Control Systems Diagrams DDC Hardware OWS and Accessories

2.2. ALTERNATIVE MANUFACTURER AND SUPPLIER

- 2.2.1. Equipment and materials are specifically described for the purpose of indicating standards of quality and workmanship. Base Bid on the items specified in Section 20 25 00 as "Basis of Design" or "Alternative Manufacturer".
- 2.2.2. Maximize the Canadian content of all equipment and materials used on this project.
- 2.2.3. Alternate equipment or materials may be submitted with the Bid Form, indicate appropriate cost saving. Supply with each alternative, following bid submission, upon request by Consultant, the following information:
- 2.2.3.1. details of manufacturer
 - 2.2.3.2. dimensions including required clearance
 - 2.2.3.3. performance data
 - 2.2.3.4. the cost saving for piping, ductwork and electrical changes imposed by the alternative
 - 2.2.3.5. the effect upon and estimated cost to other trades
 - 2.2.3.6. Canadian content percentage
- 2.2.4. Where alternates are accepted, there will be no further cost allowances for subsequent changes in Division 20 00 00 work or other Contracts to make the alternates complete and equal to the specified equipment and materials.
- 2.2.5. If alternate equipment is accepted, prepare when requested equipment layouts at no extra cost. Show clearly in plan, elevations and sections, all equipment details including dimensional changes. Show location changes to ducts, pipes and wiring and the effect of these changes on the building. Drawings shall be {1:50}[1/4"=1'0"] scale.
- 2.2.6. The right is reserved to accept or reject any alternative.

2.3. SAMPLES

- 2.3.1. Submit samples or provide site mockup of proposed materials upon request of the Consultant, including:
 - 2.3.1.1. valve tags and equipment identification plates
 - 2.3.1.2. insulation and adhesives
 - 2.3.1.3. access doors
 - 2.3.1.4. hangers, pipe supports, inserts and fastening devices
 - 2.3.1.5. pipe and duct identification
 - 2.3.1.6. sprinkler heads and guards
 - 2.3.1.7. flexible ductwork
 - 2.3.1.8. lavatory trim
 - 2.3.1.9. thermostat, cover and guards
 - 2.3.1.10. radiation covers, supports and hangers
 - 2.3.1.11. access doors and panels
 - 2.3.1.12. diffusers, registers and grilles
 - 2.3.1.13. air terminal control unit
 - 2.3.1.14. air filters
 - 2.3.1.15. thermometers
 - 2.3.1.16. pressure gauges
 - 2.3.1.17. EMCS instrumentation
 - 2.3.1.18. supervisory switch
- 2.3.2. Provide site mockup of proposed materials before proceeding.

2.4. COORDINATION DRAWINGS

- 2.4.1. Division 20 00 00 shall take the lead role in preparation of electronic interference/coordination drawings. Use all other disciplines' electronic drawings as basis for preparation of interference drawings. Position all Division 20 00 00 services to accommodate the work of other divisions.
- 2.4.2. Division 20 00 00 shall take the lead role in preparation of Revit interference/coordination drawings. Use all other disciplines' Revit drawings as basis for preparation of interference drawings. Position all Division 20 00 00 services to accommodate the work of other divisions.
- 2.4.3. Prior to commencement of work, submit for Consultant review, pipe, duct and equipment interference and sleeving drawings for each floor level and for all Division 20 00 00 work. Drawings must be coordinated and certified correct for review.

- 2.4.4. Coordination drawings shall be to a scale sufficient to show the necessary details. Submit for review, using the same procedures as specified for Shop Drawings.
- 2.4.5. Prepare drawings in conjunction with other Divisions, wherever possible conflict due to the positioning of Division 20 00 00 equipment, piping or ductwork exists.
- 2.4.6. Dimension proposed location of Division 20 00 00 work with respect to building elevations and established grid lines.
- 2.4.7. Prepare fully dimensioned detail drawings of all shafts, duct spaces and pipe spaces. Show sleeving, recessed and formed holes required in concrete for Division 20 00 00 work. Include information pertaining to access, clearances, tappings, housekeeping pads, drains and electrical connections.
- 2.4.8. Base information used to prepare drawings on reviewed Shop Drawings.
- 2.4.9. Provide field drawings with position of various services when required by Consultant.
- 2.4.10. Submit a list of access doors and panels showing proposed type, size and location. Coordinate drawings with Architectural detail drawings and reflected ceiling plans prior to submission.
- 2.4.11. Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to your work.
- 2.4.12. All shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- 2.4.13. Use the project's CAD files as the starting point for the creation of coordination drawings. Use the structural steel contractor's CAD files and not the design files. The contractor's drawings will show angles, braces, supports, etc. that are not in the design model. Use the electrical contractor's CAD file in combination with the electrical consultant's model.
- 2.4.14. Continuously update the CAD model to accurately reflect all instructions issued by the architect and consultants in whatever format these instructions are issued. They most likely will not be issued as CAD files.
- 2.4.15. Use the project's Revit files as the starting point for the creation of coordination drawings. Use the structural steel contractor's Revit files and not the design files. The contractor's drawings will show angles, braces, supports, etc. that are not in the design model. Use the electrical contractor's Revit file in combination with the electrical consultant's model.
- 2.4.16. Include the cost of a full time Revit designer(s) for the full term of construction starting the day the project is awarded. Ensure appropriate staffing resources are allocated based on the size and complexity of this project. This person(s) along with the designated mechanical project manager will be responsible for the full coordination of all mechanical services with the existing building, new construction, and all new and existing services from all disciplines.
- 2.4.17. Continuously update the Revit model to accurately reflect all instructions issued by the architect and consultants in whatever format these instructions are issued. They most likely will not be issued as Revit files.

- 2.4.18. The tender documents, including the Revit model, are not complete and fully coordinated. The model is not to be considered complete enough to build from. The mechanical contractor must fully develop a Revit model using models from all other contractors and fully coordinate the installation prior to fabrication or installation of any services. Submit the completed model for review.

2.5. RECORD DRAWINGS

- 2.5.1. Meet the requirements of Section 01 78 39.
- 2.5.2. Suitably store and protect drawings on site and make available at all times for inspection.
- 2.5.3. Record inverts of underground piping at building entry/exit and below floor slab at each branch, riser base, change in direction as well as at least three points on straight runs.
- 2.5.4. Show locations of access doors and panels and identify the equipment and components that they serve.
- 2.5.5. Transfer all record drawings to AutoCAD prior to submission to Consultant.
- 2.5.6. Submit record drawings for review in PDF format.
- 2.5.7. Complete Mechanical Revit Model will be submitted to the Owner and Consultant.

2.6. OPERATING AND MAINTENANCE MANUALS

- 2.6.1. Meet the requirements of Section 01 78 00. Arrange manuals into system sections and subsections consistent with the layout and function of the mechanical system.
- 2.6.2. It is absolutely unacceptable to submit the operations and maintenance manual in "bits and pieces". Submit one comprehensive fully complete manual for review.
- 2.6.3. Submit a searchable PDF file.
- 2.6.4. Submit one fully organized PDF for review at least two weeks before instructions to Owner are commenced.
- 2.6.5. Submit one final manual after incorporating all requested changes to the consultant.
- 2.6.6. Ensure that the terminology used in various sections of the manual is consistent.
- 2.6.7. Each manual shall contain the following information:
- 2.6.7.1. description of each system with description of each major component of system
 - 2.6.7.2. complete sets of page size equipment Shop Drawings
 - 2.6.7.3. equipment manufacturer's installation, startup and operation manuals
 - 2.6.7.4. equipment manufacturer's recommended spare parts lists
 - 2.6.7.5. equipment wiring diagrams
 - 2.6.7.6. lubrication schedule for all equipment
 - 2.6.7.7. equipment identification list with serial numbers

- 2.6.7.8. page size valve tag schedule and flow diagrams
- 2.6.7.9. final balancing reports
- 2.6.7.10. water treatment procedure and tests
- 2.6.7.11. control drawings, sequences of operation
- 2.6.7.12. extended warranty documentation
- 2.6.7.13. belt schedule/inventory/list

PART 3 - EXECUTION

3.1. INSPECTION, TESTING AND CERTIFICATES

- 3.1.1. Periodic inspections of the work in progress will be made to check general conformity of the work to the Contract Documents. Observed deficiencies will be reported. Correct deficiencies immediately.
- 3.1.2. Meet the requirements of all laws, bylaws, codes, regulations and authorities having jurisdiction.
- 3.1.3. Where the Contract Documents, instructions or the governing authorities require Division 20 00 00 work to be tested, inspected, or approved, give sufficient notice of its readiness for inspection and schedule the date and time for such inspection.
- 3.1.4. Uncover Division 20 00 00 work that is covered up without consent, upon Consultant request, for examination and restore at no extra cost to the Owner.
- 3.1.5. Furnish certificates and evidence that Division 20 00 00 work meets the requirements of authorities having jurisdiction.
- 3.1.6. Correct deficiencies immediately upon notification.

3.2. TEMPORARY SERVICES

- 3.2.1. Provide temporary mechanical services in accordance with the requirements of Section 01 50 00.
- 3.2.2. Make connections to temporary power source for use by Division 20 00 00.
- 3.2.3. Provide and maintain temporary fire protection services as required by the authorities having jurisdiction.
- 3.2.4. When the permanent water service is installed, it shall be used to supply water for the use of Other Contractors.
- 3.2.5. Perform operations necessary for checking, testing and balancing after written approval is given to start up systems. Ensure that care is taken to protect equipment from damage and to prevent distribution of dust through duct systems.
- 3.2.6. Do not use permanent plumbing, heating or air conditioning systems for temporary services during construction, except with written permission from Consultant.

3.3. CUTTING AND PATCHING

- 3.3.1. Meet the requirements of Section 01 73 29.

- 3.3.2. Give notification in time to Other Contractors of openings required for Division 20 00 00 work. Supply accurate details of location and size. When this requirement is not met, bear the cost of cutting and patching.
- 3.3.3. In existing work, cutting, patching and restoration of finished work to original condition will be carried out by Other Contractors at the expense of Division 20 00 00.
- 3.3.4. Obtain written Consultant approval before cutting openings through structure.
- 3.3.5. Where new work connects with existing and where existing work is altered, cut, patch and restore to match existing work.

3.4. PROTECTION

- 3.4.1. Protect all work from damage. Keep all equipment dry and clean at all times.
- 3.4.2. Cover openings in equipment, pipes and ducts, with caps or heavy gauge plastic sheeting until final connections are made.
- 3.4.3. Repair any damage caused by improper storage, handling or installation of equipment and materials.
- 3.4.4. Protect equipment, pipes and temporary services from weather damage.

3.5. TEMPORARY AND TRIAL USE

- 3.5.1. Obtain written permission from Consultant to use and test permanent equipment and systems prior to Substantial Performance acceptance by Consultant.
- 3.5.2. Consultant may use equipment and systems for test purposes prior to acceptance. Provide labour, fuel, material and instruments required for testing. Rectify incomplete work immediately to satisfaction of Consultant.
- 3.5.3. Protect equipment and system openings from dirt, dust and other foreign materials during temporary usage. Whenever air handling systems are used for temporary services, in addition to other requirements specified, provide minimum {12 mm}{1/2"} thick glass fibre filter media in all supply openings, exhaust opening and all return air openings, transfer openings and other identified openings.
- 3.5.4. In all HVAC equipment serving construction areas, provide temporary {15 mm}{1/2"} thick glass fiber filter media upstream of all equipment filter assemblies.
- 3.5.5. Maintain all temporary filters described above throughout the duration of the project. Replace filters as necessary.
- 3.5.6. Clean and renew equipment and systems used prior to acceptance.
- 3.5.7. Warranty, including duration and commencement date, shall not to be affected by startup date of equipment.

3.6. CAN/ULC-S1001 COMMISSIONING ASSISTANCE

- 3.6.1. Assist the Integrated Testing Coordinator through the Integrated Systems Testing of Fire Protection and Life Safety Systems per CAN-ULC-S1001 and Ontario Building Code Section 3.2.10. Provide support staff that are experienced and technically knowledgeable on the subject matter. Coordinate with the testing coordinator in advance of the testing dates and provide all

input they may request. Make staff available for all testing dates and subsequent review periods.

- 3.6.2. Take the lead in coordinating the efforts with the TAB contractor (Section 23 05 93), fire protection sprinkler trade (Section 21 13 00), and controls contractor (Section 25 50 00).

3.7. COMPLETION

- 3.7.1. Meet the requirements of Section 01 78 13.
- 3.7.2. Remove all debris from inside systems and equipment.
- 3.7.3. Rectify deficiencies and complete work before submitting request for Substantial Performance inspection.
- 3.7.4. Follow manufacturer's written instructions regarding bearing lubrication.
- 3.7.5. Check and align all drives to manufacturer's acceptable tolerances.
- 3.7.6. Adjust belts for proper tension.
- 3.7.7. Check and align all pumps to manufacturer's acceptable tolerances.
- 3.7.8. Remove all temporary protection and covers.
- 3.7.9. Remove oil and grease from equipment and bases.
- 3.7.10. Clean all fixtures and equipment. Polish all plated surfaces.
- 3.7.11. Vacuum clean the inside of all air handling systems, including fans, ducts, coils and terminal units to ensure that they are free from debris and dust.
- 3.7.12. Change air and water filters.
- 3.7.13. Remove, clean and reinstall pipeline strainer screens.
- 3.7.14. Leave Division 20 00 00 work in as new working order.

3.8. INSTRUCTIONS TO OWNER

- 3.8.1. Meet the requirements of Section 01 79 00.
- 3.8.2. Submit check lists for each system or piece of equipment, indicating that all components have been checked and are complete prior to instruction period.
- 3.8.3. Thoroughly instruct the Owner in the safe and efficient operation of the systems and equipment.
- 3.8.4. Arrange and pay for the services of qualified manufacturer's representatives to instruct Owner on specialized portions of the installation, such as refrigeration machines, boilers, automatic controls and water treatment.
- 3.8.5. Submit a complete record of instructions given to the Owner. For each instruction period, supply the following data:
- 3.8.5.1. date

- 3.8.5.2. duration
- 3.8.5.3. system or equipment involved
- 3.8.5.4. names of persons giving instructions
- 3.8.5.5. names of persons being instructed
- 3.8.5.6. other persons present
- 3.8.6. Submit receipted verification of completed training to Consultant prior to final release of retentions.
- 3.8.7. Carry out instructional period during a period of 5 days scheduled at Owner's convenience.

3.9. INTERRUPTION OF EXISTING SERVICES

- 3.9.1. Arrange, schedule and perform work with minimum disturbance to existing facilities and services.
- 3.9.2. Submit a complete schedule of service interruptions and changeovers with approximate dates required, durations and times of day, for approval at commencement of project and during the shop drawing phase.
- 3.9.3. Include for all pipe freezing and hot tap procedures to connect to existing systems.
- 3.9.4. Notify Owner at least 72 hours in advance of planned interruption to existing services.
- 3.9.5. Interruption of services must occur after hours at the times and for the duration stipulated by the Owner.
- 3.9.6. Keep service interruption duration to an absolute minimum. Carry out all preparatory work, measurements, prefabrication, etc., without interruption of existing services.
- 3.9.7. If service interruptions are required by the Owner during the night or on weekends, etc., premium time shall be included in the Contract Price. No extra charges will be allowed at a later date for failure to include same.

3.10. REMOVAL AND REUSE OF EXISTING MATERIALS

- 3.10.1. Carry out demolition work in accordance with the Occupational Health and Safety Code.
- 3.10.2. Remove existing equipment, services and obstacles where required for refinishing or restoring existing surfaces. Replace same as work progresses.
- 3.10.3. Include for removal and disposal of all equipment and systems hazardous substances including refrigerant, oil, fuel oil and other hazardous substances to meet all local laws, regulations and bylaws.
- 3.10.4. Turn over to the Owner existing material and equipment removed but not identified for reuse on site. Acceptance of removed material and equipment is at discretion of Owner. Remove such items from site when deemed unsuitable.
- 3.10.5. Period to be scheduled.
- 3.10.6. Where computer room air conditioning equipment is indicated to be existing, include for the disconnection and removal of this equipment from the location of existing equipment. Include

for protection of the equipment per equipment manufacturer's recommendations, transport to the new building and position to locations shown on the Drawing.

- 3.10.7. Prepare new site for immediate conversion and connection of reused equipment. Carry out all preparatory work, measurements, prefabrication, etc., without interruption of existing services. All work to disconnect, remove, relocate, convert, connect, test and commission reused equipment shall be performed during a two-day weekend shutdown period. Include premium time in the Contract Price.
- 3.10.8. Execute work with least possible interference or disturbance to Owner and to other work taking place over the same time period.
- 3.10.9. Use only elevators assigned for Contractor use for moving men and material within buildings. Protect walls of elevators to satisfaction of Owner prior to use and accept liability for damage, safety of equipment and overloading of existing equipment.

3.11. PROTECTION OF OWNER'S PREMISES

- 3.11.1. Adhere strictly to the Owner's requirements.
- 3.11.2. Confer with the Owner concerning schedule, dust and noise control prior to commencing work in or adjacent to existing facilities where such work might affect either those facilities or their occupants.
- 3.11.3. Execute work with least possible interference or disturbance to occupants, public and normal use of premises.
- 3.11.4. Provide temporary means to maintain security when security has been reduced by work under this Division.
- 3.11.5. Only elevators, dumbwaiters, conveyors or escalators assigned for Contractor's use may be used for moving men and material within building. Protect walls of passenger elevators, to approval of Owner prior to use. Accept liability for damage, safety of equipment and overloading of existing equipment.
- 3.11.6. Provide temporary dust screens, barriers, warning signs in locations where renovations and alteration work is adjacent to areas which will be operative during work.
- 3.11.7. Drawings indicate approximate locations of known existing underground and above ground facilities. Avoid damage to existing services. Bear the cost of repairs and replacements.
- 3.11.8. Immediately advise Consultant when unknown services are encountered and await instructions.
- 3.11.9. Accept liability for costs incurred by the Owner in repairing and cleaning equipment, etc., resulting from failure to comply with the above requirements.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Provide all labour, materials, products, equipment and services to supply and install the basic mechanical materials indicated on the Drawings and specified in all mechanical specifications including, but not limited to, Division 20, 21, 22, 23, 25 of these Specifications.

1.2. EQUIPMENT CONDITION, STORAGE, AND HANDLING

- 1.2.1. All equipment and materials provided under Division 20 shall be new, unused, and of current manufacture at the time of delivery to site. Equipment shall have a manufacturing date no more than 18 months prior to installation unless approved otherwise in writing by the Consultant.
- 1.2.2. Store all equipment and materials in accordance with the manufacturer's written recommendations. Provide protective measures appropriate to the equipment type, duration of storage, and environmental conditions.
- 1.2.3. Maintain original packaging and crating until installation unless earlier removal is required for inspection, submittals, or coordination.
- 1.2.4. Store all materials and equipment in a clean, dry, and secure location protected from weather, physical damage, and contaminants including dust, moisture, UV radiation, and corrosive substances.
- 1.2.5. Protect equipment with moving parts (e.g., pumps, fans, compressors, motors) from vibration during storage. Use shipping blocks or restraints as recommended by the manufacturer.
- 1.2.6. Rotate stored mechanical equipment such as motors or pumps in accordance with the manufacturer's storage procedures to prevent damage to bearings, seals, and shafts.
- 1.2.7. Where outdoor storage is unavoidable, provide weatherproof, ventilated enclosures or covers that prevent water ingress and condensation. Elevate materials off the ground to prevent contact with moisture.
- 1.2.8. Handle and store materials in a manner that prevents deformation, warping, impact damage, or contamination. Use lifting equipment and handling procedures appropriate to the product.
- 1.2.9. Replace any equipment or materials found to be damaged, corroded, improperly stored, or otherwise unsuitable for installation at no additional cost to the Owner.
- 1.2.10. For equipment expected to be stored on site for longer than three (3) months, submit the manufacturer's recommended storage and maintenance procedures as part of the shop drawing submission.
- 1.2.11. Inspect all equipment and materials upon delivery. Replace or repair items found to be damaged in transit at no additional cost to the Owner.

1.3. IDENTIFICATION OF MECHANICAL SERVICES

- 1.3.1. Identify all mechanical services after finish painting is complete.
- 1.3.2. Use terminology consistent:
- 1.3.2.1. with the Drawings and Specifications.
- 1.3.2.2. with the Owner's requirements and standards.

- 1.3.3. Identify lay-in type acoustic ceilings used for access to equipment and components by a method acceptable to Consultant.
- 1.3.4. Mark valve and equipment identification on Record Drawings.
- 1.3.5. Provide typewritten master lists for each Equipment Room. Frame under glass. Insert copies in Operating and Maintenance Instruction Manuals.

1.4. PIPE AND DUCTWORK IDENTIFICATION

- 1.4.1. Provide SMS Wrap-Mark or Primark Pipe Markers on all pipe coverings, using Wrap-Mark pipe markers with flow arrow and alternating wording. For outside diameters up to {150 mm}{6"}, allow marker to completely wrap pipe. For larger outside diameters, secure markers with stainless steel springs. Secure markers on vertical piping and elsewhere where markers could be inadvertently moved.
 - 1.4.2. Use stencils and stencil paint on ductwork or ductwork insulation. Apply solid black capitalized lettering {50 mm}{2"} high and solid black flow arrows {150 mm}{6"} long x {50 mm}{2"} wide.
 - 1.4.3. Locate identification and flow arrows so they can be seen clearly from floor and service platforms:
 - 1.4.3.1. at least once in each room
 - 1.4.3.2. at each piece of equipment
 - 1.4.3.3. at each branch close to connection point to main piping and ductwork
 - 1.4.3.4. at not greater than intervals of {15 metres}{50 ft} on straight runs of exposed piping and ductwork
 - 1.4.3.5. at entry and leaving point to pipe and duct chases, or other concealed spaces
 - 1.4.3.6. both sides where piping and ductwork passes through walls, partitions and floors
 - 1.4.3.7. on vertical pipes and ducts approximately {1800 mm}{6 ft} above floor
 - 1.4.3.8. behind each access door and panel
 - 1.4.3.9. at valves, identify piping upstream of valves and identify branch, equipment, building part or building serviced downstream of valve
 - 1.4.4. Colour code pipes to meet code and Owner's requirements. At minimum, colour code pipes with {50 mm}{2"} wide bands in accordance with the detail shown on the drawings.
 - 1.4.5. Identify electrical tracing of pipes on pipe insulation.
- #### **1.5. VALVE TAGS**
- 1.5.1. Provide {40 mm}{1-1/2"} dia., {1 mm}{0.040"} thick brass tags with {10mm}{3/8"} high die-stamped black letters.
 - 1.5.2. Attach to valves with {100 mm}{4"} long brass chains.
 - 1.5.3. Tag all valves except for small valves isolating a single piece of equipment such as a unit heater, fan coil unit, terminal reheat coil and radiation section.

1.6. EQUIPMENT NAMEPLATES

- 1.6.1. Identify equipment, starters, and remote control devices in a manner consistent with the Drawings.
- 1.6.2. Use solid black capitalized lettering {100 mm}{4"} high.
- 1.6.3. Where equipment size does not permit stencil identification, use lamacoid labels, engraved white on black, mechanically fastened to the equipment. Minimum lettering size {10 mm}{3/8"}.

1.7. CONTROLS IDENTIFICATION

- 1.7.1. Meet Section 25 30 00 requirements.

1.8. FLOW DIAGRAMS

- 1.8.1. Prepare neat diagrams {1200 mm x 900 mm}{48" x 36"} of piping systems to identify equipment and valves.
- 1.8.2. Insert legible page size copies into each Operating and Maintenance Manual.
- 1.8.3. Install diagrams, framed under glass, on Equipment Room walls where directed by Owner.

PART 2 - PRODUCTS

2.1. INSERTS

- 2.1.1. Submit proposed materials and methods for cast-in-place inserts.
- 2.1.2. Where inserts must be placed after concrete is poured, use Phillips Red Head Multiset II Anchor system or equivalent Hilti System.

2.2. PIPING HANGERS AND SUPPORTS

- 2.2.1. Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with the Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe Hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to the following requirements:
 - 2.2.1.1. unless otherwise specified, all ferrous hanger and support products are to be electro-galvanized
 - 2.2.1.2. hangers and supports for insulated piping are to be sized to fit around the insulation and the insulation jacket
- 2.2.2. Horizontal suspended piping/hangers and supports shall be:
 - 2.2.2.1. adjustable steel clevis hanger – Anvil Fig. 260 – MSS Type 1
 - 2.2.2.2. adjustable swivel ring band type hanger – Anvil Fig. 69 – MSS Type 10
 - 2.2.2.3. adjustable roller hanger – Anvil Fig's 171, 177 & 181 – MSS Types 41, 43, and/or 45, with Anvil Fig. 160 to 166A – MSS Type 39 steel protection saddle
- 2.2.3. Horizontal pipe on vertical surfaces shall be:

- 2.2.3.1. steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170
- 2.2.3.2. heavy-duty steel pipe bracket – Anvil Fig. 262 or Myatt Fig. 161 – MSS Type 26
- 2.2.3.3. single steel pipe hook – Myatt Fig. 156
- 2.2.3.4. Epoxy coated steel pipe stays are not permitted
- 2.2.4. Floor supports for vertical risers shall be:
 - 2.2.4.1. copper tubing riser clamp – Anvil Fig. CT-121, Anvil Fig. CT-121C (plastic coated), or Myatt Fig. 150CT – MSS Type 8
 - 2.2.4.2. heavy-duty steel riser clamp – Anvil Fig. 261, or Myatt Fig's. 182, 183, 190 and 191 – MSS Type 8
- 2.2.5. Vertical piping on vertical surfaces shall be:
 - 2.2.5.1. steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170
 - 2.2.5.2. heavy-duty steel pipe bracket or soil pipe bracket – Anvil Fig. 262 or Myatt Fig. 161 – MSS Type 26
 - 2.2.5.3. extension split pipe clamp – Anvil Fig.'s 138R or Myatt Fig. 129 – MSS Type 12
 - 2.2.5.4. for piping on an existing roof – Portable Pipe Hangers (Canada) Inc. "PP" Series prefabricated portable pipe support system components to suit the pipe, complete with all required accessories including bases, galvanized structural steel frames, and galvanized steel pipe hangers and/or supports conforming to MSS SP-58
 - 2.2.5.5. for piping on new roofs – Lexcor "Flash-Tite" or Thaler Roofing Specialties Products Inc. "MERS" Series insulated aluminum support risers with diameter, height, securement method and flashing to suit the application, all required accessories, channel type aluminum cross members, and galvanized steel pipe hangers and/or supports conforming to MSS Type SP-58, complete with all required accessories
 - 2.2.5.6. for glass drain and vent piping – special padded hangers supplied by the pipe supplier
 - 2.2.5.7. for plastic piping – generally as specified above but in accordance with the pipe manufacturer's printed recommendations
 - 2.2.5.8. for fire protection piping – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of the NFPA Standard applicable to the piping system
 - 2.2.5.9. for bare horizontal copper piping – generally as above but factory vinyl coated to prevent direct copper/steel contact
 - 2.2.5.10. for bare copper vertical piping – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate the pipe from the clamp
 - 2.2.5.11. insulation protection shields to and including {40 mm}[1-1/2"] dia. – equal to Anvil "Rib-Lok" Fig. 168 galvanized steel shields with ribs to keep the shield centred on the hanger
 - 2.2.5.12. Epoxy coated steel pipe stays are not permitted.
- 2.2.6. Hanger rods shall be electro-galvanized carbon steel (unless otherwise specified), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers, sized to

suit the loading in accordance with Table 3 in MSS SP-58, but in any case minimum {9.5 mm}{3/8"} dia.

- 2.2.7. Base of vertical risers supports for vertical risers in excess of {6 m}{20'} high extending out from base mounted equipment is to consist of a base elbow support with flange equal to Empire Tool & Mfg. Co. Fig. 830.
- 2.2.8. Horizontal pipe on racks shall be Unistrut or equal galvanized steel pipe racks with pipe securing hardware as follows:
 - 2.2.8.1. standard galvanized steel U-bolts/clamps supplied by the rack manufacturer
 - 2.2.8.2. adjustable roller chair – Anvil Fig. 175 with Fig. 160-165 steel protection saddle
- 2.2.9. Special hangers and supports for various applications are as follows:
 - 2.2.9.1. vibration isolated riser supports – black steel riser clamps as specified above, complete with neoprene-steel-neoprene sandwich type vibration isolation pads between the clamp and the floor
 - 2.2.9.2. for groups of pipes having the same slope – Anvil Fig. 195 welded steel brackets, Anvil Fig. 46 universal trapeze assemblies, or Unistrut or equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place
 - 2.2.9.3. for sections of piping connected to vibration isolated equipment – hangers and supports as specified above but complete with MSS Type 48 spring cushions

2.3. PIPE ESCUTCHEON PLATES

- 2.3.1. One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the pipe sleeve or building surface opening, and to fit tightly around the pipe or pipe connection.

2.4. EQUIPMENT RIGGING SUPPORTS

- 2.4.1. Provide eyebolts suitable for block and tackle connection, adequately supported by the structure above for:
 - 2.4.1.1. chiller and condenser shell heads
 - 2.4.1.2. heat exchanger and shell heads
 - 2.4.1.3. sewage and bilge pumps
 - 2.4.1.4. pumps in Mechanical Equipment Rooms
 - 2.4.1.5. motors
 - 2.4.1.6. other equipment which will require block and tackle handling

2.5. SLEEVES, WALL AND FLOOR PLATES

- 2.5.1. For pipe sleeves, use machine cut and reamed standard weight steel piping.
- 2.5.2. For pipe sleeves in a parking garage, loading area, and structural chloride protection zones, stainless steel sleeves shall be used and shall extend minimum {125 mm}{5"} above the finished surface. Refer to structural drawings for the extent of chloride protection zones.

- 2.5.3. Concealed perimeter risers and runouts may have sleeves of {1.31 mm}[18 gauge] galvanized steel set around section of insulation to provide freedom of movement of piping. Extend {50 mm}[2"] above finished floor level.
- 2.5.4. For piping through exterior walls, cooperate with the waterproofing trade at all times, and do not break any waterproofing seal without consent of the waterproofing trade. Provide waterproof link seals as detailed on Drawings.
- 2.5.5. Provide leak plates where pipe sleeves pass through exterior building walls. Each leak plate shall be a {3.42 mm}[10 gauge] steel plate, welded to the sleeve, {100 mm}[4"] diameter greater than sleeve outside diameter.
- 2.5.6. Provide {1.31 mm}[18 gauge] galvanized steel duct sleeves. Provide adequate bracing for support of sleeves during concrete and masonry work. For fire rated floors and walls, build fire damper assemblies into structure to attain fire rated construction, in a manner acceptable to the governing authorities.
- 2.5.7. Cover pipe sleeves in walls and ceilings of finished areas, other than Equipment Rooms, with satin finish stainless steel, or satin finish chrome or nickel plated brass escutcheons, with non-ferrous set screws. Do not use stamped steel split plates. Split cast plates with screw locks, however, may be used.
- 2.5.8. Cover exposed duct sleeves in finished areas with {1.31 mm}[18 gauge] galvanized steel plates in the form of duct collars. Fix in position with non-ferrous metal screws.

2.6. PROVISION FOR PIPE EXPANSION, CONTRACTION AND BUILDING SHRINKAGE

- 2.6.1. Provide expansion loops and offsets to permit the safe expansion and contraction of piping due to thermal effects, building shrinkage and movement. Where space limitations do not permit the use of expansion loops or offsets, provide Flexonics Expansion Joints properly selected for system operating pressures according to the following:
 - 2.6.1.1. For piping up to and including {65 mm}[2-1/2"], select ends to suit specified pipe fittings. Pressure ratings for Model H and HB expansion compensated as {1400 kPa}[200 psi] and {1050 kPa}[150 psi].
 - 2.6.1.2. Steel Piping - Flexonics Model H expansion compensator with two ply stainless steel bellows.
 - 2.6.1.3. Copper Piping - Flexonics Model HB expansion compensator with two ply bellow, all bronze construction.
 - 2.6.1.4. For piping {75 mm}[3"] and above, use flanged ends.
 - 2.6.1.5. Steel Piping - Flexonics controlled, flexing expansion joint with stainless steel pressure carrier, flanged ends.
 - 2.6.1.6. Copper Piping - Flexonics controlled, flexing expansion joint with monel pressure carrier, and brass flanged ends.
 - 2.6.1.7. Flexible hose connectors for chilled or heating water shall be Goodyear SS Braidedrubber hose with crimped on brass ends, 2400 kPa pressure rating, -40°C to 93°C temperature rating, EPDM liner size and length to suit application.
 - 2.6.1.8. Flexible hose connectors for glycol media shall be Weatherhead SS braided with smooth bore Teflon hose, complete with crimped on steel hose ends. 2070 kPa pressure rating, -53°C to 230°C temperature rating, size and length to suit application.

2.7. PIPE GUIDES AND ANCHORS

- 2.7.1. Pipe reaction and loads where indicated on the drawings are for reference only. Refer to Architectural and structural drawings for location of embedments and structural beams required to be provided by this Division for the support of pipe risers.
- 2.7.2. Be responsible for the design and installation of guides and anchors in all vertical and horizontal piping, including piping such as generator exhaust piping, boiler flues, etc.
- 2.7.3. Submit to Consultant, drawings showing the riser sizes, offsets, location of expansion joints, anchors and guides and other pertinent information. Provide details of the design of riser anchors, guides, attachments and loads imposed on structure. All designs and calculations shall be stamped and sealed by a Professional Engineer Contracted by the Division.
- 2.7.4. The concrete structure will undergo elastic shortening as it is built. Make due allowance for shrinkage of the building. The exact amount is to be determined by the Structural Engineer and will be approximately {8 mm}[0.31"] per floor. Ensure sleeve openings are adequate to accommodate movement and that sufficient resilient packing is left. Ensure that pipe and duct will not shear as a result of shrinkage.
- 2.7.5. The Contractor shall review all sleeved penetrations in the core and shall provide a written report testifying that all sleeves and anchorages have provision for shrinkage.

2.8. STRAINERS

- 2.8.1. Provide Spirax Canada Limited pipeline strainers with stainless steel screens according to the following:

Pipe Sched	Pipe Size	Type	Model	Screen Perforatic
Copper	All sizes	Y	BT Bronze	{0.76mm}[.030"] 20 Mesh
Steel	up to {50 mm}[2"]	Y	IT Cast Iron	{0.76mm}[.030"] 20 Mesh
Steel	{65 mm to 150 mm}[2- - 6"]	Y	IF Standard, for water for steam	{3 mm}[1/8"] {1.2 mm}[3/64"]
Steel	{200 mm}[8"] and up		Basket 528B Ca Iron	{3 mm}[1/8"]

- 2.8.2. Supply strainers with extra construction screens and remove after systems have been thoroughly cleaned.
- 2.8.3. Equip each strainer {40 mm}[1-1/2"] and smaller in size, with plugged blow off tappings.
- 2.8.4. Equip each strainer {50 mm}[2"] and larger in size, with blow off tapping. Provide blow off piping complete with capped shut off valve. Terminate in downward vertical position. Size blow off piping and valve the same size as the blow off tapping.
- 2.8.5. Ensure that each strainer can be isolated from piping systems with isolating valves on each side of strainer, and which are not more than {3 metres}[10 ft] away from strainer.
- 2.8.6. Provide strainers in the following locations:

- 2.8.6.1. at the suction side of each pump
- 2.8.6.2. immediately upstream of each pressure reducing valve
- 2.8.6.3. immediately upstream of each control valve (except control valves, which serve an individual coil, such as a unit heater, fan coil unit, terminal reheat coil, or length of radiation)
- 2.8.6.4. immediately upstream of each entering side of a plate and frame heat exchanger
- 2.8.6.5. where shown on Detail Drawings

2.9. DRAINS

- 2.9.1. Provide {40 mm}[1-1/2"] minimum size copper pipe drains from overflows, condensate pans and pump bases to floor drains.
- 2.9.2. Provide minimum {20 mm}[3/4"] ball valve with hose end adapter, metal cap and chain at all low points of all systems. Locate to allow easy connection of hose.
- 2.9.3. Provide {40 mm}[1-1/2"] minimum size drains from ductwork connected to intake hoods and wall louvres. Equip drains with deep seal traps. Locate traps in heated areas.
- 2.9.4. Provide {20 mm}[3/4"] valves with metal caps and chains at the base of all pipe risers. Install hose end ball valve in conjunction with {450 mm}[18"] minimum length full line size dirt leg.

2.10. WELLS

- 2.10.1. Install wells or sensing elements where required and where directed by the Automatic Controls Trade.
- 2.10.2. Provide suitable separable chrome plated forged brass thermometer wells, complete with caps and chains in the following locations:
 - 2.10.2.1. where shown on Detail Drawings
 - 2.10.2.2. on entering and leaving sides of chillers and condensers
 - 2.10.2.3. on the entering and leaving sides of liquid-to-liquid heat exchangers, and
 - 2.10.2.4. on the water side entering and leaving and on the steam supply line on steam-to-liquid heat exchangers
 - 2.10.2.5. on the entering and leaving sides of water heating and cooling coils
 - 2.10.2.6. on downstream side of mixing valves
 - 2.10.2.7. domestic hot water storage tanks
 - 2.10.2.8. on individual supply and return lines at each boiler
 - 2.10.2.9. where shown on the Mechanical Drawings
- 2.10.3. Use extension necks where required to locate sockets outside of insulation.

2.11. THERMOMETERS

- 2.11.1. For air thermometers, refer to Section 25 30 00.

- 2.11.2. Liquid thermometers shall be Trerice BX9 Series adjustable angle separable well type, calibrated in °C and °F.
- 2.11.3. Thermometers shall be complete with fully adjustable angle hinge assembly, {225 mm}[9"] aluminum case, unbreakable window, lens front, red appearing mercury tubing and brass stem. Locate to be easily read from {1500 mm}[5 ft] level.
- 2.11.4. Select thermometers to suit full temperature range of liquid. Operating temperature shall indicate at approximately midpoint of scale.
- 2.11.5. Thermometers shall have a reservoir top to allow not less than 25% temperature over scale without damage.
- 2.11.6. Submit schedule in the form of Shop Drawings to show for each thermometer, the duty, location and scale range.
- 2.11.7. Provide thermometers in the following locations:
 - 2.11.7.1. where shown on Detail Drawings
 - 2.11.7.2. on entering and leaving sides of chillers and condensers
 - 2.11.7.3. on entering and leaving sides of liquid-to-liquid heat exchangers
 - 2.11.7.4. on the water side entering and leaving and on the steam supply line on steam-to-liquid heat exchangers
 - 2.11.7.5. on entering and leaving sides of water heating and cooling coils
 - 2.11.7.6. on downstream side of mixing valves
 - 2.11.7.7. domestic hot water storage tanks
 - 2.11.7.8. individual supply line from each boiler
 - 2.11.7.9. individual return line to each boiler
 - 2.11.7.10. where shown on the Mechanical Drawings
- 2.11.8. Supply to the Owner, for his use, two additional thermometers, representative of the above scale ranges.

2.12. PRESSURE GAUGE CONNECTIONS

- 2.12.1. Provide pressure gauge connections in the following locations:
 - 2.12.1.1. where shown on Detail Drawings
 - 2.12.1.2. on entering and leaving sides of chillers, condensers and on cooling tower headers
 - 2.12.1.3. on the entering and leaving sides of liquid-to-liquid heat exchangers
 - 2.12.1.4. on the water side entering and leaving and on the steam supply line on steam-to-liquid heat exchangers
 - 2.12.1.5. on entering and leaving sides of each water heating and cooling coil
 - 2.12.1.6. on entering domestic cold water services

- 2.12.1.7. on suction and discharge sides of pumps and circulators
- 2.12.1.8. at the top of fire protection pipe risers
- 2.12.1.9. on expansion tanks
- 2.12.1.10. on entering and leaving sides of strainers
- 2.12.1.11. on entering and leaving sides of pressure reducing valves
- 2.12.1.12. at top and bottom of each main supply and return riser (excluding perimeter risers)
- 2.12.1.13. where shown on Mechanical Drawings.
- 2.12.2. Provide Trerice No. 735 {6 mm}[1/4"] brass needle valves at each pressure gauge connection.
- 2.12.3. Where gauges are not connected, cap gauge connections after balancing of system.
- 2.12.4. Locate gauge connections to ensure that gauges can be read easily from a level {1500 mm}[5 ft] above the floor.

2.13. PRESSURE GAUGES

- 2.13.1. Gauges shall be Trerice {113 mm}[4-1/2"] size No. 600CB with black finish cast aluminum case, phosphor bronze Bourdon tube, brass rotary type movement, bronze brushed, silver brazed tip and socket joints, adjustable type pointer and calibrated in kPa and psi.
- 2.13.2. Provide ULC listed and labelled gauges in fire standpipe and sprinkler systems.
- 2.13.3. Install each gauge with Trerice brass impulse dampener.
- 2.13.4. Select gauges to suit an overpressure of 25% without damage to movement. Normal operating pressure shall indicate approximately at midpoint of dial. Provide compound type gauge and scale for suction connection to pumps connected to open systems or equipment.
- 2.13.5. Provide gauges with an accuracy of 1% of full scale.
- 2.13.6. Submit a schedule to show for each gauge, the duty and dial range.
- 2.13.7. Provide gauges in the following locations:
 - 2.13.7.1. where shown on Detail Drawings
 - 2.13.7.2. on entering and leaving sides of chillers, condensers and on cooling tower headers
 - 2.13.7.3. on the entering and leaving sides of liquid heat exchangers
 - 2.13.7.4. on the water side entering and leaving and on the steam supply line on steam-to-liquid heat exchangers
 - 2.13.7.5. on entering domestic cold water services
 - 2.13.7.6. on suction and discharge sides of pumps and circulators
 - 2.13.7.7. at the top of fire protection pipe risers
 - 2.13.7.8. on expansion tanks

- 2.13.7.9. on entering and leaving sides of pressure reducing valves
- 2.13.7.10. where shown on Mechanical Drawings.
- 2.13.8. Supply two additional gauges to the Owner for his use, representative of the above scale ranges.

2.14. ACCESS DOORS AND PANELS

- 2.14.1. Provide access for concealed mechanical equipment and install systems and components to minimize number of access doors and panels. Install equipment and components to be readily accessible through doors and panels.
- 2.14.2. Supply for installation by Other Contractors, doors, panels and frames.
- 2.14.3. Select access doors and panels to suit finishes as noted and large enough to provide adequate access to equipment and components. Where personnel must pass through, provide minimum {600 mm x 600 mm}[24" x 24"] doors and panels. Otherwise, provide minimum {300 mm x 300 mm}[12" x 12"] doors and panels. Provide access doors as follows:
 - 2.14.3.1. Drywall and Block Partition
 - 2.14.3.1.1. 16 gauge steel completely prime coated flush style door with rounded safety corners, one piece seamless {38mm}[1-1/2"] wide trim flange, fully concealed continuous one piece pivot rod hinge, 16 gauge return wall frame and screwdriver operated cam locks (doors larger than {300 mm x 300 mm}[12" x 12"] to have multiple cam locks).
 - 2.14.3.2. Ceilings
 - 2.14.3.2.1. 14 gauge steel, {25 mm}[1"] recessed door suitable to accept drywall insert, complete with 16 gauge steel frame with {25 mm}[1"] wide perforated frame of 24 gauge galvanized steel, concealed one piece pivot rod hinge and screwdriver operated cam locks.
 - 2.14.3.3. Ceramic Tile and Shower Areas
 - 2.14.3.3.1. 16 gauge #304 stainless steel with No. 4 satin finish flush style door with rounded safety corners with one piece seamless {38mm}[1-1/2"] wide trim flange, fully concealed continuous one piece pivot rod hinge, 16 gauge return wall frame and screwdriver operated cam locks (doors larger than {300 mm x 300 mm}[12" x 12"] to have multiple cam locks).
 - 2.14.3.4. 2 Hour Fire Rated Partitions
 - 2.14.3.4.1. 18 gauge completely baked grey enamel prime coated insulated fire rated door with rolled safety edge and 16 gauge trim and return. Door to have 1-1/2 hour "B" label rating with maximum 250°F temperature rise after 30 mins for vertical wall installation. Door shall be self-closing and locking complete with one fully concealed, pivot type hinge allowing 170° opening. Door shall be complete with self latching latch and be furnished standard with access key and knurled knob.
 - 2.14.3.5. Secure Areas
 - 2.14.3.5.1. Minimum 12 gauge completely prime coated steel flush style door with rounded safety corners and 16 gauge seamless frame, semi-concealed piano hinge, 16 gauge return wall frame, anchor straps, and minimum of three (3) torx and pin operated cam locks, doors {600 mm x 600 mm}[24" x 24"] to have minimum of four (4) torx and pin operated cam locks.

2.15. FLASHING

- 2.15.1. Flashing shall be by Division 07 60 00 for roof curbs shown on the Architectural or Structural Drawings.
- 2.15.2. Provide flashing for pipe openings, duct openings, or premanufactured roof curbs required for all mechanical systems.
- 2.15.3. Provide counterflashing for roof mounted mechanical equipment and for pipes and ducts passing through roof. Fit counterflashing over flashing or curb. Pitch pockets are not acceptable.

2.16. CURBS

- 2.16.1. Curbs required for Division 20 00 00 work and shown on the Structural or Architectural Drawings will be carried out under other Divisions.
- 2.16.2. Premanufactured curbs for roof mounted mechanical equipment will be supplied by equipment manufacturer and are specified under other Sections.
- 2.16.3. Provide curbs for roof mounted equipment, around ducts passing through roof and surrounding groups of pipes and/or ducts pass through Equipment Room floors, Kitchens and similar areas.
- 2.16.4. Provide roof curbs of a sufficient height to be at least {450 mm}[18"] above finished roof assembly, unless exceeded by Architectural considerations.
- 2.16.5. Provide concrete curbs around holes in Equipment Room floors, extending at least {150 mm}[6"] above finished floor. Make watertight connection between curb and floor.

2.17. CONCRETE

- 2.17.1. Provide {100 mm}[4"] concrete housekeeping pads under all floor mounted mechanical equipment and supports. Extend pads over the full equipment base and isolator area.
- 2.17.2. Provide floating reinforced concrete bases, and floating floors which are specified under Section 09 62 48. Meet Division 03 00 00 requirements.
- 2.17.3. Concrete work, including housekeeping pads, required for Division 20 00 00 work and shown on the Structural or Architectural Drawings will be provided by Division 03 00 00.
- 2.17.4. Provide all concrete required in isolation bases for pumps and fans.
- 2.17.5. Provide other concrete work required for Division 20 00 00 work, including reinforcing steel.

2.18. COVERS

- 2.18.1. Supply frames for installation by Division 03 00 00.
- 2.18.2. Provide covers for pits and sumps.
- 2.18.3. Provide gas tight gaskets for sewage pits.
- 2.18.4. Trench gratings will be provided by Division 05 00 00 - Metals.
- 2.18.5. All covers/grates shall be suitable for the traffic loading requirements within space.

2.19. STEEL

- 2.19.1. Provide steel required for Division 20 00 00 not shown on Structural or Architectural Drawings. Provide steel for framing, lintels, etc.
- 2.19.2. Provide steel of adequate strength to support equipment and materials during all operating and test conditions. All support steel shall be secured and supported by/from building structure.
- 2.19.3. Support suspended equipment from the bottom or from manufacturer's designated suspension points. Support tanks and similar equipment with adequate beam strength by saddles with curvature to match the equipment. Continuously support other equipment.
- 2.19.4. Provide base supports for all pipe risers. Design to distribute operating and static loads.
- 2.19.5. Fabricate steel supports in contact with water or humidity conditions from materials having approved corrosion resistance or galvanize after fabrication or brush welds clean and apply a prime coat of rust inhibiting paint.

2.20. FIRESTOPPING

- 2.20.1. Provide ULC classified firestopping products by 3M, Hilti or Specified Technologies Inc. which have been tested in accordance with CAN4-S115.

2.21. WELDING AND BRAZING

- 2.21.1. All welding and brazing shall conform to the following codes and standards:
 - 2.21.1.1. Building Services Piping Code ANSI/ASME B 31.9 (latest edition)
 - 2.21.1.2. CSA B51 (latest edition), Boiler, Pressure Vessel and Pressure Piping Code
 - 2.21.1.3. ASME Boiler Code - Section IX
 - 2.21.1.4. All requirements of the Technical Standards and Safety Authority (TSSA)
- 2.21.2. Welding shall conform to a welding procedure which must be in accordance with TSSA requirements and include materials, weld preparation, heat treatment and welding equipment to be used.
- 2.21.3. Qualify welders according to ASME equivalent testing procedures. Do not use welders, on or off site, who are not qualified for the work. Maintain records for all qualification testing and provide copies to the Consultant on request.
- 2.21.4. Identify work in accordance with codes and standards. Welds shall be full penetration, continuous and without defects. After deposition, each layer of weld shall be cleaned to remove slag and scale by wire brushing or grinding, then chipped where necessary to prepare for proper deposition of the next layer. The weld reinforcement shall not be less than {1.6 mm}[1/16"] and not more than {3.2 mm}[1/8"] above the normal surface of the joined sections. The reinforcement shall be crowned at the centre and shall merge into the base material without excessive shoulder or undercut.
- 2.21.5. Welding shall be made by machine or manual shielded metallic arc process. Direct current shall be used exclusively with the base material on the negative side of the line. Electrodes used shall be an approved all position rod type.
- 2.21.6. Provide a copy of TSSA registration and include with Maintenance Manuals.

PART 3 - EXECUTION

3.1. EXCAVATION AND BACKFILL

3.1.1. Read subsurface information data. See Division 31 23 00.

3.1.2. Excavation and backfill required for Division 20 00 00 work inside the building and to a point {1.5 m}[5 ft] outside building shall be carried out by the Division listed in the following schedule:

Work	Description	Responsibility
Excavation	Initial excavation to {150 mm}[6"] above inverts	Division 20 00 00
	Final excavation to pipe inverts	Division 20 00 00
Backfill	Initial backfill with sand to {300 mm}[12"] above of pipes	Division 20 00 00
	Final backfill to finished grade	Division 20 00 00

3.1.3. Ensure that excavation work is executed to attain required inverts and grades.

3.1.4. Remove material excavated and not to be reused, from the site.

3.1.5. Do all excavation, backfill and related work required for your work. Perform such work in accordance with requirements of the Division 31 23 00 Excavation and Backfill work Section, except as modified by this Article. Obtain a copy of the soil test report and review during the bidding period.

3.1.6. Grade the bottom of trench excavations as required.

3.1.7. In firm, undisturbed soil, lay pipes directly on the soil, unless otherwise directed.

3.1.8. Unless otherwise specified, backfill trenches within the building with clean sharp sand in individual layers of maximum {150 mm}[6"] thickness compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum {300 mm}[12"] above the top of the pipe. Hand or machine compact the balance up to grade.

3.1.9. In lieu of the above, high performance bedding may be provided for bedding and backfill of piping. Install as per manufacturer's recommendations and best practices.

3.1.10. Where bedding or backfill materials of differing gradation are used in proximity (e.g., sand adjacent to clear stone or granular), provide a geotextile separator between materials to prevent migration of fines, in accordance with CSA B182.11 and ASTM D2321. This includes but is not limited to shared trench conditions involving mechanical and civil piping systems.

3.1.11. Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of {450 mm}[18"] thick above the pipe, hand compacted to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in {150 mm}[6"] layers with approved excavated material, compacted to 95% Standard Proctor density.

3.1.12. Unless otherwise specified, backfill trenches outside the building under roads, parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding {150 mm}[6"] thickness, compacted to 100% Standard Proctor density up to grade level.

- 3.1.13. The location and inverts of existing underground site services shown on the drawings are based on available information and are assumed to be correct, however, prior to excavation, carefully check inverts and locations and report any serious discrepancy and contact Utilities to accurately locate their services.
- 3.1.14. You will be held responsible for any damage done to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.
- 3.1.15. Ensure that all underground piping subject to freezing and located outside the building has a minimum of {1370 mm}{54"} of cover.
- 3.1.16. Ensure that all underground piping subject to freezing and located inside the building has a minimum of {450 mm}{18"} of cover.
- 3.1.17. After the first lift of backfill has been compacted, mark the entire path of pipe using continuous {75 mm}{3"} wide detectable identified marking tape equal to SMS Ltd. D-UGMT.
- 3.1.18. Where excavation is necessary close to and below the level of any footing, backfill with {14,000 kPa}{2000 psi} concrete to the level of the highest adjacent footing. Do not proceed with the work prior to receiving written approval from Consultant.
- 3.1.19. Obtain approval from governing authorities and Consultant before backfilling.

3.2. PIPE, DUCT AND EQUIPMENT INSTALLATION

- 3.2.1. Locate distribution systems, equipment and materials for maximum usable space, optimum service clearances and to accommodate current requirements and identified future expansion.
- 3.2.2. Coordinate Division 20 00 00 services installation above ceilings to allow installation and future relocation of lights and air terminals without interfering with or requiring relocation of mechanical, electrical or other services, or removal of ceiling grid.
- 3.2.3. Plumbing stub outs in ceiling voids for future connection by others shall be located as low as possible to provide maximum drainage runs. Vents and supply lines shall be located as high as possible to eliminate interference with other services.
- 3.2.4. Include all pipe and duct offsets required to eliminate interference with the work of other Divisions.
- 3.2.5. Install equipment and materials to present a neat appearance. Run piping, ducts and conduit parallel to or perpendicular to building planes. Conceal piping, ducts and conduit in finished areas. Install so as to require a minimum amount of furring.
- 3.2.6. Install pipe, duct and conduit straight, parallel and close to walls and slab or deck underside, with specified pitch.
- 3.2.7. Use standard fittings for all direction changes. Do not use drilled tees and other field fabricated fittings.
- 3.2.8. Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.
- 3.2.9. Where pipe sizes differ from connection sizes of equipment, provide reducing fittings between inline components such as valves, strainers and fittings, and equipment. Reducing bushings are not permitted.
- 3.2.10. Cap open ends of piping during installation.

- 3.2.11. Lay copper tubing so that it is not in contact with dissimilar metal and will not kink or collapse.
- 3.2.12. Use non-corrosive lubricant or teflon tape equal to and apply on male thread.
- 3.2.13. Provide brass adaptors or dielectric couplings wherever dissimilar metals are joined.
- 3.2.14. No pipe to be laid in water or when, in opinion of Consultant conditions are unsuitable.
- 3.2.15. Protect buried copper and steel piping with Tapecoat materials using procedures recommended by Tapecoat Company of Canada Limited, or other approved manufacturer.
- 3.2.16. Ensure that pipe installation does not transmit vibration to the walls and floors through which they pass.
- 3.2.17. Make provisions for neat insulation finish around equipment and materials. Do not mount equipment within insulation depth.
- 3.2.18. In electrical rooms and elevator machine rooms, provide drip trays under the entire length of all pipe within the confines of the room. Pipe drip tray to nearest floor drain.
- 3.2.19. Perform pipe welding to meet ANSI B31.9.
- 3.2.20. Provide isolation valves at all take-offs from risers and as shown on drawings.
- 3.2.21. Provide isolation valves at all take-offs from piping systems as shown on drawings.

3.3. CONNECTIONS TO EQUIPMENT

- 3.3.1. Provide unions or flanges at all connections to equipment. Ensure that piping adjacent to equipment is readily removable for servicing and/or removal of equipment without shutting down entire system.
- 3.3.2. Install unions in piping up to and including {50 mm}[2"] pipe size. Install flanges in piping {65 mm}[2-1/2"] pipe size and larger.
- 3.3.3. Prevent galvanic corrosion by isolating copper and steel. Use red brass adapters, or completely isolate flanges using full face gaskets with bolts installed through phenolic sleeves with insulating fibre washers. Where the Plumbing Code prohibits the use of red brass adapters, use insulating couplings. Where valves are required, solid brass isolating valves may be used in lieu of adapters or couplings.
- 3.3.4. Provide metallic code rated continuity link between flanges or unions, where pipes carry flammable fluids or gases.
- 3.3.5. Make all plumbing and sheet metal connections to equipment provided by the Owner.

3.4. INSERTS

- 3.4.1. Size and space for the loads to be supported.
- 3.4.2. Properly locate and firmly secure inserts to forms before concrete is poured.
- 3.4.3. Place inserts only within main structure and not in any finishing materials.
- 3.4.4. When inserts are required in precast concrete, supply inserts and location drawings to the precast concrete supplier for casting into material. Otherwise, have precast concrete supplier install inserts at site.

3.4.5. Do not use powder actuated tools.

3.5. HANGERS

3.5.1. Suspend piping, ductwork and equipment with all necessary hangers and supports for a safe and neat installation. Ensure that pipes are free to expand and contract and are graded properly. Adjust each hanger to take its full share of the weight.

3.5.2. Suspend hanger rods directly from the structure. Do not suspend pipes, ducts or equipment from other pipes, ducts, equipment, or ceilings.

3.5.3. Provide auxiliary structural steel angles, channels and beams (vertical and horizontal) where ductwork, piping and equipment is suspended between joists or beams. All support assemblies shall be secured and supported by building structure.

3.5.4. Use galvanized rods, steel support angles, channels and beams where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.

3.5.5. Space hangers to ensure that structural steel members are not over stressed. Do not space hangers further apart than indicated in the tables. When requested, submit detailed drawings showing locations and magnitude of ductwork, piping and equipment loads on the structure. Provide calculations when requested by Consultant.

3.5.6. Do not use trapeze type hangers for support of piping, without prior review by Consultant. Where permitted, fabricate from angle or channel frames, and space hangers to suit the smallest pipe size.

3.5.7. Do not use hooks, chains or straps to support equipment and materials.

3.5.8. Ensure that copper materials are completely isolated from ferrous materials. Use plastic or epoxy coated hangers and clamps. Use non-lead inserts between copper piping and other ferrous materials.

3.5.9. Provide round steel threaded rods meeting ASTM A-36. Provide cadmium plated rod and accessories where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.

3.5.10. The following table establishes minimum standards of rod sizes and hanger spacing for steel and copper piping.

Maximum Horizontal Spacing of Supports			
Pipe Size {mm}{in}	Rod Size {mm}{in}	Steel {m}{ft}	Copper {m}{ft}
{12}{1/2}	{10}{3/8}	{1.5}{05}	{1.5}{05}
{20}{3/4}	{10}{3/8}	{1.8}{06}	{1.8}{06}
{25}{1}	{10}{3/8}	{1.8}{06}	{1.8}{06}
{32}{1-1/4}	{10}{3/8}	{2.4}{08}	{2.1}{07}
{40}{1-1/2}	{10}{3/8}	{2.7}{09}	{2.4}{08}
{50}{2}	{10}{3/8}	{2.7}{09}	{2.7}{09}
{65}{2-1/2}	{12}{1/2}	{3.0}{10}	{3.0}{10}
{75}{3}	{12}{1/2}	{3.0}{10}	{3.0}{10}
{90}{3-1/2}	{12}{1/2}	{3.0}{10}	{3.3}{11}
{100}{4}	{16}{5/8}	{3.0}{10}	{3.7}{12}
{125}{5}	{16}{5/8}	{3.7}{12}	{3.7}{12}

Maximum Horizontal Spacing of Supports			
Pipe Size {mm}[in]	Rod Size {mm}[in]	Steel {m}[ft]	Copper {m}[ft]
{150}[6]	{20}[3/4]	{3.7}[12]	{3.7}[12]
{200}[8]	{22}[7/8]	{3.7}[12]	
{250}[10]	{22}[7/8]	{3.7}[12]	
{300}[12]	{22}[7/8]	{3.7}[12]	
{350}[14]	{25}[1]	{3.7}[12]	
{400}[16]	{25}[1]	{3.7}[12]	
{450}[18]	{29}[1-1/8]	{3.7}[12]	
{500}[20]	{32}[1-1/4]	{3.7}[12]	
{600}[24]	{32}[1-1/4]	{3.7}[12]	

- 3.5.11. For steel pipe sizes larger than {600 mm}[24"], refer to Drawings.
- 3.5.12. In addition to these basic requirements, provide hangers in the following location:
- 3.5.12.1. to eliminate vibration
- 3.5.12.2. at points of vertical and horizontal change of direction of pipe
- 3.5.12.3. at inline centrifugal pumps
- 3.5.12.4. at valves and strainers
- 3.5.12.5. on mains at branch takeoffs
- 3.5.12.6. to avoid stress on equipment connections
- 3.5.13. Install spring hangers or other special supports specified in Section 20 05 48.
- 3.5.14. Support horizontal cast iron soil pipe at each hub. Where groups of fittings occur, support at every three joints.
- 3.5.15. Refer to applicable articles of the Specification regarding thermal insulation requirements. Unless shown specifically on Drawings, provide the following support methods.
- 3.5.15.1. For insulated warm and hot water piping, for condensate piping and for steam piping up to {65 mm}[2-1/2"] diameter, support with hangers directly on piping.
- 3.5.15.2. For steam piping {75 mm}[3"] diameter and above, support with hangers under protection saddles.
- 3.5.15.3. For chilled water and domestic cold water piping, hangers shall be large enough to fit over specified pipe covering. At each point of support, install specified saddles with sufficient length to prevent crushing of insulation.
- 3.5.16. Generally, support ducts with {2.7 mm}[12 gauge] by {25 mm}[1"] wide galvanized hangers or with {12 mm}[1/2"] dia. rods and {40 mm}[1-1/2"] rolled angle saddles to meet SMACNA or ASHRAE Standards.
- 3.5.17. Support vertical duct risers at each floor with rolled angle collars bearing on building structure.

3.6. SLEEVES, WALL PLATES, FLOOR PLATES

- 3.6.1. Set sleeves for piping and ductwork in conjunction with erection of floors and walls. Locate sleeves accurately in accordance with submittal drawings, and as follows:
 - 3.6.1.1. Through interior walls, set sleeves flush with finished surfaces on both sides.
 - 3.6.1.2. Through exterior walls above grade, set sleeves flush with finished surfaces on inside and to suit flashing on outside.
 - 3.6.1.3. For floors in Mechanical Equipment Rooms, Janitors Closets, Kitchens and similar areas where a water dam is required, set sleeves flush to underside of structure and extending {50 mm}{2"} above finished floor.
 - 3.6.1.4. For other floors, set sleeves flush to both finished surfaces. Refer to Room Finish Schedule.
- 3.6.2. Size sleeves to provide {25 mm}{1"} clearance around insulated piping and ductwork.
- 3.6.3. Provide continuous insulation runs through fire separations. Ensure piping and ductwork does not touch sleeves or for warm and hot water piping and ductwork terminate insulation cover on each side of sleeve. For chilled water and domestic cold water piping, provide same thickness Manville Thermo-12 pipe insulation with all purpose vapour barrier jacket through fire separation to a point {100 mm}{4"} on each side of fire separation.
- 3.6.4. Install leak tight seals to meet the manufacturer's requirements. Select inside diameter of wall sleeve opening to fit the pipe and seal leak tight.
- 3.6.5. Additional sleeving requirements:
 - 3.6.5.1. Provide sleeves for systems not part of Contract but identified to be required on Drawings.
 - 3.6.5.2. Provide sleeves to accommodate compressed air piping and wiring conduits required for Division 20 00 00 work.
 - 3.6.5.3. Provide sleeves to accommodate future services. Include for the cost of drilling and setting sleeves.
 - 3.6.5.4. Fill unused sleeves through fire separations with firestop material (see Firestopping article). Fill other unused sleeves with suitable noncombustible materials.

3.7. FIRESTOPPING

- 3.7.1. Ensure that fire ratings of floors and walls are maintained.
- 3.7.2. Fill spaces between openings, pipes and ducts passing through fire separations and install firestopping systems in accordance with the appropriate ULC system number for the products and type of penetration.
- 3.7.3. Install firestopping systems using personnel trained or instructed by the product manufacturer.

3.8. PROVISION FOR PIPE EXPANSION, CONTRACTION AND BUILDING SHRINKAGE

- 3.8.1. Make provision for pipe expansion, contraction and building shrinkage with suitable anchors, offsets or expansion loops.

- 3.8.2. Install piping to allow freedom of movement in all planes without imposing undue stress on any section of main piping, branch piping, equipment or structure.
- 3.8.3. Use offsets at takeoffs to radiation, unit heaters, fan coil units, risers and other branch lines.
- 3.8.4. Select expansion joints for the calculated movement according to the following temperature ranges.
 - 3.8.4.1. For cold pipes, from minimum operating temperature to {38°C}{100°F}, plus 25% safety factor.
 - 3.8.4.2. For warm and hot pipes, from minimum ambient, but not lower than {-5°C}{23°F}, to maximum operating temperature plus 25% safety factor.
- 3.8.5. Where ambient temperature during installation is higher than operating temperature, use precompressed expansion joints.
- 3.8.6. Select expansion joints to withstand system test pressure, as well as operating pressures and temperatures.
- 3.8.7. Install expansion joints in accordance with manufacturer's published instructions.
- 3.8.8. During the construction and warranty periods, regularly review provisions for building shrinkage and make necessary adjustments to ensure freedom from binding and stress.

3.9. PIPE GUIDES AND ANCHORS

- 3.9.1. Install pipe guides for expansion joints according to manufacturer's published recommendations. Use at least two guides on each side of expansion joint.
- 3.9.2. Install manufactured or field fabricated alignment guides to allow movement in axial direction only.
- 3.9.3. Install vertical risers properly anchored and guided to maintain accurate vertical position of piping. At time of startup, clean and lubricate guides, and adjust to allow free sliding at operating conditions.
- 3.9.4. For piping up to and including {75 mm}{3"}, guide pipes at every floor or every {3900 mm}{13 ft}. Guide larger pipes at every second floor or every {7500 mm}{25 ft}.
- 3.9.5. Fabricate anchors from structural steel channels, plates or angles. Submit detailed shop drawings of anchors.
- 3.9.6. Secure anchors to the structure. Avoid introduction of excessive reactive forces and operating weights into the structure and onto equipment and piping.
- 3.9.7. Where guides are provided on cold piping, provide thermal break to prevent sweating.
- 3.9.8. Where mains or branches connect to risers, the first point of support of the main or branch shall be a spring type hanger to allow movement of the riser.

3.10. PAINTING

- 3.10.1. Paint all ferrous metal work except piping, galvanized and stainless steel ductwork, with one factory prime coat, or paint one prime coat on site.
- 3.10.2. Clean and steel brush surfaces with welds. Then prime coat all steel supports and brackets.
- 3.10.3. On uninsulated piping, steel brush and prime coat welds.

- 3.10.4. Touchup or repaint surfaces damaged during shipment or installation and leave ready for finish painting.
- 3.10.5. Prime coat material shall conform to Canadian General Standards Board Standard No. 1-GP-48.
- 3.10.6. Finish painting will be provided by Division 09 90 00.

3.11. ADDITION OF NEW CIRCUITS

- 3.11.1. Before any new system is connected to an existing system, the new system shall be separately cleaned and treated by the specified method. No system may be connected to an existing system unless certified clean by the Contractor and inspected by the Consultant.

3.12. EQUIPMENT BELT DRIVES

- 3.12.1. ANSI/RMA Standard V-belt type rated at minimum 1.5 times the motor nameplate rating, and in accordance with the following requirements:
 - 3.12.1.1. belts are to be reinforced cord and rubber, and multiple belts are to be matched sets
 - 3.12.1.2. sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch ($\pm 10\%$ range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of the mechanical work to suit system air/water quantity testing and balancing work
 - 3.12.1.3. motor slide rail adjustment plates are to allow for centre line adjustment
- 3.12.2. Supply a spare belt set (tagged and identified) for each belt drive and hand to the Owner upon Substantial Performance of the work.

3.13. EQUIPMENT DRIVE GUARDS AND ACCESSORIES

- 3.13.1. For V-belt drives – removable, four sided, fully enclosed, galvanized sheet steel guards to OSHA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing the guard, and {40 mm}[1-1/2"] diameter tachometer openings at each shaft location.
- 3.13.2. For flexible couplings – removable "U" shaped galvanized steel guards to OSHA Standards with a {2.3 mm}[3/32"] thick frame and expanded mesh face.
- 3.13.3. For unprotected fan inlets and outlets – unless otherwise specified, removable {20 mm}[3/4"] galvanized steel wire mesh with galvanized steel frames, all to OSHA Standards.

3.14. GENERAL PIPING AND DUCTWORK INSTALLATION REQUIREMENTS

- 3.14.1. It is critical that all mechanical services be installed as tight to the underside of structure as possible. Locate and arrange all pipes and ducts as high as possible above the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork as required when directed to do so by Consultant.
- 3.14.2. Install mechanical systems as high as possible. Coordinate scope of work with other trades prior to installation to ensure a coordinated installation. Where required, install mechanical systems in joist/structure space. Install all sprinkler mains and branches in joist space where joists are existing or tight to underside of concrete.

- 3.14.3. Coordinate mechanical and electrical services and install such that "layering" of services is minimized. Offset services as required to minimize crossing.
- 3.14.4. Maintain the specified ceiling height while allowing {200 mm}[8"] clear for lighting below all mechanical services.
- 3.14.5. Unless otherwise specified, install all work concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.
- 3.14.6. Install all pipes and ducts parallel to building lines and to each other.
- 3.14.7. Neatly group and arrange all exposed work.
- 3.14.8. Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all valves, dampers and any other equipment which will or may need maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate the accessories at the floor level.
- 3.14.9. Make all connections between pipes of different materials using proper approved adapters. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.
- 3.14.10. Ensure that equipment and material manufacturer's installation instructions are followed unless otherwise specified herein or on the drawings and unless such instructions contradict governing codes and regulations.
- 3.14.11. Carefully clean all ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.
- 3.14.12. Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around the pipe or duct, except for ductwork at fire barriers, in which case the insulation will be terminated at each side of the duct fire damper.
- 3.14.13. Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.
- 3.14.14. Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean the piping prior to being concealed.
- 3.14.15. Provide continuous galvanized sheet metal drip pan under all drain, water and water solution piping extending through all rooms with electrical equipment such as electrical, elevator equipment and transformer rooms, and all other spaces provided primarily for the installation of electrical equipment. Drip pans are to be complete with a drain pipe connection and drain piping is to be extended to the closest drain.
- 3.14.16. For factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work is to match the original finish. This requirement also applies to galvanized finishes.

- 3.14.17. Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on the products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminum ductwork, copper or stainless steel pipe, etc.
- 3.14.18. Whether shown or specified on the drawings or not, provide screwed unions or flanges in all piping connections to equipment, and in regular intervals in long (in excess of {12 m}{40'}) piping runs to permit removal of sections of piping.

3.15. PIPE JOINT REQUIREMENTS

- 3.15.1. Do not make pipe joints in walls or slabs.
- 3.15.2. Ream all piping ends prior to making joints.
- 3.15.3. Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After the pipe has been screwed into the fitting, valve, union, or piping accessory, not more than two pipe threads are to remain exposed.
- 3.15.4. Site bevel steel pipe to be welded or supply mill beveled pipe. Remove all scale and oxide from the bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.
- 3.15.5. Welded joints are to be made by CWB certified, licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.
- 3.15.6. Unless otherwise specified, make all flanged joints with Cranite Ltd. or equivalent gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than the length necessary to screw the nut up flush to the end of the bolt. Bolts used for flanged connections in all piping with a working pressure of {690 kPa}{100 psi] and greater are to be ASTM A-193, Grade B-7, with heavy hexagon nuts to ASTM A-194, CL-2H. Provide suitable washers between each bolt head and the flange and between each nut and the flange.
- 3.15.7. A random check of bolted flanged connections will be made to verify that flanged connections are properly mated with no shear force acting on bolts. Supply all labour to disconnect and reconnect the selected flanged joints. If improperly mated joints are found, remove and reinstall the affected piping so that the flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.
- 3.15.8. Unless otherwise specified, make all soldered joints in copper piping using flux suitable for and compatible with the type of solder being used. Clean the outside of the pipe end and the inside of the fitting, valve, or similar accessory prior to soldering.
- 3.15.9. Joints in medical gas system piping are to be silver brazed in accordance with requirements of CAN/CSA-Z7396.1.
- 3.15.10. Install mechanical joint fittings and couplings in accordance with the manufacturer's instructions.

- 3.15.11. Grooves for mechanical grooved coupling systems are to be rolled. Make arrangements with the coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required and adhere to the manufacturer's instructions with respect to pipe grooving, support, type of gasket requirement, anchoring and guiding the grooved piping system. Coupling and fitting manufacturer shall periodically visit job site and review installation.
- 3.15.12. Solvent weld PVC piping in two parts, primer stage and cementing stage, in accordance with the manufacturer's recommendations, ASTM D2855, and CSA requirements.

3.16. PIPE LEAKAGE TESTING

- 3.16.1. Before new piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test all piping for leakage.
- 3.16.2. Tests are to be witnessed by the Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.
- 3.16.3. When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.
- 3.16.4. For gravity drainage and vent piping, securely close all openings and pipe ends and fill piping with water up to the highest level and ensure that the water stands at the same level for a minimum of two hours. After the fixtures and fittings are set and the pipes connected to the building drain or drains, turn on water into all pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Make a smoke test if required by the Municipality. At your option, drain and vent piping may be pressure tested with cold water at {345 kPa}[50 psi] for two hours with zero leakage.
- 3.16.5. Test pumped drainage piping with cold water at a pressure of 1½ times normal working pressure and maintain the pressure for a minimum of two hours.
- 3.16.6. Test domestic water piping with cold water at a pressure of 1½ times normal working pressure and maintain the pressure for a minimum of two hours.
- 3.16.7. Test all sprinkler system piping in accordance with requirements of NFPA No. 13, "INSTALLATION OF SPRINKLER SYSTEMS", and in accordance with any additional requirements of governing authorities.
- 3.16.8. Test all standpipe system piping in accordance with requirements of NFPA No. 14, "STANDPIPE AND HOSE SYSTEMS", and in accordance with any additional requirements of governing authorities.
- 3.16.9. Test all CO2 fire extinguishing system piping in accordance with requirements of NFPA No. 12, "STANDARD ON CARBON DIOXIDE EXTINGUISHING SYSTEMS", and in accordance with any additional requirements of governing authorities.
- 3.16.10. Test all clean agent fire extinguishing system piping in accordance with requirements of NFPA No. 2001, "STANDARD ON CLEAN AGENT EXTINGUISHING SYSTEMS", and in accordance with any additional requirements of governing authorities.
- 3.16.11. Prove hydronic piping tight under a hydrostatic test of 150% of design working pressure but not less than {700 kPa}[100 psi]. Test without pressure drop for a period of not less than 4 hours.
- 3.16.12. Test steam and condensate piping with cold water for a minimum of two hours at the following pressures:

- 3.16.12.1. {0 kPa to 105 kPa}[0 psi to 15 psi] low pressure piping – {690 kPa}[100 psi]
- 3.16.12.2. {110 kPa to 690 kPa}[16 psi to 100 psi] medium pressure piping – {1035 kPa}[150 psi]
- 3.16.12.3. greater than {690 kPa}[100 psi] high pressure piping – {1380 kPa}[200 psi]
- 3.16.13. Test natural gas piping in accordance with the requirements of CAN/CSA - B149.1. After completion of the verification test, locate the required tag stating the results of the verification test at the point of entry of the gas main into the building, affixed to the pipe in a secure manner. Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.
- 3.16.14. Test propane gas piping in accordance with the requirements of CAN/CSA -B149.2. After completion of the verification test, locate the required tag stating the results of the verification test at the point of entry of the gas main into the building, affixed to the pipe in a secure manner. Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.
- 3.16.15. Test compressed air piping with dry compressed air or nitrogen at {690 kPa}[100 psi] for a minimum of two hours. Test all piping joints with a water-soap solution while the piping is under pressure to detect leaks.
- 3.16.16. Test fuel oil piping (not tanks) with dry compressed air or nitrogen for a minimum period of two hours at {1035 kPa}[150 psi]. Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.
- 3.16.17. Test gasoline piping (not tanks) with dry compressed air or nitrogen for a minimum period of two hours at {1035 kPa}[150 psi] in accordance with TSSA requirements. Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.
- 3.16.18. Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of the ASHRAE HANDBOOK - FUNDAMENTALS.
- 3.16.19. Test control air piping and tubing with dry compressed air or nitrogen before concealing and again before connection of instruments. Rough-in test pressure is to be {345 kPa}[50 psi] maintained over twenty-four hours with a pressure drop not to exceed {35 kPa}[5 psi]. Test joints for leaks with a soap solution. Finish test is to be {205 kPa}[30 psi] with a permissible loss of {7 kPa}[1 psi] over a four hour period. Prior to connecting instruments, blow systems clean and dry and test component connections for leaks with a water/soap solution.
- 3.16.20. Perform leakage and flow tests for all medical gas system piping using oil-free compressed air or oil-free dry nitrogen in accordance with requirements of CAN/CSA Standard Z7396.1.
- 3.16.21. Test pure water piping when the piping has been properly flushed and cleaned. Test at {690 kPa}[100 psi] for 2 hours with only distilled water or filtered dry compressed air. If distilled water is used, drain the system when the testing is complete.
- 3.16.22. The following requirements apply to all testing:
 - 3.16.22.1. ensure that all piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing
 - 3.16.22.2. temporarily remove or valve off all piping system specialties or equipment which may be damaged by test pressures prior to pressure testing the systems, and flush piping to remove foreign matter
 - 3.16.22.3. when testing is carried out below the highest level of the particular system, increase the test pressure by the hydrostatic head of {7 kPa}[1 psi] for every {600 mm}[24"] below the high point

- 3.16.22.4. include for temporary piping connections required to properly complete the tests
- 3.16.22.5. piping under test pressure is to have zero pressure drop for the length of the test period
- 3.16.22.6. make tight leaks found during tests while the piping is under pressure, and if this is impossible, remove and refit the piping and reapply the test until satisfactory results are obtained
- 3.16.22.7. where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions
- 3.16.22.8. tests are to be done in reasonably sized sections so as to minimize the number of tests required
- 3.16.23. In addition to the leakage tests specified above, demonstrate proper flow throughout the systems including mains, connections and equipment, as well as proper venting and drainage, and Include for any necessary system adjustments to achieve the proper conditions.

3.17. EQUIPMENT BASES AND SUPPORTS

- 3.17.1. Unless otherwise specified or required, set all floor mounted equipment on minimum {100 mm}[4"] high reinforced concrete housekeeping pads {200 mm}[8"] clear of the equipment on each side and end, or a minimum of {200 mm}[8"] from the centre line of equipment anchor bolts to the edge of the base, whichever is larger. Provide all curbs for all equipment everywhere on this project. Conform to the following requirements:
 - 3.17.1.1. supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads
 - 3.17.1.2. place anchor bolts during the concrete pour and be responsible for all required levelling, alignment, and grouting of the equipment
 - 3.17.1.3. as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details
- 3.17.2. For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to the following requirements:
 - 3.17.2.1. all stands and supports, except those for small equipment, are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed design drawings with calculations are to be submitted as shop drawings for review
 - 3.17.2.2. all steel stands are to be flange bolted to concrete housekeeping pads
 - 3.17.2.3. all stands and supports are to be seismically restrained in accordance with applicable requirements
- 3.17.3. Provide welded, cleaned and prime coat painted structural steel platforms where shown for service access to equipment. Access platforms are to be designed by a structural engineer registered in the jurisdiction of the work and stamped and signed shop drawings with calculations are to be submitted as shop drawings for review. Service access platforms are to conform to the following requirements:
 - 3.17.3.1. platforms are to be in accordance with OSHA requirements and are to be adequately sized, braced, anchored, and as required, seismically restrained
 - 3.17.3.2. flooring is to be Fisher & Ludlow "Tru-Weld" Type 19-4, Borden type W/B (19-W-4), or equal, welded steel bar type grating

- 3.17.3.3. support legs are to be welded Schedule 40 black steel pipe with welded steel cross-bracing, securely anchored and sway braced
- 3.17.3.4. safety guard rails, constructed from minimum {32 mm}[1-1/4"] dia. Schedule 40 black steel pipe are to be provided for all platforms and are to be complete with vertical stanchions at maximum {1.2 m}[48"] centres, top and intermediate horizontal railing, and toe plates at the floor
- 3.17.3.5. vertical ladders are to be constructed of Schedule 40 black steel pipe, {25 mm}[1"] dia. for equal height rungs, {40 mm}[1-1/2"] for stringers, anchored to floors and walls and sway braced as required
- 3.17.3.6. ships ladders, which are to be used wherever space conditions permit, are to be of welded steel construction, are to climb at an approximate 60° angle, and are to be complete with channel iron stringers, open grate equal height risers approximately {165 mm}[6-1/2"] wide and factory made by the grating manufacturer, handrails, and suitable anchoring and support

3.18. USE OF MECHANICAL SYSTEMS FOR TEMPORARY HEATING

- 3.18.1. Permanent building mechanical systems are not to be used for temporary heating purposes during construction.
- 3.18.2. Permanent mechanical systems in the building may be used for temporary heating during construction subject to the following conditions:
 - 3.18.2.1. each entire system is complete, pressure tested, cleaned, and flushed out
 - 3.18.2.2. specified water treatment system has been commissioned, and treatment is being continuously monitored
 - 3.18.2.3. building has been closed in and areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes
 - 3.18.2.4. there is no possibility of damage from any cause
 - 3.18.2.5. supply ventilation systems are protected by 60% filters, which are to be inspected daily, and changed every 2 weeks, or more frequently as required
 - 3.18.2.6. return, exhaust and supply air systems have approved construction filters over all openings, inlets, and outlets
 - 3.18.2.7. all systems are operated as per the manufacturer's recommendations or instructions, and are monitored on a regular and frequent basis
 - 3.18.2.8. warranties are not affected in any way with the warranty period starting at date of substantial completion
 - 3.18.2.9. regular preventive and all other manufacturer's recommended maintenance routines are performed
 - 3.18.2.10. before Substantial Performance, each entire system is to be refurbished, cleaned internally and externally, restored to "as-new" condition, and filters in air systems replaced
 - 3.18.2.11. energy costs are to be paid by the Contractor

3.19. MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

- 3.19.1. Maintain all equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.

- 3.19.2. Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.
- 3.19.3. Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminum tubing.
- 3.19.4. All filters are to be new upon Substantial Performance of the work. This is in addition to any spare filters specified.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment, and services to supply and install the sound and vibration control devices indicated on the drawings and specified in this Section of the Specification.

1.2. QUALITY ASSURANCE

- 1.2.1. Provide vibration isolation and duct attenuators from a single sound and vibration control manufacturer, whose responsibilities shall include, but not be limited to:
 - 1.2.1.1. supply of all vibration and sound isolation equipment necessary to meet the performance requirements
 - 1.2.1.2. coordination throughout the project with all provided equipment to ensure adherence to performance criteria
 - 1.2.1.3. determination of equipment, pipe and duct mounting arrangements
 - 1.2.1.4. field supervision and inspection to assure proper installation and performance
 - 1.2.1.5. allowance for expansion and contraction when selecting and applying isolation materials
 - 1.2.1.6. coordination of any silencer provisions with sound power levels of fans specified elsewhere in this Specification
- 1.2.2. Ensure the provision of adequate vibration and sound control equipment for all fans, pumps, ducts, pipes, chillers, boilers, cooling towers, air handling units and other mechanical equipment.
- 1.2.3. Ensure that no ducts and pipe installation transmit vibration to the walls and floors through which they pass.
- 1.2.4. Provide equipment, pipe, and duct mountings non-resonant with equipment operating and building structure natural frequencies.

1.3. SUBMITTAL REQUIREMENTS

- 1.3.1. Supply to the sound and vibration control manufacturer, a copy of certified Shop Drawings of equipment to be isolated and sound power levels of equipment requiring sound attenuators.
- 1.3.2. Submit Shop Drawings of sound and vibration control components including all calculations. For each piece of equipment to be isolated, identify on the shop drawings the equipment's lowest operating speed, its weight, band, and the type and location of isolators.
- 1.3.3. Submit Shop Drawings showing adequate concrete reinforcing steel details and templates for all concrete foundations and supports, all bases including necessary concrete and steel work and vibration isolation devices, and all required hanger bolts and other appurtenances necessary for proper installation of the equipment.

1.4. VIBRATION ISOLATION PERFORMANCE

- 1.4.1. For each piece of equipment to be isolated, select the vibration isolation mounts on the basis of 98% vibration isolation efficiency at the lowest operating speed. That is, the natural frequency of each vibration isolation system shall be no higher than 1/10 of the lowest excitation frequency of the rotating machinery, whenever practicable, but in no case greater than 1/7.
- 1.4.2. Where structural floor deflection will exceed 1/10 of the determined static deflection of the isolator, increase the isolator static deflection to maintain this minimum ratio of the floor to isolator deflection.
- 1.4.3. Static deflections shown on the drawings, specified or scheduled are a guide only. Actual isolators are to achieve the required static deflection under load, with at least 50% reserve deflection.

PART 2 - PRODUCTS

2.1. BASES

- 2.1.1. The sound and vibration control manufacturer shall designate before installation, which equipment mounts shall be bolted to the structure.
- 2.1.2. Use T shaped concrete inertia bases with horizontal pumps, extended to support base elbows.
- 2.1.3. Steel bases and concrete inertia bases shall clear the sub-bases by at least {25 mm}{1"} and {50 mm}{2"} respectively. Bases shall be blocked and shimmed level so that duct and piping connections can be made to a rigid system at operating level before isolator adjustment.
- 2.1.4. Refer to the Isolation Schedule to determine which of the following types of bases shall be used:
- 2.1.4.1. Type S: Integral steel fan and motor bases, complete with motor slide rails welded in place, shall have minimum vertical sections as follows:

Horsepower	Vertical Section Size
Up to {2.25 kW}{3 hp}	{75 mm}{3"}
Up to {5.6 kW}{7-1/2 hp}	{100 mm}{4"}
Up to {14.9 kW}{20 hp}	{150 mm}{6"}
Up to {37.0 kW}{50 hp}	{200 mm}{8"}
Over {37.0 kW}{50 hp}	{250 mm}{10"}

- 2.1.4.2. Type SS: Slung steel bases of structural members with gusset plates welded to the ends. Construction shall be similar to Type S integral steel fan and motor bases.
- 2.1.4.3. Type C: Reinforced concrete inertia bases shall have full depth perimeter structural channel frames, and reinforcing rods welded in place. Spring mounts shall carry load by means of gusseted brackets, welded to the steel channel sides. Concrete strength shall be {17,500 kPa}{2500 psi}. Refer to Schedule for depth of bases.

2.2. ISOLATORS

- 2.2.1. All spring isolators shall be complete with levelling devices, {6 mm}{1/4"} thick ribbed neoprene sound pads and completely stable, colour coded springs.

- 2.2.2. Select springs to operate at no greater than 2/3 solid deflection.
- 2.2.3. Paint all hardware with zinc chromate. For applications subject to outdoor or high humidity conditions, neoprene coat springs, and paint mounts with two coats of rust resisting paint. Use neoprene instead of rubber when pads may be affected by outside weather conditions or oil contamination.
- 2.2.4. Piping connections to air compressors shall be isolated with FPM Metal Hoses.
- 2.2.5. Support equipment with one of the following types of isolators, as scheduled:
 - 2.2.5.1. Type CM: Closed spring mounts with top and bottom housing separated with neoprene rubber stabilizers.
 - 2.2.5.2. Type FS: Open spring mounts having extra stable iso-stiff springs. (Horizontal stiffness shall be equal to vertical stiffness).
 - 2.2.5.3. Type CSR: Free standing restrained mounts with heavy rigid steel base frame, built-in limit stops and removable spacer plates. Springs shall be iso-stiff with a minimum horizontal to vertical stiffness (Kx/Ky of 1.0). The clearance around the bolt holes must be a minimum {12 mm}[1/2"] such that a +/-3 degree rotational misalignment may be tolerated. As an alternative, provide rubber sleeve of minimum {3 mm}[1/8"] thick, no more than 60 Durometer hardness for limit stop bolts so that shortening would not be possible.
 - 2.2.5.4. Type HCS: Similar to Type SH, suitable for horizontal installation to limit horizontal movement of isolated equipment.
 - 2.2.5.5. Type MD: Elastomer rubber mount with threaded insert and hold down bolt holes.
 - 2.2.5.6. Type R: Waffle pads shall be 50 durometer natural rubber {14,000 kPa}[2000 psi] tensile, a minimum of {12 mm}[1/2"] thick and selected for an optimum loading of {420 kPa}[60 psi]. When pads are built into spring isolators or hangers 50 durometer {21,000 kPa}[3000 psi] tensile pads are acceptable with an optimum loading of {630 kPa}[90 psi].
 - 2.2.5.7. Type N: Waffle pads shall be 30 durometer neoprene, {12,600 kPa}[1800 psi] tensile, minimum of {12 mm}[1/2"] thick and selected for an operating load of {630 kPa}[90 psi].
 - 2.2.5.8. Type RSR: Rubber-steel-rubber pads shall consist of two layers of {12 mm}[1/2"] thick Type R pad, as specified above, bonded to each side of {6 mm}[1/4"] steel plate. All holes to be sleeved and complete with an isolation washer.
 - 2.2.5.9. Type NSN (special): Neoprene-steel-neoprene pads shall consist of two layers of {12 mm}[1/2"] thick Type N pad, as specified above, bonded to each side of {1.6 mm}[1/4"] steel plate. All holes to be sleeved and complete with isolation washers.
 - 2.2.5.10. Type KIP: Kinetic precompressed moulded fibreglass pads shall be coated with a flexible moisture impervious elastomeric membrane. Glass fibres, produced by the multiple flame attenuation process shall have a diameter not exceeding {.0045 mm}[.00018"].

2.3. SPRING HANGERS

- 2.3.1. Select springs to operate at not greater than 2/3 solid deflection. Paint all hardware with zinc chromate primer.
- 2.3.2. Spring hangers shall be Type SH or Type SHR with completely stable, colour coded springs.
- 2.3.3. The spring and cup washer assembly shall have a single stable position under load.

- 2.3.4. All hangers must be capable of tolerating a vertical misalignment of +/-15 degrees without loss of stability.
- 2.3.5. Ensure that there is no physical contact between pipes and sleeves or pipes and structure.
- 2.3.6. Type SH: Shall have fabricated steel housing with one coat anti-rust paint, and be complete with a colour coded stable spring, retaining cups and acoustic washer.
- 2.3.7. Type SHR: shall be as for Type SH above but shall have a {25 mm}{1"} elastomeric element in lieu of acoustic washer.
- 2.3.8. Attach top of hanger frame rigidly to the structure. However, do not install spring hangers in concealed locations.
- 2.3.9. Suspend piping connected to isolated equipment with Type SHR spring hangers as follows:
 - 2.3.9.1. Up to {100 mm}{4"} pipe - at first 3 points of support.
 - 2.3.9.2. {125 mm to 200 mm}{5" to 8"} - at first 4 points of support.
 - 2.3.9.3. {250 mm}{10"} and larger - at first 6 points of support.
- 2.3.10. The first point of support shall have a static deflection of twice the deflection of the isolated equipment.
- 2.3.11. If, due to space restrictions, it is impossible to use at least two spring hangers, provide rubber hose to provide flexibility. Flexible metal hose may only be used when pressure rated rubber hose is not available. Provide control cables in lieu of control rods where alignment is required.
- 2.3.12. Ensure that there is no physical contact between pipes and sleeves, or pipes and structure.

2.4. SILENCERS

- 2.4.1. Completely prefabricate all silencers using incombustible materials. Silencers shall have rounded inlets and tapered diffuser outlets. Equip circular silencers with centre bodies with spun aluminum noses and taped diffuser outlets. Select silencers to attain the specified values of maximum allowable air pressure drop, and minimum allowable duct to reverberant room insertion loss.
- 2.4.2. Acoustic media shall be inorganic, inert and rot proof. Density of media shall be {40 kg/cubic metre}{2-1/2 lb./cu.ft.} packed under 10% compression and protected from air erosion by {0.89 mm}{22gauge} perforated galvanized metal. In addition, media in silencers with internal air velocities above {23 m/s}{4500 ft/minute} shall be protected with glass fibre cloth.
- 2.4.3. Factory paint Class II circular silencers with anti rust prime coat.
- 2.4.4. Equip circular silencers {600 mm}{24"} dia. and larger with lifting lugs.
- 2.4.5. Rectangular silencers, Type RSS shall be constructed according to either of the following classes. Silencers over {1200 mm}{48"} in any one cross sectional dimension shall be constructed in modules not exceeding {1200 mm}{48"}.
 - 2.4.5.1. Class I: Outer shell shall be minimum {0.89 mm}{22 gauge} galvanized steel with airtight mastic filled seams, and {50 mm}{2"} slip connections each end.

- 2.4.5.2. Class II: Outer shell shall be minimum {1.61 mm}[16 gauge] galvanized steel with spot welded and caulked seams.
- 2.4.5.3. Class III: The outer casing shall be a minimum of {1.61 mm}[16 gauge] hot rolled steel with all seams continuously welded and steel angle flanges.
- 2.4.6. Type CCB and CST: Size {300 mm to 900 mm}[12" to 36"] dia. and up to and including {1500 mm}[60"] long shall have an outer casing of a minimum {0.89 mm}[22 gauge] galvanized steel with lock formed airtight mastic filled seams. Sizes over {900 mm}[36"] dia. and {1500 mm}[60"] long shall have an outer casing of a minimum {1.61 mm}[16 gauge] spun aluminum nose cone hot rolled steel with continuous welded seams.
- 2.4.7. Type ECCB: Sizes {300 mm to 1200 mm}[12" to 48"] dia. and up to and including {1500 mm}[60"] long shall have an outer casing of a minimum {1.52 mm}[16 gauge] hot rolled steel with continuous welded seams. Sizes over {1200 mm}[48"] dia. and {1500 mm}[60"] long shall have an outer casing of a minimum {3.04 mm}[11 gauge] hot rolled steel with continuous welded seams.
- 2.4.8. Type CTS: Crosstalk silencers shall be constructed of {0.89 mm}[22 gauge] galvanized outer shell, and {0.55 mm}[26 gauge] galvanized perforated metal.
- 2.4.9. Refer to the Silencer Schedule.

2.5. NO MEDIA SILENCERS

- 2.5.1. Provide type RNM or CNM No Media silencers as shown on plans and listed in schedule.
- 2.5.2. Silencer construction shall be galvanized casing stiffened to ASHRAE and SMACNA standards.
- 2.5.3. Absorptive media or acoustical packing shall not be used in these silencers. Any type of media or film wrapped media silencers will be also unacceptable.

2.6. ACOUSTIC PLENUMS

- 2.6.1. Construct galvanized acoustic plenums using prefabricated acoustic panels and steel supports, joiner sections, floor channels, opening frames and sealing materials. Provide {1.31 mm}[18 gauge] minimum channel stiffeners at not greater than {800 mm}[32"] centres.
- 2.6.2. Connect corners and butt joints with {1.61 mm}[16 gauge] galvanized sections. Seal all joints with rubber mastic. Use angle joints to attach panel edges to walls.
- 2.6.3. Entire acoustic plenum shall resist deflection and seal sufficiently to avoid air leakage when subjected to a pressure differential between inside and outside of {2500 Pa}[10" water gauge].
- 2.6.4. Doors in acoustic plenums shall have a transmission loss equal to acoustic panels.
- 2.6.5. Provide {100 mm}[4"] thick acoustic panels having an absorption coefficient of 0.90 at 250 Hz. Cover inner surface with minimum {0.89 mm}[22 gauge] perforated galvanized metal.
- 2.6.6. Acoustic media shall be inorganic, inert and rot proof. Density of media shall be {40 kg/cubic metre}[2-1/2 lbs./cu.ft.], packed under at least 10% compression.
- 2.6.7. Minimum Certified Performance

Octave Band	125	250	500	1000	2000	4000

Panel TL (dB)	21	28	39	50	53	56
Absorption	0.7	0.9	0.98	0.99	0.9	0.9

2.7. ACOUSTIC DUCTS

- 2.7.1. Type HTL: Provide acoustic ducts where shown on drawings consisting of a {0.89 mm}[22 gauge] outer skin and 2 layers of {16 mm}[5/8"] gypsum board, decoupled from the silencer casing by {25 mm}[1"] semi rigid fibreglass board Type AF545. The {0.89 mm}[22 gauge] outer skin shall also enclose the ends of the gypsum and fibreglass boards. Extend HTL ducts from within the mechanical equipment room, to a point at which flanking through the silencer casing is not a problem.
- 2.7.2. Provide exterior cylindrical acoustic supply air ducts as follows:
- 2.7.2.1. Refer to Drawings for number, location and diameter of ducts. Refer to Architectural Drawings for all other required dimensional data.
- 2.7.2.2. The duct enclosures of cylindrical cross section are partly straight and partly curved in a circle as shown on the Drawings. They are fixed at their bases and at their junction with the mechanical penthouse only without any intermediate support.
- 2.7.2.3. Design these enclosures to safely resist the forces given below and with sufficient stiffness without the need for external or internal stiffeners. Maintain the circular cross section throughout enclosure without kinks or facets.
- 2.7.2.4. Design and execute the connections between the individual plate elements making up the duct system.
- 2.7.2.5. Submit Shop Drawings outlining the design, the pattern of plates, the shaping of the plates, the connections between plates and to the end flanges, the field splices, the insulation and internal duct details and erection instructions.
- 2.7.2.6. Submit appropriate structural engineering calculations prepared by a Professional Engineer registered in the Province of Ontario for review by the Consultant. Include calculations confirming that the ducts will not buckle under the design loadings and temperature variations.
- 2.7.2.7. Design loadings:
- 2.7.2.7.1. Gravity - as applicable by the design
- 2.7.2.7.2. Wind - lateral forces calculated using the following formula depending on the diameter in ft. d:
 $11 \times d \text{ lbs/lin.ft.}$
- 2.7.2.7.3. Earthquake - as required by building code
- 2.7.2.8. Temperature variations from {-30°C to +50°C}[-22°F to 122°F].
- 2.7.2.9. Lateral deflection limitations - a 150th of the diagonal distance between fixing points.
- 2.7.2.10. Suggested details of the junction of the ducts with the structure are shown on the Drawings.
- 2.7.2.11. If desired by the Designer, sliding connections may be introduced at the junction with the penthouse provided all reaction forces are transmitted to the structure in a clear and safe manner.

- 2.7.2.12. Provide a sample of the welding between plates for review by the Consultant before proceeding with the fabrication.
- 2.7.2.13. Joint between segments and at termination of each rolled segment to be continuously welded. Vertical welds to be located such that they face building.
- 2.7.2.14. Outer surface to be sandblasted and shop prime painted. Finish painting by Division 09 80 00.
- 2.7.2.15. {50 mm}[2"] thick thermal insulation type AW Fibreglass to be provided between outer shell and vapour barrier.
- 2.7.2.16. Minimum {1.2 mm}[0.05"] galvanized steel continuous vapour barrier with overlapping sealed joints.
- 2.7.2.17. {25 mm}[1"] acoustic insulation protected by minimum {.76 mm}[0.03"] galvanized perforated liner shall be provided. Performance to achieve NC specification. Provide annular reinforcing rings maximum {1200 mm}[48"] centres with punch outs to minimize heat transfer (open area minimum 70%).
- 2.7.2.18. Conduct separate leak tests of the inner and outer duct walls to ensure protection from water penetration. Use the pressure decay method as described in the ANSI N510 Standard at a test pressure of {2.5 kPa}[10 in w.g.] at start of test. Allowable leakage is {0.1 L/s.m.}[.02 cfm/ft.sq.] for the inner wall. Use bubble solution to locate leaks and correct as necessary. Have test witnessed by the Consultant.

2.8. ACOUSTIC LOUVRES

- 2.8.1. Frames shall be {1.61 mm}[16 gauge] galvanized steel and noise side of blade shall be {0.89 mm}[22 gauge] galvanized perforated metal. The solid side shall be {1.31 mm}[18 gauge] galvanized metal. Acoustic media shall be {40 kg/cubic metre}[2-1/2 lbs/cu.ft.] density and packed under 10% compression. Louvres will be supplied in modules complete with {12 mm}[1/2"] birdscreen to suit size shown on Drawings.
- 2.8.2. Performance shall be as follows:

Octave Band	125	250	500	1000	2000	4000	8000
Panel Insertion Loss in dB	7	6	11	16	17	18	18

PART 3 - EXECUTION

3.1. FLOOR MOUNTED EQUIPMENT

- 3.1.1. Erect floor mounted equipment on {100 mm}[4"] high concrete pads over complete floor area of equipment. Mount vibration eliminating devices and concrete inertia blocks on {100 mm}[4"] high housekeeping pads.

3.2. VIBRATION ISOLATION SYSTEMS

- 3.2.1. Have vibration isolator manufacturer determine mounting sizes. Install in accordance with manufacturer's instructions.
- 3.2.2. Installed vibration isolation system for each floor or ceiling supported equipment shall have a maximum lateral motion under equipment startup or shut down conditions of {6 mm}[1/4"]. Restrain excess motions by approved mountings.

3.3. MOUNTING SYSTEMS EXPOSED

- 3.3.1. Protect mounting systems exposed to weather and other corrosive environments with factory corrosion resistant coatings. Hot dip galvanized metal parts of mountings (except springs and hardware). Cadmium plate and neoprene coat springs. Cadmium plate nuts and bolts.

3.4. PIPE SUPPORT

- 3.4.1. Support piping as follows:
- 3.4.1.1. Resiliently support all suspended piping connected to isolated equipment.
- 3.4.1.2. Provide resilient diagonal mountings or other approved devices to limit piping motion due to equipment startup or shutdown, to a maximum deflection of {3 mm}{1/8"}.

3.5. EXPANSION AND CONTRACTION

- 3.5.1. Allow for expansion and contraction when selecting and applying isolation materials.

3.6. NOISE LEVELS

- 3.6.1. Isolate equipment to attain acceptable noise criteria (NC) levels in occupied areas, using terms of reference set out by ASHRAE.
- 3.6.2. After systems have been balanced, take sound measurements throughout the complete range of audible frequencies from 63 Hz through 8000 Hz, in each occupied area above, below and beside each Mechanical Equipment Room and where directed. Plot readings on noise criteria NC curves.
- 3.6.3. Modify, as required and at no additional cost to the Owner, the fan distribution and other mechanical systems to achieve the specified noise criteria.
- 3.6.4. Submit a report, including sound curves, to substantiate that equipment has been isolated adequately, and that acceptable noise levels have been attained. Provide a list to indicate equipment in operation at time of readings taken. Certify report by Professional Engineer of Ontario.
- 3.6.5. Make sound measurements in accordance with the American Standard Method for the Physical Measurement of Sound, ANSI S1.2.
- 3.6.6. Sound measuring equipment shall be Type 2 Class I in accordance with ANSI Standards S1.4 or S1.11.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install thermal insulation, vapour barriers and finishes for mechanical work as indicated on the Drawings and in these Specifications.
- 1.1.3. Insulation thermal performance values and thicknesses shall meet the most stringent requirements of both The National Energy Code of Canada for Buildings 1997 and ASHRAE 90.1-2013.

1.2. SUBMITTALS

- 1.2.1. Submit samples and specification sheets of insulation materials. Include manufacturer's installation instructions.

1.3. ENVIRONMENTAL REQUIREMENTS

- 1.3.1. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulating cements.
- 1.3.2. Ensure items to be insulated are dry and clean to not promote the growth of moulds.

1.4. QUALITY ASSURANCE

- 1.4.1. Insulation materials shall be manufactured to meet ISO 9000 quality standards.

PART 2 - PRODUCTS

2.1. MATERIALS – GENERAL

- 2.1.1. All insulation pertaining to Division 23 00 00 shall be carried out by one firm specializing in insulation work. Do not mix similar products of multiple manufacturers.
- 2.1.2. Provide non-combustible insulation, jackets and finishes having a Flame Spread/Smoke Developed rating of 25/50 or less, meeting CAN/ULC S-102-M88 requirements or NFPA 90a, 101 and 255.
- 2.1.3. In high humidity environments (greater than 60% RH average ambient condition) all insulation materials shall be of the closed cell type which shall not permit the growth of molds if the insulation or insulation cover is cut, punctured or damaged.
- 2.1.4. Attain a complete and continuous vapour barrier over insulation applied to cold and dual temperature piping, sheet metal and equipment. Use Owens Corning Fiberglas "Evolution" paper free All Service Jacket and SSL II adhesive. Apply to piping, fittings, valves and inline components, sheet metal, fittings and equipment. Seal longitudinal and circumferential laps with manufacturers recommended adhesive.
- 2.1.5. Re-cover all exposed insulation and insulation finishes with minimum {0.20kg/square metre}[6oz.] canvas, and two applications of Childers CP50 or Bakor 120-09 white fire resistant coating. In mechanical rooms where insulation is exposed cover with PVC jacket and fitting covers installed as per manufacturer's instructions and conforming to the specified Flame Spread/Smoke Developed Rating.

- 2.1.6. Recover insulation outside the building with a self-adhesive, self-healing jacket comprising a composite membrane of a multi-ply embossed UV-resistant aluminum foil/polymer laminate to which is applied a layer of rubberized asphalt specially formulated for use on insulated duct and piping applications. Provide materials equivalent to Alumaguard, manufactured by Polyguard Products.

2.2. PIPE INSULATION

- 2.2.1. Provide insulation materials with a maximum thermal conductivity of {0.036 W/m.°C}{0.25 BTU.in/(hr.ft²°F)} at {38°C}{100°F} mean temperature.
- 2.2.2. On hot piping applications, hold insulation in place with flare type staples (outward clinch).
- 2.2.3. On cold and dual temperature piping applications, apply vapour barrier jacket over insulation and seal longitudinal and circumferential laps with Childers CP82 or Bakelite 230-39 adhesive. Seal all pipe terminations, including fittings, wall penetrations and pipe supports with vapour barrier mastic. For chilled water and brine systems provide vapour seal pipe terminations every four (4) pipe sections.
- 2.2.4. Apply pipe insulation over {40mm}{1-1/2"} in thickness in two layers with joints staggered.
- 2.2.5. Insulate fittings with fabricated mitered or preformed sections of specified insulation.
- 2.2.6. Insulate over flanges and mechanical couplings with specified insulation and thickness, sized to suit flange diameters. Fill spaces between insulation and adjoining pipe insulation with similar material.
- 2.2.7. Insulate valves and inline components with flexible insulation density {12kg/cubic metre}{3/4lbs./cu.ft.} compressed not more than 50% of original thickness. Build up to specified thickness with approved asbestos free finishing cement.
- 2.2.8. Do not insulate terminal unit automatic control valves installed in hot piping. Do not insulate terminal unit automatic control valves which are installed in cold and dual temperature piping and which are located over condensate drain pans.
- 2.2.9. Provide removable {1.31mm}{18gauge} galvanized sheet metal enclosures lined with Armaflex FS sheet insulation {25mm}{1"} thickness on pipeline strainers to facilitate screen access.
- 2.2.10. Under all hangers used on chilled water and domestic cold water, provide an insert between support shield and piping for piping {38 mm}{1-1/2"} or larger. Fabricate using T-12 calcium silicate or other high density insulating material suitable for temperature application. Ensure that the vapour barrier remains intact and continuous. Insulation inserts shall not be less than the following lengths:

<u>Pipe Size</u>	<u>Length</u>
{40 mm - 60 mm}{1-1/2" - 2-1/2"}	{250 mm}{10"}
{75 mm - 150 mm}{3" - 6"}	{300 mm}{12"}
{200 mm - 250 mm}{8" - 10"}	{400 mm}{16"}
{300 mm and over}{12" and over}	{550 mm}{22"}

- 2.2.11. Provide one of the following pipe insulation types, and as scheduled in the Pipe Insulation Table:
- 2.2.11.1. Type P1: Owens Corning 850 Pipe Insulation, Johns Manville Micro-Lok AP-T PLUS Fiberglas Pipe Insulation, Manson Fiberglas Pipe Insulation or Knauf Pipe Insulation with factory applied paper free ASJ vapour barrier jacket where scheduled.

- 2.2.11.2. Type P2: Johns Manville Thermo 12 Gold throughout molded hydrous calcium silicate, or Roxul Enerwrap 80 mineral fibre blanket, asbestos free pipe insulation. Insulation shall be banded securely in place with {20mmx0.5mm}[3/4"x.020"] stainless steel bands on maximum {300mm}[12"] centres.
- 2.2.11.3. Type P3: Owens Corning Flex-Wrap Pipe Insulation, Johns Manville Pipe & Tank, Manson Multi-Flex or Knauf Flex-Wrap with protective reinforced foil scrim, {48 kg /cubic metre}[3.0 lbs /cu.ft.] density.
- 2.2.11.4. Type P4: Direct bury or underground piping: Pittsburg Corning Foamglas cellular glass insulation, meeting ASTM C 552-00 and CGSB 51-GP-38 Insulation shall be banded securely in place with {20mmx0.5mm}[3/4"x.020"] stainless steel bands on maximum {300mm}[12"] centres. Wrap insulation finish with Pittwrap 125 mil heat sealable multiply laminate.
- 2.2.11.5. Type P5: High Humidity. Kingspan (Kooltherm) www.insulation.kingspan.com or Resolco Insulphen phenolic CFC free preformed pipe insulation, with factory applied reinforced aluminum foil jacket and which meets or exceeds BS 3927:1989, Table 1, Type A. For grooved coupling piping systems use Kooltherm high density phenolic foam preformed covers and jointing systems. Or Resolco International BV Insul-Phen phenolic foam insulation listed by CAN/ULC S-102-M88 for smoke and S-127- 1988 for flame spread.

2.2.12. Pipe Insulation Table:

No	Duty	Insulation T	Thickness	Vapou Barrie
1	Domestic cold water and non-pot water {100mm}[4"] and less {125mm}[5"] and larger	P-1 P-1	{12mm}[1/2"] {25mm}[1"]	Yes Yes
2	Domestic hot and domestic tempered water, and domestic hot water and tempered water recirculation {32mm}[1-1/4"] and less {40mm}[1-1/2"] and larger	P-1 P-1	{25mm}[1"] {40mm}[1-1/2"]	No No
3	Handicap Lavatory domestic cold water supply domestic hot water supply sanitary waste piping	P-1 P-1 P-1	{12mm}[1/2"] {25mm}[1"] {25mm}[1"]	Yes No Yes
4	Primary heated water supply and return, and secondary heated water supply and return (Below {94°C}[201°F]) {32mm}[1-1/4"] and less {40mm}[1-1/2"] and larger	P-1 P-1	{40mm}[1-1/2"] {50mm}[2"]	No No
5	Heat reclaim supply and return			

No	Duty	Insulation T	Thickness	Vapour Barrie
	All sizes	P-1	{25mm}[1"]	No
6	Chilled water supply and return above {4°C}[40°F]			
	All sizes	P-1	{25mm}[1"]	Yes
7	Chilled water supply and return below {4°C}[40°F]			
	{20mm}[3/4"] and less	P-1	{25mm}[1"]	Yes
	{25mm}[1"] and larger	P-1	{40mm}[1-1/2"]	Yes
8	Dual temperature supply and return piping			
	{32mm}[1-1/4"] and less	P-1	{40mm}[1-1/2"]	Yes
	{40mm}[1-1/2"] and larger	P-1	{50mm}[2"]	Yes
9	Condenser water supply and return inside and outside building			
	{100mm}[4"] and less	P-1	{25mm}[1"]	Yes
	{125mm}[5"] and larger	P-1	{40mm}[1-1/2"]	Yes
10	Horizontal storm drain and horizontal sanitary drainage			
	all pipe sizes	P-1	{25mm}[1"]	Yes
11	Refrigeration machine oil cooler and purge			
	all pipe sizes	P-1	{25mm}[1"]	Yes
12	Sprayed water			
	all pipe sizes	P-1	{25mm}[1"]	Yes
13	Horizontal condensate drains excluding with fan coil unit enclosure			
	all pipe sizes	P-1	{12mm}[1/2"]	Yes
14	Makeup, overflow, drain and equalizer lines for cooling tower			
	all pipe sizes	P-1	{25mm}[1"]	Yes
15	Dry sprinkler system drum drips	P-1	{25mm}[1"]	Yes

No	Duty	Insulation T	Thickness	Vapour Barrie
16	Steam (including relief lines) and condensate up to {103 kPa}[15 p {75mm}[3"] and less {100mm}[4"] and larger	P-1 P-1	{65mm}[2-1/2"] {75mm}[3"]	No No
17	Steam (including relief lines) from {104 kPa}[15 psig] to {827 kPa}[1 psig] {20 mm}[3/4"] and less {25 mm}[1"] to {32 mm}[1-1/4"] {40 mm} [1-1/2"] and larger	P-1 P-1 P-1	{75 mm}[3"] {100 mm}[4"] {115 mm}[4-1/2"]	No No No
18	Steam (including relief lines) abo {827 kPa}[120 psig] {20 mm}[3/4"] and less {25 mm}[1"] and larger	P-1 P-1	{115 mm}[4-1/2"] {125 mm}[5"]	No No
19	High temperature heated water {94°C-121°C}[201°F-250°F] {75 mm}[3"] and less {100mm}[4"] and larger {122°C-177°C}[251°F-350°F] {20 mm}[3/4"] and less {25 mm}[1"] to {32mm}[1-1/4"] {40mm}[1-1/2"] and larger Above {177°C}[350°F] {20 mm}[3/4"] and less {25 mm}[1"] and larger	P-1 P-1 P-1 P-1 P-1 P-1	{65mm}[2-1/2"] {75 mm}[3"] {75 mm}[3"] {100 mm}[4"] {115 mm}[4-1/2"] {115 mm}[4-1/2"] {125mm}[5"]	No No No No No No
20	Refrigerant piping suction lines {4.4°C}[40°F] and above Refrigerant piping suction lines below {4.4°C}[40°F] {25 mm}[1"] and smaller {32 mm}[1-1/4"] and larger	P-1 P-1 P-1	{25mm}[1"] {25mm}[1"] {40mm}[1-1/2"]	Yes Yes Yes
21	Emergency generator exhaust pi (other than pre-insulated engine exhaust systems)	P-2	{50mm}[2"]	No
22	Emergency generator mufflers	P-2	{50mm}[2"]	No

No	Duty	Insulation T	Thickness	Vapour Barrie
23	Above ground heat traced pipe for freeze protection {12mm}[1/2"] to {75mm}[3"] {100mm}[4"] and above			
		P-1	{25mm}[1"]	Yes
		P-1	{40mm}[1-1/2"]	Yes
24	Buried heat traced pipe	P-4	{50mm}[2"]	Yes
25	Grease drainage In fully conditioned spaces In semi or unconditional spaces (parking garage)			
		P-1	{25mm}[1"]	No
		P-1	{40mm}[1-1/2"]	No

2.2.13. In lieu of specified pipe insulation, where permitted by governing authorities, and in concealed locations, Imcoa Polyolefin or Armstrong AP Armaflex FS pipe insulation in nominal {12mm}[1/2"] thickness may be substituted for the following applications, on piping not exceeding {100mm}[4"] diameter, and shall be applied in strict accordance with manufacturer's recommendations:

- 2.2.13.1. domestic cold water
- 2.2.13.2. domestic chilled water
- 2.2.13.3. domestic chilled water recirculation
- 2.2.13.4. domestic hot and tempered water
- 2.2.13.5. domestic hot and tempered water recirculation
- 2.2.13.6. heated water, chilled water and dual temperature water runouts concealed behind perimeter enclosure
- 2.2.13.7. condensate drains

2.3. SHEET METAL INSULATION

- 2.3.1. Provide insulation with a maximum thermal conductivity of {0.036 W/m.°C}[0.25 BTU.in/(hr.ft²°F)] at {24°C}[75°F] mean temperature.
- 2.3.2. Prior to finishing of insulation of hot and cold exposed rectangular ductwork, provide corner beads similar to Roll-on Type.
- 2.3.3. Apply vapour barrier over insulation on cold and dual temperature ducts.
- 2.3.4. Circular silencers and acoustic plenums need not be externally insulated.
- 2.3.5. Ductwork and casings lined with acoustic insulation {25mm}[1"] or more in thickness need not be externally insulated. Refer to Section 23 31 00 for Acoustic Insulation.

- 2.3.6. Distribution ductwork below access floors in under floor air distribution systems (UFAD) need not be insulated.
- 2.3.7. Insulation of ducts in unconditioned spaces is required where there is a possibility of condensation forming on either surface of a duct. That is a warm duct in a cool space or a cold duct in a warm space.
- 2.3.8. Provide one of the following external sheet metal insulation types, and as scheduled in the Sheet Metal Insulation Table:
- 2.3.8.1. Type D1: Owens Corning Rigid Duct Insulation, Johns Manville 814 Spin-Glas, Manson 800 Series Spin-Glas Rigid Insulation Board or Knauf Rigid Insulation Board, not less than {48kg/cubic metre}{3lbs./cu.ft.} density. Impale insulation on mechanically fastened pins located at not greater than {300mm}{12"} centres. Secure insulation with speed washers.
- 2.3.8.2. Type D2: Owens Corning Flexible Duct Insulation, Johns Manville Microlite type 75 Duct Wrap, Manson Microlite Duct Wrap or Knauf Duct Wrap, {12kg/cubic metre}{3/4lbs./cu.ft.} density. Adhere insulation to duct surface with Childers CP82 or Bakelite 230-39 adhesive, which shall be applied in strips {150mm}{6"} wide at not greater than {300mm}{12"} centres. Lap all edges at least {50mm}{2"} and secure insulation with fire resistant tying cord, similar to Fiberglas EC9-4-T. Take care that insulation is not compressed to less than specified thickness. It is recognized that some compression of insulation will take place immediately under tying cord, but in no case shall the thickness of the compressed material be less than 75% of original specified thickness.
- 2.3.8.3. Type D3: Owens Corning Rigid Vapour Seal Duct Insulation, Johns Manville 814 Spin-Glas with FSK Facing, Manson Spin-Glas Rigid Insulating Board with reinforced foil facing, or Knauf Rigid Insulation Board with FSK facing. Density shall be not less than {48kg/cubic metre}{3lbs./cu.ft.}. Impale on mechanically fastened pins located at not greater than {300mm}{12"} centres. Secure with speed washers. Butt joints tightly together and seal washers, breaks and joints with self-adhering {100mm}{4"} wide plain aluminum tape, or adhere foil with Childers CP82 or Bakelite 230-39 adhesive.
- 2.3.8.4. Type D4: Owens Corning Flexible Duct Insulation, Johns Manville Microlite Type 75 Duct Wrap, Manson Microlite Insulation or Knauf Duct Wrap, {12kg/cubic metre}{3/4lb./cu.ft.} density with factory applied reinforced foil facing. Adhere insulation to duct surface with Childers CP82 or Bakelite 230-39 adhesive, which shall be applied in strips {150mm}{6"} wide at not greater than {300mm}{12"} centres. Butt edges of insulation tightly together, and seal breaks and joints of facing with self-adhering {100mm}{4"} wide aluminum tape or adhere foil with Childers CP82 or Bakelite 230-39 adhesive.
- 2.3.8.5. Type D5: Kingspan Kooltherm phenolic laminate board, faced with aluminum foil and glass tissue. Insulating material shall be available in thicknesses from 20 to 60 mm in increments of 5 mm. Provide v-slot insulating boards for circular shapes over 300 mm diameter. Adhere to ductwork in strict accordance with manufacturer's instructions, seal joints with self adhering foil tape. Where insulated ducting is exposed to weather, cover with aluminum sheeting and seal joints with silicone caulking.
- 2.3.9. Sheet Metal Insulation Table

No	Duty	Insulation T	Thickness	Vapou Barrie
1	Panels behind unused portio louvres	D3	{50mm}{2"}	Yes
2	Outside air plenums and duc	D3	{50mm}{2"}	Yes

No	Duty	Insulation T	Thickness	Vapour Barrie
	Outside air supply fans			
3	Mixed air plenums and ducts	D3	{40mm}[1-1/2"]	Yes
4	Relief and exhaust air plenums	D3	{40mm}[1-1/2"]	Yes
5	Exhaust ducts between motorized dampers and building exterior or final {3m}[10 ft] of exhaust air ducts whichever is greater. Ducts in unconditioned space	D3	{25mm}[1"]	Yes
6	Rectangular hot supply ducts	D1	{25mm}[1"]	No
7	Round hot supply ducts	D2	{40mm}[1-1/2"]	No
8	Cold and dual temperature supply ducts – exposed or concealed	D3	{25mm}[1"]	Yes
9	Ductwork outside the building exposed to the weather	D3	{50 mm}[2"]	Yes
10	Concealed supply air, (including ducts in shafts) to air terminal units excluding flex ducts. (Constant volume systems)	D4	{25mm}[1"]	Yes
11	Supply air, (including ducts in shafts) to air terminal control units, excluding flexible ducts (VAV systems)	D4	{25mm}[1"]	Yes
12	Free standing supply fan casings	D3	{40mm}[1-1/2"]	Yes
13	Heating and ventilating casings	D3	{25mm}[1"]	Yes
14	Air conditioning unit casings	D3	{40mm}[1-1/2"]	Yes
15	Field fabricated casings	D3	{40mm}[1-1/2"]	Yes
16	Stair pressurization ductwork from louvre to shaft or to heating coil if required.	D3	{50mm}[2"]	Yes

2.4. EQUIPMENT INSULATION

- 2.4.1. Provide insulation with a minimum thermal resistance of {0.57 W/m.°C}[0.40 BTU/in/(hr.ft²°F)] at {177°C}[350°F] mean temperature.
- 2.4.2. Apply insulation over {40mm}[1-1/2"] thickness in two layers, with staggered joints.
- 2.4.3. Apply vapour barrier over insulation on cold and dual temperature equipment.

- 2.4.4. Provide one of the following equipment insulation types and as scheduled in the Equipment Insulation Table:
- 2.4.4.1. Type E1: to {232°C}[450°F] - Owens Corning Type AF500 Series, Johns Manville 800 Series Spin-Glas, Manson AK Board, or Knauf Pipe and Tank Insulation. Cut and mitre insulation to suit surface contours. Impale insulation on mechanically fastened pins, located at not greater than {300mm}[12"] centres. Apply expanded metal lath and lace edges with {1.61mm}[16gauge] galvanized annealed wire. Secure insulation and metal lath with {40mm}[1-1/2"] OD speed washers. Apply {12mm}[1/2"] thick approved asbestos free insulating cement in two coats. Allow to dry to a smooth finish before recovering. In lieu of the above specified insulation and metal lath, Foamglas Curved Block may be substituted. Band Foamglas securely in place with {20mmx0.5mm}[3/4"x.020"] stainless steel bands on maximum {300mm}[12"] centres. Apply {12mm}[1/2"] thick approved asbestos free insulating cement in two coats.
- 2.4.4.2. Type E2: to {232°C}[450°F] - Owens Corning, Johns Manville, Manson or Knauf Insulation and application as per Type E1. Cover with {0.40mm} [.016"] thick sheet aluminum fabricated to the shape of the equipment. Mechanically fastened in place with bands, sheet metal screws or pop rivets. All corners shall be square and raw metal edges concealed. Metal covering will not be accepted as a substitute for specified vapour barrier applied directly in the insulation.
- 2.4.4.3. Type E3: to {650°C}[1200°F] - Johns Manville Thermo-12 Gold throughout hydrous calcium silicate type indicating asbestos free insulation, molded in sections or segments to suit the application. Density shall be not less than {224kg/m³}[14lbs/cu.ft.]. Insulation shall be bonded securely in place with {20mmx0.5mm}[3/4"x.020"] stainless steel bands on maximum {300mm}[12"] centres.
- 2.4.4.4. Type E4: Armstrong AP Armaflex FS elastomeric type insulation. Apply to clean and dry metal surfaces, using 100% Armstrong 520 adhesive coverage on both surfaces to be joined. Use manufacturer's compression fit method of butt joining sheets. Finish with two coats of Armaflex FS Finish, except the following shall be equipped with a removable {1.31mm}[18gauge] aluminum sheet metal enclosure with insulation applied as above to inside of cover:
- 2.4.4.4.1. chilled water pumps
- 2.4.4.4.2. chilled water pump suction and discharge guides
- 2.4.4.4.3. heated water pumps
- 2.4.4.4.4. condenser water pumps
- 2.4.4.4.5. condenser water pump suction and discharge guides
- 2.4.4.4.6. chiller shell ends
- 2.4.5. Equipment Insulation Table:

No	Duty	Insulation Ty	Thickness	Vapour Barrier
1	Chilled water pumps, suction and discharge guides	E4	{25mm}[1"]	Yes
2	Condenser water pumps, suction and discharge guides	E4	{25mm}[1"]	Yes
3		E1	{25mm}[1"]	No

No	Duty	Insulation Ty	Thickness	Vapour Barrier
	Heated water shell and tube heat exchangers			
4	Chilled and dual temperature water shell and tube heat exchangers	E1	{25mm}[1"]	Yes
5	Domestic hot water storage tank	E1	{40mm}[1-1/2"]	No
6	Water meter	E1	{40mm}[1-1/2"]	Yes
7	Expansion tanks	Insulation	not	required
8	Heated water pumps, suction and discharge guides	Insulation	not	required
9	Centrifugal refrigeration machine - suction lines - chiller shells - chiller shell ends	E4 E4 E4	{25mm}[1"] {25mm}[1"] {25mm}[1"]	Yes Yes Yes
10	Cooling tower indoor sump	E2	{25mm}[1"]	Yes
11	Boiler breeching (except pre-engineered factory insulated breeching)	E3	{50mm}[2"]	No

PART 3 - EXECUTION

3.1. PROTECTION

- 3.1.1. Protect the work of other trades with tarpaulins.
- 3.1.2. Protect the work of this trade from being defaced by other trades. Make good any damage and leave in perfect condition, ready for final painting.

3.2. INSTALLATION

- 3.2.1. Apply insulation over clean dry surfaces, firmly butting all sections together.
- 3.2.2. Apply insulation, vapour barriers and insulation finishes in strict accordance with manufacturer's recommendations.
- 3.2.3. Do not cover equipment nameplates with insulation.
- 3.2.4. Coordinate related work with other Divisions.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install motors, starters, control centres and wiring indicated on the Drawings and specified in this Section of the Specification.

1.2. REFERENCE STANDARDS

- 1.2.1. Provide all labour, materials, products, equipment and services, and perform all work in accordance with the current edition of:
 - 1.2.1.1. The Canadian Electrical Code, (CSA C22).
 - 1.2.1.2. EEMAC and NEMA Standards.
 - 1.2.1.3. All other standards and regulations referenced by the authorities having jurisdiction.

PART 2 - PRODUCTS

2.1. MOTORS

- 2.1.1. Provide, 60 cycle, 1750 rpm motors, except where noted, with the following characteristics:
 - 2.1.1.1. Under {0.373 kW}[1/2 hp] - single phase, 120 V.
 - 2.1.1.2. {0.373 kW}[1/2 hp] and over - 3 phase, 575 V.
 - 2.1.1.3. Motors {.75 kW}[1 hp] up to and including {373 kW}[500 hp] shall be premium efficiency T-frame, three phase motors. Meet the most recent issue of either CSA C390 Clause 4.10, 1998, or IEEE 112B. Provide motors to EEMAC temperature tolerance Class F suitable for 105°C temperature rise. All motors shall be rated for VFD/ inverter duty in accordance with NEMA MG1, Part 31, capable of operating from a PWM waveform at 110% of name plate voltage without saturation, capable of withstanding voltage spikes of 1800 V in a rise time of 0.1 microsecond and capable of running at 10% rated speed.
 - 2.1.1.4. All motors operated on variable frequency drives shall be equipped with a factory installed maintenance free, conductive microfiber shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge electrical shaft current within the motor and/or bearings.
 - 2.1.1.4.1. Motors up to and including {75 kW}[100 hp] shall be provided with a minimum of one shaft grounding ring on either the drive end or non-drive end.
 - 2.1.1.4.2. Motors over {75 kW}[100 hp] shall be provided with insulated bearings on the non-drive end and a shaft grounding ring on the drive end of the motor.
 - 2.1.1.5. Motor nameplates shall list the full load motor efficiency.
 - 2.1.1.6. Select motors for quiet continuous operation to suit loads imposed by equipment. Recognize that motor horsepower specified and scheduled are minimum sizes. Include extra costs for larger motors, starters, power wiring and additional control wiring if larger motors are required for Other equipment (Section 20 09 00) accepted as part of the Contract Price.

- 2.1.2. Provide motor enclosures as follows:
 - 2.1.2.1. Open drip-proof, 1.15 service factor for motors protected from the weather and moisture entrainment to operate satisfactorily at maximum temperature and moisture levels of surrounding air for motors located in air streams.
 - 2.1.2.2. Totally enclosed fan cooled 1.15 service factor for motors in all other locations.
 - 2.1.2.3. Provide explosion proof motors where scheduled.
 - 2.1.2.4. Equip motors {18 kW}[25 hp] and larger, as well as those smaller but with longer than 10 second starting time, with inherent overheat protection, consisting of thermistors, one for each phase, embedded in the stator windings. Extend wires out to motor terminal box, ready for field wiring into the starter holding coil circuit. Provide manual reset tripping device compatible with starter. For larger sizes, provide RTD's (Resistive Temperature Devices). Embed sensors in that part of the windings which is in the iron for response to both copper and iron temperature.
- 2.1.3. Provide single winding, variable torque (high and low speed) 2-speed motors where scheduled.
- 2.1.4. Provide motors less than {0.75 kW}[1 hp] with sealed bearings. Provide larger motors with serviceable fill and drain plugs at each bearing. Provide bearings with B₁₀ design life of at least 100,000 hours.

2.2. STARTERS AND MOTOR CONTROL

- 2.2.1. Refer to Starter and Disconnect Schedule for location, size and service of individual starters.
- 2.2.2. Provide motor control centres, starters and disconnects from a single manufacturer. All starters shall be provided with EEMAC type 2 enclosure, unless otherwise specified.
- 2.2.3. Provide refrigeration machine starters with the refrigeration machines. Manufacturer may be different than other starters.
- 2.2.4. Starters, factory built into the control panel of packaged equipment may be from a different manufacturer.
- 2.2.5. Provide 50,000 SCIA (Short Circuit Interrupting Ampacity) Symmetrical rating for all starters and disconnects.
- 2.2.6. For single phase motors, provide surface mounted manual starters with properly sized thermal overload protection, indicating pilot lights and toggle operator. In finished areas or where identified on the Starter Schedules, recess starters or provide stainless steel flush cover plates.
- 2.2.7. For 3 phase motors and heaters, up to {11 kW}[15 hp] provide combination magnetic starters and contactors with circuit breakers, properly sized thermal overload protection in 3 phases, 120V holding coil, and control transformer, pilot lights, either hand/off/automatic, on/off or start/stop pushbuttons mounted in cover. Refer to detailed controls information and provide at least two N.O and two N.C auxiliary contacts for the specified equipment interlock and control system interfacing.
- 2.2.8. For single speed motors {14.9 kW}[20 hp] or larger, provide solid-state "Soft Starters" reduced voltage starters with circuit breakers and adjustable voltage taps (40% to 100%, ramp time of 0.1 to 20 seconds). Provide overload relay where long starting time is involved. Provide auxiliary contact blocks and coil surge suppressors. Provide other features similar to standard three phase starters.
- 2.2.9. In addition to the above features, provide the following:

- 2.2.9.1. Weatherproof enclosure NEMA type 3R for outdoor installation.
- 2.2.9.2. Provide NEMA type 7 explosion proof enclosure where environment may contain explosive mixtures or gas.
- 2.2.9.3. Provide key operated, tamper proof operation where starter is accessible to the public or where specified.
- 2.2.9.4. Double voltage relay for interfacing with Fire Alarm System. Coordinate relay coil voltage with Division 26 00 00 fire alarm system supplier. Refer to Starter Schedule.
- 2.2.9.5. Two speed motor starters shall be variable torque, single winding type.
- 2.2.10. Include allowance for changing heaters or overload relays in field to suit job conditions.
- 2.2.11. Where two motors are controlled from a single variable frequency drive, provided overload protection for each motor.
- 2.2.12. Where multiple motors are provided for a single unit, i.e. two or more fans in a single housing, provide separate disconnects and overload protection for each motor.
- 2.2.13. Provide fully ambient compensated relays where the difference between ambient of motor and ambient of starter may be more than {20°C}[68°F].
- 2.2.14. In each starter that controls a motor with thermistor protection, provide a latching relay, a pilot light (blue), an auxiliary contact and a reset pushbutton. The latching relay shall control the pilot light upon activation of thermistor and the auxiliary contact installed in series with the overloads. The reset pushbutton shall be utilized for resetting the latching relay only.
- 2.2.15. Provide remote unfused, motor-rated, disconnect switches of NEMA type 1 or 3R design where shown or identified in the Starter Schedule, or where motor is out of sight or further than {9.1 metres}[30 ft] from starter.

PART 3 - EXECUTION

3.1. INSTALLATION AND WIRING

- 3.1.1. Provide motors, starters, contactors, disconnect switches and control devices for all Division 20 00 00 work.
- 3.1.2. Provide all power wiring from load side of variable frequency drives, starters, and contactors required for Division 20 00 00 work.
- 3.1.3. Provide power wiring for electrical tracing, controls and elsewhere where required.
- 3.1.4. Provide control wiring for all equipment provided or supplied under Division 20 00 00.
- 3.1.5. Provide all interlock connections and relays.
- 3.1.6. Provide complete wiring diagrams of all controls and pilot circuits.
- 3.1.7. Provide conduit and wiring materials and methods in strict accordance with Division 26 00 00 requirements.
- 3.1.8. Make connections to motors in flexible seal tight conduit, and with sufficient material to reduce vibration transmission and to allow full travel of motor for belt adjustment.
- 3.1.9. Install wiring materials parallel to or perpendicular to building planes.

- 3.1.10. Provide Pyrotenax "MI" fire rated cable in accordance with OBC for power wiring and control wiring connected to life safety equipment. (Wiring located only within the room in which the equipment is located need not be fire rated.)
- 3.1.11. Refer to Division 26 00 00:
- 3.1.11.1. Power wiring from line side of starters and contactors required for Division 20 00 00 work.
- 3.1.11.2. Line side power wiring to loose starters, disconnects, MCC's and contactors.
- 3.1.11.3. Power wiring for electrical tracing, controls and elsewhere where required.
- 3.1.11.4. Normal and emergency power service locations.

3.2. WIRING DIAGRAMS

- 3.2.1. Submit electrical field wiring diagrams of the complete motor and heater control system, with all relays and interlocks required for operation as outlined in Starter schedule and Control Sequences.

3.3. WARNING NOTICES

- 3.3.1. Place warning notices at each starter and on or close to each motor under EMCS control.
- 3.3.2. Provide conspicuous notices with bold lettering and advising that the motor is under EMCS control and may start at any time without warning. Submit notices at the shop drawing stage for Consultant review.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install variable speed drives and motors, as indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

- 1.2.1. Use only products which have been successfully used on other projects in similar applications, and for which there are local parts and service.
- 1.2.2. Provide drives from suppliers who have been established locally for at least five years.

1.3. QUALITY ASSURANCE

- 1.3.1. The VFD manufacturing facility shall be ISO 9001 certified.
- 1.3.2. The VFD shall be listed by UL 508C, C-UL (ULC), certified by CSA.
- 1.3.3. Variable Speed Drives shall be in compliance with the following:
 - 1.3.3.1. National Electrical Manufacturers Association NEMA ICS 7.0, AC Variable Frequency Drives
 - 1.3.3.2. National Electrical Code 430.120 and equivalent Canadian Electrical Safety Code.
 - 1.3.3.3. International Building code 2006 Seismic reference ICC AC-156
 - 1.3.3.4. European Union (EU electromagnetic compatibility directive).
- 1.3.4. Components shall be rated for 100,000 amps interrupting capacity.
- 1.3.5. The drive shall be designed to provide 100,000 hours mean time before failure (MTBF) when the specified preventative maintenance is performed.

1.4. RELATED WORK

- 1.4.1. For motors connected to variable speed drives, refer to requirements of Section 20 09 00.
- 1.4.2. To ensure adequate service and technical support, VFD's manufactured by one company and branded by another company shall not be allowed.
- 1.4.3. All VFD's provided on this project shall be from the same manufacturer.

PART 2 - PRODUCTS

2.1. GENERAL REQUIREMENTS

- 2.1.1. Provide adjustable frequency AC drives capable of driving a standard AC induction motor. Motor current shall approximate a sine wave. Voltage shall be varied with frequency to maintain the desired magnetizing current suitable for the driven load. The motor shall not be derated nor shall it operate within the service factor at full rated current, voltage and speed, as a result of using a VFD.

- 2.1.2. Include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.
- 2.1.3. Provide dual 5% impedance DC Link reactor on the positive and negative rails of the DC bus to minimize harmonics and to protect the VFD from power line transients. Chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the load range shall not be acceptable. VFD's with saturating (non-linear) DC link reactors shall provide an additional 3% AC Line reactor to provide acceptable harmonic performance at full load. Meet IEEE 519 for harmonic distortion.
- 2.1.4. VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated current for 0.5 seconds while starting. Demonstrate the ability to provide full motor torque from 20 to 60Hz while providing a variable torque output at reduced speed. Breakaway current of 150% of rated current shall be available.
- 2.1.5. Provide an adaptation algorithm to compare motor stator resistance and reactance to optimize efficiency. Continuously monitor motor speed and load and adjust applied voltage to maximize energy savings.
- 2.1.6. Provide integral EMI filters to attenuate radio interference conducted to the AC line. Provide adjustable carrier frequency. Automatically adjust the carrier frequency to optimize operation and reduce motor noise.
- 2.1.7. Provide isolation between power and control circuitry to ensure safety and to protect electronic controls from damage caused by voltage spikes, current surges, ground loop currents.
- 2.1.8. VFD shall be provided with at minimum EEMAC type 12 enclosures, suitable for installation in a return air plenum.
- 2.1.9. Provide variable speed drives as scheduled herein or as shown on the equipment schedules.

2.2. SERVICE CONDITIONS

- 2.2.1. VFD units shall be capable of operating under the following conditions:
 - 2.2.1.1. Ambient temperature at full load {-10°C to 45°C}[15°F to 115°F] through 125 HP at 460 and 600 volts, through 60 HP at 208 volts.
 - 2.2.1.2. 0-95% relative humidity, non-condensing.
 - 2.2.1.3. Up to {1000 m}[3280 ft] ASL without derating.
 - 2.2.1.4. AC line voltage variation of $\pm 15\%$.
 - 2.2.1.5. Preferred bottom entry for all cables, no side clearance requirement. Units rated for installation in a return air plenum.

2.3. PROTECTIVE FEATURES

- 2.3.1. Minimum Class 20 programmable electronic motor overload protection for single motor application. Automatically compensate for changes in motor speed.
- 2.3.2. Protection against the following faults:
 - 2.3.2.1. input transients
 - 2.3.2.2. loss of AC line phase

- 2.3.2.3. output short circuit
- 2.3.2.4. output ground fault
- 2.3.2.5. over or under voltage
- 2.3.2.6. VFD and motor over temperature
- 2.3.3. Display all faults in plain language, not code.
- 2.3.4. Provide programmable critical frequency lockout ranges to prevent equipment from operating continuously in unstable ranges.
- 2.3.5. Provide temperature controlled cooling fan(s) to maintain desirable operating conditions. Automatically turn off fans when not required.

2.4. INTERFACE FEATURES

- 2.4.1. All units shall have the same user interface, consisting of digital display and keypad, regardless of size or horsepower rating. Provide password protection on keypad. Keypad shall be removable, capable of remote mounting and shall allow uploading/downloading of multiple parameters as an aid to start-up of multiple VFDs. Keypad shall include:
 - 2.4.1.1. Hand-Off-Auto selector with manual speed control.
 - 2.4.1.2. Bump less transfer when switching between Hand and Auto modes.
 - 2.4.1.3. Fault reset and "Help" including online assistance.
 - 2.4.1.4. Built-in real time clock with battery back up. Clock shall date and time stamp faults and record operating parameters at the time of fault. Clock shall be programmable for control of start/stop functions, PID parameter sets. Provide four independent timer functions with both week and weekend settings.
 - 2.4.1.5. Provide pre-programmed application macro designed to facilitate start up. The macro shall utilize one command to reprogram all parameters and interfaces for a particular application.
 - 2.4.1.6. Fire alarm override input. On receipt of a contact closure from FA, the VFD shall operate on one of two modes a) operate at a predetermined fixed speed, b) Operate in a specific override PID algorithm that automatically adjusts motor speed based on an override point and feedback (such as static pressure).
 - 2.4.1.7. Provide at least two PID set point controllers (pressure and flow), each with two independent parameter sets, switchable from and external digital signal such as day/night or summer/winter.
 - 2.4.1.8. Two programmable analogue inputs which shall accept current or voltage signals.
 - 2.4.1.9. Two programmable analogue outputs, (0-20 ma or 4-20ma). Outputs shall be programmable to be proportional to frequency, motor speed, output voltage, output current, motor torque, motor power (kW), DC bus voltage, or other data.
 - 2.4.1.10. Minimum of four programmable digital inputs for interfacing with external devices. Each shall initiate on application of 24VDC or 24VAC.
 - 2.4.1.11. Two programmable relay (Form C) outputs capable of switching 240 VAC at 2 A, complete with adjustable delay of both on and off functions.

- 2.4.1.12. Run permissive circuit, sensing dry contact closure (end switch), allowing the motor to start or stop.
- 2.4.1.13. Minimum of six preset speeds. With independently adjustable acceleration/deceleration ramps with 1sec to 30 min adjustable time ramps.

2.5. SERIAL COMMUNICATION

- 2.5.1. Provide EIA – 485 communications port as standard. The preferred protocol is BACnet MS/TP however Modbus, LON Works, N2 or EitherNet protocols shall also be available. Third party gateways or multiplexers are not acceptable. Connections shall be certified by the governing authority (BTL Listing for BACNet).
- 2.5.2. Serial communications capabilities shall include but not be limited to:
 - 2.5.2.1. Run-Stop control
 - 2.5.2.2. Speed set adjustment
 - 2.5.2.3. PID control adjustment
 - 2.5.2.4. Accel/Decel time adjustment
 - 2.5.2.5. Lock/Unlock control
 - 2.5.2.6. Current limit control
- 2.5.3. The VFD shall allow the BAS capability for monitoring process variable feedback such as:
 - 2.5.3.1. Output speed/frequency
 - 2.5.3.2. Current (amps)
 - 2.5.3.3. % Torque
 - 2.5.3.4. Power (kW)
 - 2.5.3.5. Kilowatt hours (resettable)
 - 2.5.3.6. Operating hours (resettable)
 - 2.5.3.7. Drive temperature

2.6. OPTIONAL FEATURES

- 2.6.1. Provide the following features:
 - 2.6.1.1. All features shall be built, mounted, tested and warranted by the VFD manufacturer and shall be listed and labelled similarly to the VFD.
 - 2.6.1.1.1. Three contactor bypass to allow operation of the motor in case of VFD failure. Provide the following features:
 - 2.6.1.1.1.1. Drive/off/bypass/test selector switch.
 - 2.6.1.1.1.2. Bypass pilot light.
 - 2.6.1.1.1.3. UL listed overload protection consisting of fast acting input fuses.

- 2.6.1.1.1.4. Single phase protection.
- 2.6.1.1.1.5. Common start/stop command when operating in bypass or VFD mode.
- 2.6.1.1.1.6. Selectable Run Permissive logic shall operate in either VFD or bypass mode. When activated, a command to start the motor shall close a relay, allowing operation of another device such as a damper. A contact closure from the device shall confirm operation and allow the motor to start.
- 2.6.1.1.1.7. External safety interlocks to disable motor operation in either bypass or VFD mode.
- 2.6.1.1.1.8. Selectable time delay (0-60 sec) before initiating bypass operation. This allows deceleration of motor prior to switching to bypass and allows BAS to prepare for bypass operation.
- 2.6.1.1.1.9. Selectable automatic bypass, as above.
- 2.6.1.1.1.10. Overload protection shall be provided in the bypass mode.
- 2.6.1.1.1.11. Main input power disconnect for both bypass and VFD.
- 2.6.1.1.1.12. Serial communication capability allowing BAS control of the VFD in the bypass mode.
- 2.6.1.2. For fan systems with motors 20 HP or larger, provide 3 contact bypass similar to above, plus integral soft start starter factory wired and tested.
- 2.6.1.3. Door interlocked pad lockable circuit breaker that will disconnect all input power from the VFD. Available with or without bypass option.
- 2.6.1.4. Door interlocked pad lockable disconnect switch that will disconnect all input power from the VFD. Available with or without bypass option.
- 2.6.1.5. Field Bus adaptors for optional protocols such as LON Works, EtherNet, etc. shall be available with the addition of an option card.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1. Meet manufacturer's installation instructions.
- 3.1.2. Field wiring of automatic controls shall be provided by the Controls Subcontractor.
- 3.1.3. Provide a disconnect switch at the motor where required by the authorities having jurisdiction. Where such a switch is installed, provide an auxiliary contact or switch at the disconnect, mounted to open when the disconnect switch is opened and wired to the MCP terminal strip such that opening the disconnect switch initiates a drive shut down and prevents the drive from starting in either Line or Drive positions.
- 3.1.4. Locate and mount VSD panels in Mechanical Rooms where shown on the Drawings, or within line of sight if equipment on an accessible wall, do not mount VFD panels on rotating or vibrating equipment.
- 3.1.5. Arrange for the manufacturer's technical representative or local representative, if qualified, to inspect the installation of each drive and to commission operation with startup and testing procedures. Arrange for the controls subcontractor to provide coordination of control sequences for startup and testing.

3.2. WARRANTY

- 3.2.1. Warranty shall be 24 months from the date of certified startup, not to exceed 30 months from the date of shipment. The warranty shall include all parts and labour.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

1.1.1. Meet contract requirements of Division 01 00 00.

1.1.2. Work included shall consist of the total content of Contract Documents, except for the work listed in this section.

END OF SECTION

PART 1 - INSTRUCTIONS TO BIDDERS

1.1. SEPARATE PRICES

- 1.1.1. Submit requested Separate Prices with the Bid Form or in accordance with the bid requirements by attaching a completed version of this section.
- 1.1.2. Express requested separate prices as an addition to or deduction from the Stipulated Bid Sum or as no change to the Stipulated Bid Sum.
- 1.1.3. The Stipulated Bid Sum **will not include** any additions or deductions shown as separate prices.
- 1.1.4. The Owner reserves the right to accept or reject any separate price offered.
- 1.1.5. The Stipulated Bid Sum will be adjusted by the addition or deduction of separate prices accepted by Owner to form the Contract Price.
- 1.1.6. The Owner may select the Contractor on the basis of the adjusted Stipulated Bid Sum.
- 1.1.7. Separate prices are for systems and or equipment installed complete in all regards.
- 1.1.8. Provide the following separate prices:

No.		Add / (Deduct)
.1	Provide duct silencers on discharge duct of fan coil unit where indicated on mechanical drawings.	

1.2. IDENTIFIED PRICES

- 1.2.1. Submit requested identified prices with Bid Form and in accordance with the bid requirements.
- 1.2.2. The Stipulated Bid Sum **will include** identified prices.
- 1.2.3. The Owner reserves the right to delete any identified price offered.
- 1.2.4. The Stipulated Bid Sum may be adjusted by the deduction of identified prices accepted by Owner to form the Contract Price.
- 1.2.5. The Owner may select the Contractor on the basis of the adjusted Stipulated Bid Sum.
- 1.2.6. Identified prices are for systems and/or equipment installed and complete in all regards.
- 1.2.7. Provide the following identified prices:

No.		Add / (Deduct)
.1	Provide an itemized price to provide a Maxiblu (or equivalent) condensate pump. Price to include allowance for a dedicated electrical 120/1/60 feed that would be provided by Division 26.	
.2	Condensate pumps shall be provide based upon site conditions where gravity drainage is not feasible.	

END OF SECTION

PART 1 - INSTRUCTION TO BIDDERS

- 1.1.1. The Stipulated Bid Sum shall be for 'basis of design' or 'alternative' manufacturer only. The bidder acknowledges that if an alternative is bid, there may be differences in equipment size, orientation, weight, etc., Include all necessary changes in design when an alternate product is bid. Where a choice of **'Other'** equipment is given, indicate selection included in Stipulated Bid Sum by submitting this Section. **'Other'** products may be considered where an appropriate saving is offered. Failure to complete and submit this section will indicate that the Contractor has agreed to provide the 'basis of design' equipment specified in each specification section, listed in each equipment schedule, and/or shown on the Drawings.
- 1.1.2. Express **'Other'** prices as an addition to or deduction from the Stipulated Bid Sum.
- 1.1.3. The Owner reserves the right to accept or reject any 'other' price offered.
- 1.1.4. The Stipulated Bid Sum will be adjusted by the addition or deduction of 'Other' prices accepted by Owner to form the Contract Price.
- 1.1.5. The Owner may select the Contractor on the basis of the adjusted bid price.
- 1.1.6. Where modifications to the work of Other Trades is required as a result or part of the "other" offered, include the cost of said modifications in the 'other' price offered.
- 1.1.7. Submit the following list of base bid and alternative suppliers in accordance with Bid requirements.

Spec. Reference Section	Equipment	Basis of Design Manufacturer or Supplier	Alternative Manufacturer or Supplier	Other Manufacturer or Supplier	Add or Deduct From Base Bid Price for Other
20 05 00	Strainers	Spirax	() Hayward () Colton () SSI Equipment	_____	\$ _____
20 05 00	Thermometers and Pressure Gauges	Tterice	() Taylor () Winters () Weiss	() Wika () Weksler	\$ _____
20 05 00	Expansion Joints and Guides		() Metraflex () United () Flex-Pressions	_____	\$ _____
20 05 00	Hangers and Supports	Anvil	() Myatt () Taylor	_____	\$ _____
20 05 48	Sound and Vibration Controls	Kinetics	() Vibron () Ductmaster () E H Price () Vibro Acoustics	_____	\$ _____
20 07 00	Thermal Insulation	Fibreglass Flexonics Canada	() Johns Manville () Manson () Knauf () Owens Corning	_____	\$ _____
20 09 00	Motors	Westinghouse	() GE () Emerson () US Electric () WEG	() Baldor () Marathon	\$ _____ \$ _____

Spec. Reference Section	Equipment	Basis of Design Manufacturer or Supplier	Alternative Manufacturer or Supplier	Other Manufacturer or Supplier	Add or Deduct From Base Bid Price for Other
20 09 00	Starters, Contactors and Motor Control Centre	Klockner Moeller	() Westinghouse () Emerson () Square D () Cutler Hammer	Siemens	\$ _____
20 09 50	Variable Speed Drives	Graham (Danfoss)	() ABB () Hitachi	() Emerson () Siemens	\$ _____
21 14 00	Fire Hose Cabinets	NFE	Wilson Cousins	_____	\$ _____
21 14 00	Water Pressure Reducing Valves	Cla-Val	() Watts () Singer () Conbraco () Wilkins	_____	\$ _____
21 14 00	Backflow Preventers	Watts	() Cla-Val () Conbraco () Wilkins	_____	\$ _____
21 14 00	Sprinkler Heads	Reliable	() Tyco () Viking () Victaulic	_____	\$ _____
21 31 00	Fire Pumps (Horizontal Split Case)	Xylem AC Fire Pump	() Aurora () Peerless () Patterson () Armstrong	_____	\$ _____
22 11 00	Gate, Globe, Check and Ball Valves	Kitz	() Jenkins () Crane () Newman Hattersley	() Toyo () Nibco () Red & White	\$ _____ \$ _____ \$ _____
22 11 00	Butterfly Valves	DeZurik	() WKM () Crane () Keystone () Victaulic () Kitz	Centreline Bray Challenger	\$ _____ \$ _____ \$ _____
22 30 00	Drainage Products	Zurn	() Smith () Watts	Mifab	\$ _____
22 30 00	Back Flow Preventor	Watts	() Conbraco () Wilkins	_____	\$ _____
22 33 00	Dom. Hot Water Heaters (electric)	PVI	() Rheem () Ruud () A O Smith	_____	\$ _____
22 33 00	Water Tanks	Drummond	() Clemmer () O'Conner () Fulton	_____	\$ _____
22 40 00	Flush Valves	Sloan	() Cambridge/ De () Zurn	_____	\$ _____
22 40 00	Plumbing Fixtures	American Standard	() Kohler () Zurn	_____	\$ _____

Spec. Reference Section	Equipment	Basis of Design Manufacturer or Supplier	Alternative Manufacturer or Supplier	Other Manufacturer or Supplier	Add or Deduct From Base Bid Price for Other
22 40 00	Drinking Coolers	Filtrine	() Halsey Taylor () Acorn () Elkay	_____	\$ _____
22 40 00	Emergency Shower	Bradley	() Guardian () Western () Acorn	_____	\$ _____
22 63 00	Medical Air Compressors	Essex	() Class 1 () Squire	_____	\$ _____
22 63 00	Medical Gas Products	Essex	() Class 1 () VitalAir	_____	\$ _____
23 21 13	Radiation Valves	Delta	() Belimo () Dahl () Spirax	_____	\$ _____
23 21 13	Gate, Globe, Check and Ball Valves	Kitz	() Crane () Jenkins () WKM	Toyo Nibco Red White Newman Hattersley	\$ _____ \$ _____ \$ _____ \$ _____
23 21 13	Butterfly Valves	DeZurik	() Challenger () Crane () Keystone () Jenkins	Centreline Victaulic Bray	\$ _____ \$ _____ \$ _____
23 21 13	Circuit Balancing Valves	Tour & Andersson	() ITT () Oventrop () Newman Hatter	_____	\$ _____
23 25 00	HVAC Water Treatment	Klenzoid	() PMC () Chem-Aqua () Solenis	Magnus	\$ _____
23 31 00	Dampers	Tamco	() Ruskin () AMI	_____	\$ _____
23 31 00	Fire Dampers	Nailor	() Ruskin () AMI () E.H. Price () Greenheck	_____	\$ _____
23 31 00	Smoke and Fire/Smoke Dampers	Nailor	() Ruskin () AMI () Greenheck	_____	\$ _____
23 34 00	Axial Fans	PennBarry	() Twin City () Greenheck () Chicago () Sheldons () Howden () Woods (Americ Fan Co.) () Cook	_____	\$ _____

Spec. Reference Section	Equipment	Basis of Design Manufacturer or Supplier	Alternative Manufacturer or Supplier	Other Manufacturer or Supplier	Add or Deduct From Base Bid Price for Other
23 34 00	Mixed-Flow Fans	PennBarry	() Twin City () Greenheck () Sheldons () Chicago () Carnes () Cook () Woods (Americ Fan Co.)	_____	\$ _____
23 34 00	VPIM Fans	Woods (American Fan Co.)	() Chicago () Howden	_____	\$ _____
23 34 00	Propeller Fans	PennBarry	() Twin City () Greenheck () Sheldons () Chicago () Carnes () Cook	_____	\$ _____
23 34 00	Utility Vent Sets	PennBarry	() Twin City () Greenheck () Sheldons () Chicago () Carnes () Cook () Woods (Americ Fan Co.)	_____	\$ _____
23 34 00	Centrifugal Fans	PennBarry	() Twin City () Greenheck () Sheldons () Chicago () Cook () Trane () Woods (Americ Fan Co.)	_____	\$ _____
23 34 00	Roof Exhausters	PennBarry	() Greenheck () Sheldons () Carnes () Cook	_____	\$ _____
23 34 00	Inline Centrifugal Fans	PennBarry	() Twin City () Greenheck () Sheldons () Chicago () Carnes () Cook	_____	\$ _____
23 34 00	Above Ceiling Fans	PennBarry	() Greenheck () Zonex () Carnes () Cook	_____	\$ _____

Spec. Reference Section	Equipment	Basis of Design Manufacturer or Supplier	Alternative Manufacturer or Supplier	Other Manufacturer or Supplier	Add or Deduct From Base Bid Price for Other
23 36 30	Air Terminal Control Units-Digital	E H Price	() Nailor () Trox () Carnes () Metalaire	_____	\$ _____
23 37 13	Air Terminals	E H Price	() Nailor () Carnes () Metalaire	_____	\$ _____
23 39 00	Louvres	Const. Specialties	() E.H. Price () M.W. McGill () Ventex	_____	\$ _____
23 41 00	Filters	Camfil Farr	() AAF () Cambridge	_____	\$ _____
23 76 00	Split Dx Air Conditioning Units	Daikin	() Mitsubishi () LG () Lennox () Carrier	_____	\$ _____
23 79 20	Dust Collector & Welding exhaust	Lev-Co	() Carmon		
23 81 23	Computer Room Air Conditioning Units	Liebert	() Ecosaire () Canatel () Stulz	Skymark	\$ _____ \$ _____
23 81 45	Unitary Heat Pumps	McQuay	() Carrier		
23 82 00	Cabinet Unit Heaters, Unit Heaters	Eng Air	() Trane () Dunham Bush	_____	\$ _____
23 82 00	Wall-fin	Runtal	() Trane () Sigma () Eng Air	_____	\$ _____
23 82 00	Wall-fin with Extruded Aluminum Enclosure	Runtal	() Sigma () Trane () Dunham Bush () Eng Air	_____	\$ _____
23 82 00	Wall-fin with Custom Enclosure	Runtal	() Sigma () Rosemex () Eng Air	_____	\$ _____
23 82 00	Radiant Ceiling Panels	Eng Air	() Airtex () Sigma	_____	\$ _____
23 82 00	Panel Radiator	Runtal	() Panel Radiator () Hudevad	_____	\$ _____
23 82 16	Air Coils	Aerofin	() Trane () Eng. Air () USA Coil () Daikin	_____	\$ _____

Spec. Reference Section	Equipment	Basis of Design Manufacturer or Supplier	Alternative Manufacturer or Supplier	Other Manufacturer or Supplier	Add or Deduct From Base Bid Price for Other
23 82 19	Fan Coil	Daikin	() Trane () Dunham Bush () International () Williams () Eng Air	_____	\$ _____
23 89 50	Electric Baseboard Heating	Ouellet	() Dimplex () Indeeco () Stelpro	_____	\$ _____
23 89 50	Electric Baseboard Heating with Special Enclosures	Design Architectural Heating	() Ouellet () Dimplex () Indeeco () Stelpro	_____	\$ _____
23 89 50	Electric Unit Heaters and Cabinet Heaters	Ouellet	() Dimplex () Indeeco () Stelpro	_____	\$ _____
23 89 50	Electric Duct Heaters, Electric Reheat Coils	Thermolec	() E.H. Price () Indeeco	_____	\$ _____
23 89 50	Electric Heating Cable, Tracing Cable	Raychem	() Thermon () Pyrotenax	_____	\$ _____
25 30 00	Airflow Measurement	Ebtron	() Airbar () Presso	_____	\$ _____
25 30 00	Waterflow Measurement	Annubar	() Onicon () Presso	_____	\$ _____
25 30 00	Carbon Dioxide Detection	Optinet	() QEL () MSA () Vulcain	_____	\$ _____
25 30 00	Dampers	Tamco	() Ruskin () AMI () Alumavent	_____	\$ _____
25 30 00	Actuators, Valve & Damper	Belimo	() Distech () Siemens () Johnson () Honeywell	_____	\$ _____
25 30 00	Control Valves <50mm	Delta	Belimo () JCI () Siemens	_____	\$ _____
25 30 00	Control Valves 65 mm or more	Dezurik	() Kitz () WKM () Delta () Challenger () JCI () Siemens	_____	\$ _____
25 30 00	Leak Detector	Ray Chem	() Liquitek	_____	\$ _____

Spec. Reference Section	Equipment	Basis of Design Manufacturer or Supplier	Alternative Manufacturer or Supplier	Other Manufacturer or Supplier	Add or Deduct From Base Bid Price for Other
25 40 00	Carbon Monoxide Detection & Control System	Enmet	() MSA () Vulcain () QEL	_____	\$ _____
25 50 00	Electronic Controls and Monitoring	Automated Logic	() Siemens () Johnson () Invensys () Honeywell () Distech () Alerton	_____	\$ _____

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. These Specifications are an integral part of the Contract Documents. Tendering and Contract Requirements and Division 01 00 00, General Requirements apply to all Division 20 00 00 Specification Sections.
- 1.1.2. Provide labour, materials, products, equipment, and services required to complete the demolition work specified herein.
- 1.1.3. Refer to Drawings for extent of demolition work. The drawings indicate the approximate locations of services as far as these are known.
- 1.1.4. Dispose, off site, of all debris in accordance with the jurisdictional authorities.
- 1.1.5. Removal and storage of salvageable items will be as directed by this specification section and the Owner or their representative.
- 1.1.6. During the course of this work, suspected hazardous or contaminated materials will probably be encountered. The Owner has engaged the services of **(insert name of firm)** to carry out a contaminated materials survey. The results of this survey are available by request.
- 1.1.7. Mechanical demolition work associated with this building is indicated on the demolition drawings and generally and consists of the following:
 - 1.1.7.1. Plumbing and Drainage
 - 1.1.7.2. Sprinklers and Fire Protection
 - 1.1.7.3. HVAC systems and equipment
 - 1.1.7.4. Building Control Systems

1.2. REFERENCE STANDARDS

- 1.2.1. Meet the requirements and recommendations of all Municipal, Provincial and Federal Bylaws and Ordinances.
- 1.2.2. Execute this work in accordance with the latest edition of the following codes and standards.
 - 1.2.2.1. CAN/CSA-S350-M1980 - Code of Practice for Safety in Demolition of Structures.
 - 1.2.2.2. Ontario Building Code.
 - 1.2.2.3. Occupational Health and Safety Act.
 - 1.2.2.4. Regulations for Construction Projects.
 - 1.2.2.5. Ontario Fire Code.
 - 1.2.2.6. Regulations under Fire Marshals Act.

1.3. QUALITY ASSURANCE

- 1.3.1. All work shall be performed by a firm having adequate equipment and skilled labour and being able to provide written evidence of satisfactorily completed work, similar to that specified during the past immediate five (5) years.
- 1.3.2. Removal from site and disposal of debris shall be carried out in accordance with the requirements of the local jurisdictional authorities.
- 1.3.3. Arrange and pay for all permits, notices and inspections necessary for the proper execution and completion of the demolition work.

1.4. SUBMITTALS

- 1.4.1. Submit shop drawings as requested by the consultant, indicating demolition sequence, cutting and patching, bracing and protection of existing services designated to remain.

PART 2 - PRODUCTS

2.1. DISPOSAL OF MATERIALS

- 2.1.1. All materials which have not been designated for salvage from the demolition shall become the property of the Contractor. Remove all material and debris from the site as quickly as possible and dispose of legally. Burning of debris or selling of materials on the site will not be permitted.
- 2.1.2. Present to the Owner existing equipment removed but not identified for salvage on site. Acceptance of removed equipment is at the discretion of the Owner. Remove such items from site when deemed unsuitable.
- 2.1.3. Conform to requirements of municipality's Works Department regarding disposal of waste materials.
- 2.1.4. Materials prohibited from municipality waste management facilities shall be removed from site and disposed to recycling companies specializing in recyclable materials.

2.2. SALVAGEABLE ITEMS

- 2.2.1. The following is a list of salvageable items to be carefully disconnected, removed and turned over to the Owner:
 - 2.2.1.1. Plumbing fixtures and trim.
 - 2.2.1.2. Fire hose cabinets, fire extinguishers and sprinkler heads.
 - 2.2.1.3. Terminal control units such as VAV boxes, reheat coils etc.
 - 2.2.1.4. Air terminals, such as diffusers and grilles.
 - 2.2.1.5. Controls such as control valves, actuators, thermostats and EMCS network hardware.
 - 2.2.1.6. Pumps complete with respective suction guides and triple duty valves.
 - 2.2.1.7. Boilers.
 - 2.2.1.8. Chillers and Cooling Towers
 - 2.2.1.9. Cabinet unit heaters and fan coils.

PART 3 - EXECUTION

3.1. GENERAL INSTRUCTIONS

- 3.1.1. At the end of each work shift, leave work in a safe condition.
- 3.1.2. Patch fire rated partitions and floors to maintain rating upon removal of mechanical services originally spanning fire rated assembly.
- 3.1.3. Demolish work into sections of practical size for removal without alteration or damage to existing building.

3.2. STORAGE OF MATERIALS

- 3.2.1. Store materials only in areas designated by the Owner and as permitted by the local jurisdictional authorities.
- 3.2.2. Materials and debris shall not be stacked in the building to the extent that overloading of any part of the structure will occur.

3.3. PROTECTION OF OWNERS PREMISES

- 3.3.1. Adhere strictly to the Owner's requirements.
- 3.3.2. Confer with the Owner concerning schedule, dust and noise control prior to commencing work in or adjacent to existing facilities where such work might affect either those facilities or their occupants.
- 3.3.3. Execute work with the least possible interference or disturbance to occupants, public and normal use of premises.
- 3.3.4. Provide temporary means to maintain security when security has been reduced by Division 20 00 00.
- 3.3.5. Only elevators, dumbwaiters, conveyors or escalators assigned for Contractor's use may be used for moving men and material within building. Protect walls of passenger elevators, to approval of Owner prior to use. Accept liability for damage, safety of equipment and overloading of existing equipment.
- 3.3.6. Provide temporary dust screens, barriers, and warning signs in locations where renovations and alteration work is adjacent to areas which will be operative during work.
- 3.3.7. Protect all mechanical systems, indicated to remain, from damage.
- 3.3.8. Provide and maintain ready access to firefighting equipment at all times.
- 3.3.9. Provide and maintain proper and suitable fire extinguishers throughout the duration of the work.
- 3.3.10. The drawings indicate the approximate locations of services as far as these are known. Should any mechanical or electrical service line be broken, or disrupted by operations specified under this contract, repair service lines, and make good all damage due to the disruption or break, at no expense to the Owner. Notify the Owner immediately whenever any service line is broken or damaged.
- 3.3.11. The drawings indicate the approximate locations of services as far as these are known. Immediately advise Consultant in writing when unknown services are encountered.

- 3.3.12. Accept liability for costs incurred by the Owner in repairing and cleaning equipment, etc., resulting from failure to comply with the above requirements.

3.4. RESTRICTIONS ON USE OF PREMISES

- 3.4.1. Use only those existing entrances and stairs designated by the Owner for access to and egress from the existing buildings and various floors where work of this contract is to be carried out. No traffic through other areas of the building will be permitted without the prior consent of the Owner.
- 3.4.2. Keep stairs and corridors clear and open as required by Fire Marshall for exit purposes in case of fire, and as required for use by the Owner's personnel.
- 3.4.3. Owner will designate which toilet facilities may be used.

3.5. PRE-DEMOLITION AUDIT

- 3.5.1. The Division 20 00 00 contractor shall, in the presence of the Owner and the Consultant, conduct a pre-demolition audit to determine exactly which materials in the existing building are to be included in the demolition work and which materials can be either reused by the Owner or resold by the Contractor. Submit, in writing, to the Owner, findings from the audit.
- 3.5.2. Items from demolition which will be disposed of shall be so done in accordance with the applicable requirements of the "Build Green Project" in force at the place of work, at the time of this work.

3.6. PREPARATION

- 3.6.1. Notify the consultant a minimum of **48 hours** prior to commencing this work.
- 3.6.2. Prior to commencing this work arrange to have the appropriate trades concerned present for the disconnection of all utility services.
- 3.6.3. Ensure that all existing services designated to remain are adequately protected.

3.7. TERMINATION OF EXISTING SERVICES

- 3.7.1. Arrange and pay for the disconnection, capping and for plugging of gas, water, sewer, storm and other services to the building to be demolished. In each case the utility company involved shall be notified in advance and its approval obtained before commencing that portion of the work. Disconnect and cap services at the locations indicated by the Consultant.

3.8. INTERRUPTION OF EXISTING SERVICES

- 3.8.1. Arrange, schedule and perform work with minimum disturbance to existing facilities and services.
- 3.8.2. Submit a complete schedule of service interruptions and changeovers with approximate dates required, durations and times of day, for approval before proceeding.
- 3.8.3. Notify Owner in writing at least 72 hours in advance of planned interruption to existing services.
- 3.8.4. Interruption of service must occur at the times and for the duration stipulated by the Owner.
- 3.8.5. Keep service interruption duration to an absolute minimum. Carry out all preparatory work, measurements, etc., without interruption of existing services.

- 3.8.6. If service interruptions are required by the Owner during the night or on weekends, etc., premium time shall be included at the Contract Price. No extra charges will be allowed at a later date for failure to include same.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install standpipe and fire hose systems as indicated on the Drawings and specified in this Section of the Specification.

1.2. CERTIFICATE OF COMPLIANCE

- 1.2.1. Provide certificate of compliance that components are compatible and, where applicable, certified for intended use by nationally recognized testing agency.
- 1.2.2. The successful sprinkler contractor must hydraulically calculate the project and prepare dimensioned shop drawings. The sprinkler contractor's engineer becomes the "Engineer of Record" for the sprinkler work associated with this project.
- 1.2.3. Submit a signed, stamped certificate of compliance.

1.3. REFERENCE STANDARDS

- 1.3.1. Meet Federal, Provincial and Municipal building and fire regulation, including the most recent issue of the following:
 - 1.3.1.1. National Building Code of Canada
 - 1.3.1.2. Ontario Building Code
 - 1.3.1.3. NFPA14 - Standard for the Installation of Standpipe and Hose Systems
 - 1.3.1.4. NFPA10-Standard for Portable Fire Extinguishers
 - 1.3.1.5. Federal Communications Commission
 - 1.3.1.6. All components of the standpipe and fire hose systems shall be ULC listed and labelled and FM approved
- 1.3.2. Material shall meet current ASTM and ANSI standards.

1.4. GOVERNING AUTHORITY APPROVAL

- 1.4.1. Obtain City of Toronto, Ontario Fire Marshall and Federal Communications Commission approval for entire installation, including equipment and materials.
- 1.4.2. Perform all tests and provide certification as required by authorities having jurisdiction.

1.5. COORDINATION

- 1.5.1. Confirm fire hose cabinet locations and quantities from both Architectural and Mechanical Drawings and provide higher count including piping connections. Report any discrepancies to Consultant prior to bid close.

PART 2 - PRODUCTS

2.1. PIPING

- 2.1.1. Provide Schedule 40 black steel for all piping used for standpipes, fire hose supply lines.
- 2.1.2. Provide {1200 kPa}[175 psig] working pressure fittings of threaded cast iron, threaded malleable iron, and flanged cast iron. Unions are permissible for pipe {50 mm}[2"] and smaller.
- 2.1.3. Provide welded joints for pipe {65 mm}[2"] diameter and larger.
- 2.1.4. Victaulic mechanical joints Model 005 up to {150 mm}[6"] dia. or Model 07 above {150 mm}[6"] diameter will be acceptable on Victaulic systems in accessible areas only and where permitted by governing authorities. Use Grade E, Type A Vic Plus gaskets. Provide Victaulic installation instructions on site. Weld joints in non-accessible locations.
- 2.1.5. Fasten flanges with square or hex headed bolts and heavy hex nuts.
- 2.1.6. Provide flange gaskets {1.6 mm}[1/16"] thick.
- 2.1.7. Provide pipe hangers to meet NFPA 14 for hose systems.

2.2. VALVES

- 2.2.1. Provide valves of one manufacturer, bearing manufacturer's name, trademark and pressure rating. Unless otherwise specified or indicated, all valves shall be designed for {1200 kPa}[175 psig] working pressure.
- 2.2.2. Provide supervisory alarm contact switch for each valve in fire system. Refer to Division 26 00 00 for alarm wiring and connections to annunciator panel.
- 2.2.3. Where system pressures exceed the rating of listed valves, obtain approval from authority having jurisdiction on a specific valve of suitable rating, prior to submitting Shop Drawings.
- 2.2.4. Provide Crane or Jenkins gate valves as follows:
 - 2.2.4.1. Valves {50 mm}[2"] and smaller, Underwriters Laboratories pattern, bronze to ASTM B61 solid wedge and screwed ends. OS & Y {1210 Pa}[175 psi] w.o.g. Jenkins 820.
 - 2.2.4.2. Valves {65 mm}[2-1/2"] and larger, Underwriters Laboratories pattern, iron body, bronze mounted, OS&Y solid wedge, flanged ends, {1200 kPa}[175 psi] w.o.g. Jenkins 825A.
- 2.2.5. Provide Jenkins or Grinnell butterfly valves as follows:
 - 2.2.5.1. Valves {100 mm}[4"] and larger, Underwriters Laboratories pattern, iron body, 416 stainless steel upper and lower stems, bronze disc and copper alloy bearings.
 - 2.2.5.2. Lug Style - {1400 kPa}[200 psi] w.o.g. Jenkins 2232 BU
 - 2.2.5.3. Wafer Style - {1400 kPa}[200 psi] w.o.g. Jenkins 2222 BU
- 2.2.6. Provide Crane or Jenkins check valves as follows:
 - 2.2.6.1. Valves {50 mm}[2"] and smaller, bronze to ASTM B61 designed for both horizontal and vertical mounting replaceable composition disc, screwed cap and ends, {1400 kPa}[200 psig] w.o.g. Jenkins 4449 (not UL approved).

- 2.2.6.2. Valves {65 mm}[2-1/2"] and larger, iron body, Underwriters Laboratories pattern, bronze mounted, regrind renew bronze disc and seat ring, bolted cap, designed for either horizontal or vertical mounting, flanged ends, {1200 kPa}[175 psig] w.o.g. Jenkins 477.
- 2.2.7. Fabricate signs of metal with white letters on red background and suspension chain.
- 2.2.8. Where Victaulic piping systems are used, provide Victaulic Series 705W or 727 Fireball valves with built-in supervisory switch and Victaulic No. 717 check valves. All components shall be ULC and FM approved.

2.3. BACKFLOW PREVENTERS

- 2.3.1. Provide Cla-val ULC listed and labelled double check, backflow preventers as required to conform to governing Plumbing Code for protection of potable water.
- 2.3.2. Valve bodies and covers shall be galvanized iron complete with vents.

2.4. WATER PRESSURE REDUCING VALVES

- 2.4.1. Provide ULC listed pressure reducing stations where shown on Drawings.
- 2.4.2. Provide Cla-val pressure reducing valves complete with isolating valves, relief valve, strainer, pressure gauges, cast iron body and bronze trim.
- 2.4.3. Provide ULC (FM) listed valves in accordance with the schedule.

2.5. PRESSURE GAUGES

- 2.5.1. Provide a water pressure gauge at the top of each standpipe, meeting the requirements of Section 20 05 00.

2.6. FIRE HOSE CABINETS

- 2.6.1. Provide National Fire Equipment Ltd. Model Knight 200-2 recessed cabinets with {1.19 mm}[18 gauge] white prime coat painted corrosion protected steel tubs, {2 mm}[14 gauge] grey prime coat painted corrosion protected steel doors with hollow channel reinforcement, and adjustable frames with full length semi-concealed piano hinge, Southco stainless steel flush door catch, and a full panel of {6 mm}[1/4"] thick Duo-lite safety glass.
- 2.6.2. Cabinets shall be fully recessed type, as indicated on Drawings. Provide outside trim for flush mounting.
- 2.6.3. Overall size of cabinet shall be {750 mm x 750 mm x 200 mm}[30" x 30" x 8"] deep.
- 2.6.4. Cabinets shall be prime coat painted or stainless steel.
- 2.6.5. Equip each fire hose cabinet with the following:
- 2.6.5.1. A Model A51 Angle {38 mm}[1-1/2"] female x male forged brass body complete with hydrolator drain vent, where standpipe pressure is less than {620 kPa}[90 psi].
- 2.6.5.2. A Model A156 {38 mm}[1-1/2"] forged brass, adjustable, pressure restricting valve complete with hydrolator drain vent where standpipe pressure is greater than {620 kPa}[90 psi].
- 2.6.5.3. A Zurn Model Z-2100 pressure regulating angle valve {38 mm}[1-1/2"] female x male red handwheel, brass body. ULC approved complete with hydrolator drain vent, where standpipe pressure is greater than {1050 kPa}[150 psi].

- 2.6.5.4. A Model A75 {38 mm}[1-1/2"] forged brass combination fog nozzle adjustable for fog, straight steam and shutoff.
- 2.6.5.5. {30 m}[100 ft] of {38 mm}[1-1/2"] diameter Poly-Flex hose with Model A70BO forged brass couplings, a Model S-4 stationary hose rack with independent swivelling pins, and a Model S-5 automatic water stop.
- 2.6.5.6. A Model C-21 Trinal spanner wrench.
- 2.6.5.7. A Model ABC-5, multi-purpose, 3A:10BC rated dry chemical fire extinguisher.
- 2.6.5.8. A56 {65 mm}[2-1/2"] female x male fire department hose thread, red handwheel, forged brass body complete with 2500 {65 mm}[2-1/2"] red lexan cap and chain.
- 2.6.6. Locate {40 mm}[1-1/2"] angle valve maximum {1.5 metres}[5 ft] above floor.
- 2.6.7. All brass items in cabinets shall be highly polished chrome plated finish.

2.7. FIRE EXTINGUISHER CABINETS

- 2.7.1. Provide National Fire Equipment Ltd. fire extinguisher cabinets as follows:
 - 2.7.1.1. Model 102RS {200 mm x 425 mm x 125 mm}[8" x 17" x 5"] extinguisher cabinet, semi-recessed with {25 mm}[1"] return, prime painted, full glass front, piano hinge, flush stainless steel latch complete with Duolite Clear Safety Glass Panel {100 mm x 325 mm}[4" x 13"] (for ABC-5 dry chemical extinguisher).
 - 2.7.1.2. Model #C950 {225 mm x 600 mm x 150 mm}[9" x 24" x 6"] extinguisher cabinet, fully recessed, no return, non-adjustable, prime painted, full glass front, piano hinge, flush stainless steel latch complete with Duolite Clear Safety Glass Panel {125 mm x 500mm}[5" x 20"] (for ABC-10 dry chemical extinguisher).
 - 2.7.1.3. Model #CE-950-2 extinguisher cabinet {250 mm x 750 mm x 200 mm}[10" x 30" x 8"], prime painted, full glass front, piano hinge, flush stainless steel latch complete with Duolite Clear Safety Glass Panel {150 mm x 650 mm}[6" x 26"] (for PWS-250 water type extinguisher).
 - 2.7.1.4. Model #CE-950-1 {365 mm x 750 mm x 100 mm}[14-1/2" x 30" x 4"] extinguisher cabinet, semi-recessed, prime painted, piano hinge, flush stainless steel latch complete with bubble type canopy (for ABC-10 or PWS-250 extinguisher in {100 mm}[4"] block wall).

2.8. FIRE EXTINGUISHERS

- 2.8.1. Type 1: Provide for typical office floors, National Fire Equipment Ltd. Model ABC-050-HW, 3A10BC rated multi-purpose dry chemical extinguishers for future mounting in quantities listed in the following schedule. Provide wall brackets or fire extinguisher cabinets as shown on Drawings.

Office Floor	Quantity
Floors 1 to 15	2 per Floor
Floors 17 to 32	3 per Floor

- 2.8.2. Provide extinguisher wall brackets type as recommended by extinguisher manufacturer for non cabinet mounted fire extinguishers.

2.9. BALL DRIP

- 2.9.1. National Fire Equipment Ltd., Model #A58 {15 mm}{2"} diameter automatic ball drip to drain the piping between a siamese and the associated check valve. To be installed in horizontal position.

2.10. FIRE BLANKET

- 2.10.1. Model FB-6078-MC non-asbestos fibreglass cloth {1/8 m x 1.5 m}{6' x 5'} complete with red enamel metal container.

2.11. 2 HR STANDPIPE WRAP SYSTEM

- 2.11.1. For standpipes up to and including {150 mm}{6"} Provide one {38mm}{1-1/2"} layer 3M Fire Barrier Duct Wrap 615 in accordance with 3M literature, including the 3M Steel Water Supply, Drain & Sprinkler Standpipe Application.
- 2.11.2. All seams shall be overlapped {75 mm}{3"}.
- 2.11.3. Secure wrap with {13 mm}{1/2"} wide stainless steel banding, applied on {267 mm}{10-1/2"} centers and within {38 mm}{1-1/2"} of each overlap.

PART 3 - EXECUTION

3.1. INSPECTION

- 3.1.1. Do not recess, paint or conceal any work including piping and accessory equipment before it has been inspected and approved.

3.2. TESTING

- 3.2.1. Test all standpipe and fire hose systems to the requirements of NFPA 14.
- 3.2.2. If impossible to test whole installation in a single operation, subdivide into several zones and test each zone in the manner prescribed.
- 3.2.3. Test systems and equipment to hydrostatic and operational pressures as follows:
- 3.2.3.1. Fire standpipe systems including water supply connections and fire department connections shall be hydrostatically pressure tested at {345 kPa}{50 psig} in excess of normal working pressure, but not less than {1380 kPa}{200 psig} for 2 hours without pressure loss.
- 3.2.3.2. Carry out any additional tests required by the authorities having jurisdiction.
- 3.2.4. Provide certification that installed standpipe and hose system meets all specified standards and the requirements of all authorities having jurisdiction.

3.3. EXTINGUISHER INSTALLATION

- 3.3.1. Install extinguishers in cabinets or on brackets as indicated on Drawings.
- 3.3.2. Provide certification that each extinguisher has been properly charged, including:
- 3.3.2.1. date extinguisher was charged
- 3.3.2.2. name of person who charged extinguisher and the name of his organization

- 3.3.2.3. signature of person giving certification, and the name of his organization
- 3.3.3. Affix certification to each extinguisher tag provided in this Contract. Provide space for future service data entry.

3.4. STANDPIPE FIRE SEPERATION

- 3.4.1. Provide 2 hr fire separation around all vertical and horizontal standpipes not installed within an exit stair.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install sprinkler systems as indicated on the Drawings and specified in this Section of the Specifications.
- 1.1.3. Provide all labour, materials, products, equipment and services to supply and install sprinkler systems and to relocate existing sprinkler heads and branches, as indicated on the Drawings and specified in this Section of the Specifications.
- 1.1.4. Provide all labour, materials, products, equipment and services to supply and install new sprinkler system including new sprinkler heads, branches and mains, as indicated on the Drawings and specified in this Section of the Specifications. Existing branches and mains may be re-used if there is no interference with other trades and such use is acceptable with the Owner.
- 1.1.5. Provide sprinkler systems including.
 - 1.1.5.1. hydraulically designed automatic wet pipe system
 - 1.1.5.2. hydraulically designed automatic dry pipe system
 - 1.1.5.3. preaction, deluge and glycol systems
 - 1.1.5.4. zoning indicated on Drawings
 - 1.1.5.5. additional heads as required by Code to achieve a fully sprinklered building.

1.2. CERTIFICATE OF COMPLIANCE

- 1.2.1. Provide certificate of compliance that components are compatible and, where applicable, certified for intended use by nationally recognized testing agency.
- 1.2.2. The successful sprinkler contractor must hydraulically calculate the project and prepare dimensioned shop drawings. The sprinkler contractor's engineer becomes the "Engineer of Record" for the sprinkler work associated with this project.
- 1.2.3. Submit a signed, stamped certificate of compliance.

1.3. SUBMITTALS

- 1.3.1. Submittals shall include layout drawings, component shop drawings, specifications and hydraulic design calculations.
- 1.3.2. Submit a sample of each different type of sprinkler head to be employed on this project.
- 1.3.3. Provide Submittals incorporating requirements of local authorities. Drawings shall be certified correct bearing Contractor's Engineer's stamp prior to submission as follows:
 - 1.3.3.1. Prepare PDF sets of fabrication and installation drawings. Submit in sequence to:
 - 1.3.3.1.1. The Insurance Authority - Owners

- 1.3.3.1.2. Local Fire Department and other governing authorities
- 1.3.3.1.3. Consultant for review
- 1.3.4. At the same time as submission to the Insurance Authority, an initial preliminary single copy of this same submission (together with copy of insurance transmittal form), shall be forwarded to the Consultant for an initial cursory review and file record.
- 1.3.5. No work on systems installations shall commence until after working plans are reviewed by all the above parties, unless permission in writing is received from both Owner and Consultant. Expedite production of shop drawings as soon as possible and immediately after award of Contract.
- 1.3.6. After the reviews have been performed, make all required changes to the final fabrication drawings. Forward written confirmation to the Consultant that all review information has been incorporated and forwarded to the site for installations.
- 1.3.7. Upon completion of the installation, recalculate systems and submit hydraulic design data based on as-built installation.

1.4. REFERENCE STANDARDS

- 1.4.1. Provide ULC approved, FM approved, sprinkler fire protection systems and equipment.
- 1.4.2. Supply, install, and test sprinkler fire protection systems and equipment in accordance with the applicable requirements of the current versions of:
 - 1.4.2.1. National Building Code of Canada
 - 1.4.2.2. Ontario Building Code
 - 1.4.2.3. Canadian Electrical Code
 - 1.4.2.4. National Fire Protection Association Standards, including NFPA-13 – Standard for the Installation of Sprinkler Systems
 - 1.4.2.5. Federal Fire Commissioner of Canada
 - 1.4.2.6. Ontario Fire Marshall
 - 1.4.2.7. Municipal authorities having jurisdiction, including the Building Department and the Fire Department
 - 1.4.2.8. FM-1637
 - 1.4.2.9. UL 2443

1.5. GOVERNING AUTHORITY APPROVAL

- 1.5.1. Obtain City of Oshawa Fire Chief, Ontario Fire Marshall and Regional Federal Fire Commissioner of Canada approval for entire installation, equipment and materials.
- 1.5.2. Perform all tests and provide certification as required by authorities having jurisdiction.

1.6. COORDINATION

- 1.6.1. Refer to final Architectural Reflected Ceiling Plans and coordinate locations of sprinkler heads with lighting and other ceiling mounted components. Coordinate sprinkler piping to avoid interference with all other services.

1.7. CAN/ULC-S1001 INTEGRATED LIFE SAFETY SYSTEMS TESTING

- 1.7.1. Participate in Integrated Life Safety Systems Testing per CAN/ULC-S1001 requirements and as directed by the associated commissioning agent. Refer to PART 3 – EXECUTION for further requirements.

PART 2 - PRODUCTS

2.1. GENERAL

- 2.1.1. Select, install and test all sprinkler system materials and products in compliance with NFPA 13 and the requirements of all authorities having jurisdiction.
- 2.1.2. All products shall be ULC listed, FM approved., including but not limited to valves, fittings, sprinkler heads, hangers, all components of proprietary piping systems (such as Victaulic Pressfit), couplings, pressure switches, flow switches, alarms, gongs, accelerators, flow alarm valves, preaction valves, deluge valves, preaction and deluge control systems, excess pressure pumps, drum drips, backflow preventers, fire department connections, antifreeze system components, test and drain assemblies.
- 2.1.3. All materials shall meet current applicable ANSI and ASTM standards.

2.2. PIPE AND FITTINGS

- 2.2.1. Meet NFPA 13 and requirements specified herein.
- 2.2.2. On piping {65 mm}[2-1/2"] and larger in accessible areas only, and where permitted by governing authority, Victaulic Model 005 and 07 couplings may be used. Use Grade E Vic Plus gaskets. Victaulic Pressfit system may not be used anywhere in the building.
- 2.2.3. Weld sprinkler piping in non-accessible locations and in shafts and above drywall and other non-removable ceilings. Field fabricated fittings will not be acceptable.
- 2.2.4. Provide pipe hangers and supports to meet NFPA 13.
- 2.2.5. Provide schedule 40 galvanized pipe and fittings for dry, deluge, and pre-action sprinkler systems.
- 2.2.6. Provide flush-fit gaskets, which will not trap water, in grooved joint piping and fittings installed in dry, deluge, and pre-action sprinkler systems.

2.3. VALVES

- 2.3.1. Provide sprinkler system according to the following schedules:
- 2.3.1.1. Above Ground Gate Valves:
- 2.3.1.1.1. {50 mm}[2"] and smaller - {1400 kPa}[200 psi] w.o.g. Jenkins 820, bronze screwed {1210 kPa}[175 psig] cold water, OS&Y, Underwriters pattern.

- 2.3.1.1.2. {65 mm}[2-1/2"] and larger - Grinnell listed gear operated butterfly valves, steel flanged, {1210 kPa}[175 psig] cold water with downstream flange removed.
- 2.3.1.1.3. Where Victaulic piping systems are used, provide Victaulic Fireball Series 705W or 727 valves with builtin supervisory switch and Victaulic No. 717 check valves.
- 2.3.1.2. Above Ground Check Valves:
 - 2.3.1.2.1. {65 mm}[2-1/2"] and larger - Check-Rite wafer style.
- 2.3.1.3. Where system pressures exceed the rating of listed valves, obtain approval from authority having jurisdiction on a specific valve of suitable rating, prior to submitting Shop Drawings.
- 2.3.2. Provide Potter OSYS-UA1 tamper-proof supervisory alarm contact switch for each valve. Refer to Division 26 00 00 for alarm wiring and connection to annunciator panel.
- 2.3.3. Flexible Sprinkler Fitting System
 - 2.3.3.1. FM listed and UL approved stainless steel sprinkler fitting system may be used in lieu of rigid pipe to locate sprinklers in finished ceiling systems. The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel male threaded nipple or IGS groove style 108 (or {25 mm}[1"] capture) coupling for connection to branch line piping, and a zinc plated steel reducer with female thread for connection to the sprinkler head.
 - 2.3.3.2. The drop shall include a UL approved braided hose with a bend radius to {50 mm}[2"] and shall be listed for 4 bends at {800 mm}(32") length.
 - 2.3.3.3. Union joints shall be provided for ease of installation. The flexible drop shall attach to the ceiling grid using a one-piece open gate series AB1 or AB2 bracket. The bracket shall allow installation before the ceiling tile is in place.
 - 2.3.3.4. The braided rope system is UL listed for sprinklers services to {1206 kPa}[175 psi] and FM Approved to {1380 kPa}[200 psi].
 - 2.3.3.5. All hoses shall be factory pressure tested to {2760 kPa}[400 psi].
 - 2.3.3.6. Flexible Dry Sprinkler: In lieu of rigid connections to dry sprinkler heads, a flexible dry sprinkler, Model VS1 may be used. The sprinkler shall provide a vertical or horizontal flexible connection with a bend radius to {50 mm}[2"] and allow for up to 4 bends. The sprinkler body shall be die cast brass with brass deflector, supplied ((VC-250) (chrome plated) (white) (flat-black) coated) (plain brass), and glass bulb with glycerin solution. The product shall consist of a braided type 300 stainless steel flexible hose with a swivel type branch line threaded connection, EPDM gasket seal, with PTFE-coated Beryllium Nickel and stainless-steel spring-seal assembly. The bracket shall be (open gate) (metal strap) to provide for sprinkler placement and alignment. The flexible dry sprinkler and bracket system is UL listed for sprinkler services to {1206 kPa}[175 psi].

2.4. SPRINKLER HEADS

- 2.4.1. Provide the following head types as shown and specified:
 - 2.4.1.1. Pendant: chrome plated recessed sprinkler heads with chrome plated escutcheons.
 - 2.4.1.2. Upright (finished areas): bronze upright sprinkler heads with bright chrome finish.
 - 2.4.1.3. Upright (unfinished areas): rough bronze upright sprinkler heads.

- 2.4.1.4. Concealed: concealed sprinkler heads with cover plate having white paint finish.
- 2.4.1.5. Sidewall (finished areas): horizontal chrome plated sidewall sprinkler heads.
- 2.4.1.6. Sidewall (unfinished areas): horizontal bronze sidewall sprinkler heads.
- 2.4.2. Provide high temperature heads where required to suit the governing authority, and where located in elevator machine rooms, in electrical rooms and near heat producing equipment.
- 2.4.3. Provide quick response heads in all light hazard occupancies, and where required by governing authorities.

2.5. TEST AND DRAIN FITTINGS

- 2.5.1. Provide ULC combined test and drain fitting with orifice sized according to installed sprinkler heads. Provide Victaulic Style 718 or 719, or National Fire Equipment Model A60 fittings.

2.6. CABINET AND SPARE SPRINKLERS

- 2.6.1. Provide metal cabinet containing the required number of spare sprinklers of each type and of each melting point temperature and the tools required to replace heads.
- 2.6.2. Install accessory cabinet where indicated by Owner on site.

2.7. PROVISION FOR FUTURE SPRINKLER HEADS

- 2.7.1. For each typical floor office level sprinkler system provide minimum {25 mm}{1"} outlets at each head location on branch lines and size branch lines hydraulically so that the water flow for one (1) extra head can be added anywhere on the branch line without increasing branch line sizes.
- 2.7.2. Calculate size of cross mains with additional capacity as follows:
 - 2.7.2.1. Light Hazard – add 100% to water flow – (ie: .1 x 1500 x 2.00 = 300 gpm)
 - 2.7.2.2. Ordinary Hazard Group 1 – add 65% to water flow (ie: .15 x 1500 x 1.65 = 371 gpm)

2.8. PROHIBITED PRODUCTS

- 2.8.1. The following products and materials are strictly prohibited:
 - 2.8.1.1. “Mechanical tee” fittings. This includes standard mechanical tee fittings and fittings utilizing “U-bolts” to secure the fitting against the pipe being connected to.
 - 2.8.1.1.1. Any fitting that utilizes a hole core in the side of the pipe is strictly prohibited unless the pipe connecting to the opening is joined via electric resistance welding.
 - 2.8.1.1.2. Any fitting that is not connected via the approved pipe joining method for the installation is strictly prohibited.
 - 2.8.1.1.3. Sprinkler heads shall be installed per contract details and consultant approved alternatives only.

PART 3 - EXECUTION

3.1. TESTING

- 3.1.1. Comply with NFPA-13 requirements.
- 3.1.2. Carry out any additional tests required by the authorities having jurisdiction.
- 3.1.3. Perform tests in the presence of each governing authority's authorized inspector.
- 3.1.4. Submit certification that systems have been designed and installed in accordance with local requirements.
- 3.1.5. Perform tests before piping is concealed.
- 3.1.6. Remove all components which will not withstand test pressure and replace after tests.
- 3.1.7. Eliminate leaks or remove and refit defective parts. Caulking of threaded or welded joints will not be permitted.
- 3.1.8. Repeat tests as often as necessary to obtain certification.

3.2. SPRINKLER HEAD INSTALLATION

- 3.2.1. Install sprinkler heads symmetrically in ceiling tiles, unless otherwise directed by the Consultant.

3.3. PROTECTION

- 3.3.1. Provide guards for sprinkler heads in elevator machine rooms, garbage room, mechanical rooms, storage rooms and where indicated on Drawings.
- 3.3.2. Assume full responsibility for protecting sprinkler heads during painting. Replace damaged and painted components.

3.4. PROTECTION AREA LIMITATIONS

- 3.4.1. The following criteria apply to the design of the fire protection system for this project.
- 3.4.2. Refer to NFPA 13 for hazard categories based on occupancy.
 - 3.4.2.1. Light Hazard
 - 3.4.2.1.1. Design wet systems for 0.1 GPM/ft² per 1500 square feet.
 - 3.4.2.2. Ordinary Hazard Group 1
 - 3.4.2.2.1. Design wet systems for 0.15 GPM/ft² per 1500 square feet.
 - 3.4.2.3. Ordinary Hazard Group 2
 - 3.4.2.3.1. Design wet systems for 0.2 GPM/ft² per 1500 square feet.
 - 3.4.2.4. Extra Hazard Group 1
 - 3.4.2.4.1. Design wet systems for 0.3 GPM/ft² per 2500 square feet.

- 3.4.2.5. Extra Hazard Group 2
 - 3.4.2.5.1. Design wet systems for 0.4 GPM/ft² per 2500 square feet.
- 3.4.2.6. Generator rooms.
 - 3.4.2.6.1. Design systems for 0.3 gpm/ft² over the most remote 2500 ft².
- 3.4.2.7. Hose Demand
 - 3.4.2.7.1. Use the following:
 - 3.4.2.7.1.1. 100 USGPM for 30 minutes minimum – light hazard
 - 3.4.2.7.1.2. 250 USGPM for 90 minutes minimum – ordinary hazard
 - 3.4.2.7.1.3. 500 USGPM for 120 minutes minimum – extra hazard
- 3.4.2.8. Retail Head Spacing
 - 3.4.2.8.1. Maximum head spacing in all retail commercial units (CRU) is 10' x 10'.
- 3.4.2.9. Enclosed Parking Garages
 - 3.4.2.9.1. Enclosed parking garages shall be a minimum hazard of Ordinary Hazard Group 2.

3.5. AS-BUILT REQUIREMENTS

- 3.5.1. Be responsible for necessary modifications to the installation in the event the as-built hydraulic calculations do not meet the design criteria.

3.6. AUTOMATIC AIR VENTS

- 3.6.1. Provide a ULC and FM approved automatic air vent located near a high point in the system for each wet sprinkler system to allow air to be removed from that portion of the system per NFPA 13.

3.7. CAN/ULC-S1001 COMMISSIONING ASSISTANCE

- 3.7.1. Assist the third-party commission agent through the Integrated Systems Testing of Fire Protection and Life Safety Systems per CAN-ULC-S1001 and Ontario Building Code Section 3.2.10. Provide support staff that are experienced and technically knowledgeable on the subject matter. Coordinate with the commissioning agent in advance of the testing dates and provide all input they may request. Make appropriate staff available for all testing dates and subsequent review periods.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install the plumbing and drainage inside the building to point of connection outside the exterior building wall as indicated on the Drawings and specified in this Section.
- 1.1.3. Provide all venting required for a complete and functional drainage and venting system, even where not indicated on drawings, to the requirements of the Ontario Building Code.

PART 2 - PRODUCTS

2.1. PIPE AND FITTINGS

- 2.1.1. Provide chrome plating on all exposed piping within washrooms.
- 2.1.2. Drainage and Vent Piping:

	Pipe Size {65 mm} [2-1/2"] and Smaller	Pipe Size {75 mm} [3"] and Larger
Sanitary - Above Ground	DWV copper pipe with drainage fittings and 95/5 tin/antimony solder joints.	CSA Series 4000 cast iron hubless soil pipe and fittings, with SD 4000 heavy duty mechanical joint couplings.
Sanitary - Urinal, Above Ground	Type L hard copper with drainage fittings and 95/5 tin/antimony solder joints for automatic flush valves. XFR pipe with solvent cement joints for manual flush or waterless urinals	CSA Series 4000 cast iron hubless soil pipe and fittings, with SD 4000 heavy duty mechanical joint couplings.
Sanitary - Below Ground	ABS (DWV) pipe or Profile PVC sewer pipe with solvent welded fittings.	CSA Series 4000 cast iron hubless soil pipe and fittings, with mechanical joints or IPEX Ring-Tite SDR35, CSA certified to B182.2 PVC gasketed or solvent welded sewer pipe and fittings.

	Pipe Size {65 mm} [2-1/2"] and Smaller	Pipe Size {75 mm} [3"] and Larger
Storm - Above Ground	DWV copper pipe with drainage fittings and 95/5 tin/antimony solder joints.	CSA Series 4000 cast iron hubless soil pipe and fittings, with SD 4000 heavy duty mechanical joint couplings.
Storm - Below Ground	Not applicable.	CSA Series 4000 cast iron hubless soil pipe and fittings, with mechanical joints or IPEX Ring-Tite SDR35, CSA certified to B182.2 PVC gasketed or solvent welded sewer pipe and fittings.
Vent Piping - Above Ground	DWV copper pipe with drainage fittings, 95/5 tin /antimony solder joints.	CSA Series 4000 cast iron soil pipe and fittings with SD 4000 heavy duty mechanical joint couplings.
Vent Piping - Urinal, Above Ground	Type L hard copper with drainage fittings and 95/5 tin/antimony solder joints.	Not applicable.
Vent Piping - Below Ground	ABS (DWV) pipe or Profile PVC sewer pipe with solvent welded fittings.	CSA Series 4000 cast iron soil pipe and fittings, with SD 4000 heavy duty mechanical joint couplings, or IPEX Ring-Tite SDR35, CSA certified to B182.2 PVC gasketed or solvent welded sewer pipe and fittings.

- 2.1.2.1. Where mechanical joints are used, provide bracing across all joints on piping larger than 150 mm diameter, refer to details on drawings.
- 2.1.2.2. Sewers may surcharge, causing the build up of internal pressure in gravity sewers. Ensure that piping is properly braced and rigidly supported to withstand such pressure.
- 2.1.3. Domestic Water
 - 2.1.3.1. Domestic hot water and recirculation - all sizes up to {100 mm} [4"] diameter:
 - 2.1.3.1.1. Type L hard copper pipe, wrought copper fittings with 95/5 tin/antimony solder joints.
 - 2.1.3.2. Domestic cold water and domestic chilled water all sizes up to {100 mm} [4"] diameter.
 - 2.1.3.2.1. Type L hard copper pipe, wrought copper fittings with 95/5 tin/antimony solder joints.
 - 2.1.3.3. Domestic cold water sizes over {100 mm} [4"] diameter

- 2.1.3.3.1. Type L hard copper pipe, wrought copper fittings with 95/5 tin/antimony solder joints.
- 2.1.3.3.2. 304/304L Stainless Steel pipe with stainless steel fittings.
- 2.1.3.3.2.1. Piping shall be schedule 10 for 150 mm and smaller.
- 2.1.3.3.2.2. Piping shall be schedule 40 for pipes larger than 150 mm.
- 2.1.3.4. Provide Type K soft copper pipe without joints below ground.
- 2.1.3.5. For working pressures up to {2100 kPa} [300 psig]:
- 2.1.3.6. Shurjoint Style C305 (Copper piping systems) or Z07G (stainless steel systems) couplings with Grade EPDM EHP gasket blend for water water systems with operating temperatures to {82°C} [180°F], and grooved copper or stainless steel piping systems may be used in accessible areas for domestic water.
- 2.1.3.7. Victaulic style 607 (copper piping systems) or 807 (stainless steel systems) couplings with Grade P Fluoroelastomer blend gasket for water systems with operating temperatures to {82°C} [180°F], and grooved copper or stainless steel piping systems may be used in accessible areas for domestic water.
- 2.1.4. Bilge and Sewage Pump Discharge Piping:
 - 2.1.4.1. {50 mm} [2"] and smaller:
 - 2.1.4.1.1. All pipe and fittings of any size to be a minimum of 150 PSI rated but 1.5 time the discharge pressure of the pumps if that is more than 150 PSI.
 - 2.1.4.2. {75 mm} [3"] and larger:
 - 2.1.4.2.1. ASTM A53 Schedule 40 galvanized pipe with {1050 kPa} [150 lbs.] galvanized malleable iron fittings.

2.2. VALVES

- 2.2.1. Provide ASTM domestic water valves to the following Kitz figure numbers:
 - 2.2.1.1. Gate Valves:
 - 2.2.1.1.1. {50 mm} [2"] and smaller - soldered {1400 kPa} [200 psi] w.o.g. Fig. 44.
 - 2.2.1.1.2. {65 mm} [2-1/2"] and larger - flanged {1400 kPa} [200 psi] w.o.g. Fig. 75.
 - 2.2.1.2. Globe Valves:
 - 2.2.1.2.1. {50 mm} [2"] and smaller - soldered {2070 kPa} [300 psi] w.o.g. Fig. 10 with suitable composition disc.
 - 2.2.1.2.2. {65 mm} [2-1/2"] and larger - flanged {1400 kPa} [200 psi] w.o.g. Fig. 76.
 - 2.2.1.3. Standard Check Valves:
 - 2.2.1.3.1. {50 mm} [2"] and smaller - soldered {2070 kPa} [300 psi] w.o.g. Fig. 23.
 - 2.2.1.3.2. {65 mm} [2-1/2"] and larger - flanged {1400 kPa} [200 psi] w.o.g. Fig. 78.

- 2.2.2. For valves on booster water system below the ____ floor where subjected to the full height of the building:
 - 2.2.2.1. Gate Valves - {3450 kPa} [500 psi] w.o.g. Fig. Kitz 300SCL.
 - 2.2.2.2. Globe Valves - {3450 kPa} [500 psi] w.o.g. Fig. Kitz 300SCJ.
 - 2.2.2.3. Check Valves - {3450 kPa} [500 psi] w.o.g. Fig. Kitz 300SCO.
- 2.2.3. For {50 mm} [2"] and smaller, ball valves may be provided as substitute for gate and globe valves. Provide ball valves with brass or bronze body, chrome plated solid ball, PTFE seats and seals and full port.
 - 2.2.3.1. up to {50 mm} [2"] - {4140 kPa} [600 psig] w.o.g. - soldered Fig 69.
- 2.2.4. Provide Check-Rite or Centre Line non-slam check valves on discharge side of pumps and where shown or specified.
- 2.2.5. For grooved piping systems conforming to CSA B242 and AWWA C606, provide Shurjoint series SJC300 lever handle butterfly valves, complete with Grape E gasket and drive hub extension insulation block or Victaulic Series 608 lever handle, butterfly valves complete with Grape P Fluoroelastomer gasket and drive hub extension insulation block.

PART 3 - EXECUTION

3.1. VERIFICATION OF INVERTS

- 3.1.1. Verify all field service conditions immediately after award of Contract to ensure that drainage runs can meet the inverts of the site services.
- 3.1.2. Give notification immediately of any apparent difficulties or discrepancies.
- 3.1.3. No extra will be paid at a later date for rerouting of drains because site inverts cannot be met.

3.2. INSTALLATION OF UNDERGROUND DRAINAGE PIPING

- 3.2.1. Install underground piping with bedding and backfill in accordance with Section 20 05 00.
- 3.2.2. Install all underground drainage piping in accordance with the local building code, CSA B182.1/B182.2, and the pipe manufacturer's installation instructions.
- 3.2.3. Maintain minimum pipe slopes per local Building Code, unless noted otherwise on drawings.
- 3.2.4. Coordinate trench layouts with other underground systems (e.g., weeping tile, site services, electrical) to avoid conflicts and ensure proper pipe support.
- 3.2.5. Where drainage piping is installed adjacent to foundation drainage or other systems using coarse backfill (e.g., clear stone), provide a geotextile separator between materials to prevent migration of bedding. Refer to CSA B182.11 and ASTM D2321 for guidance.
- 3.2.6. Install underground drainage piping to maintain continuous support, positive slope, and protection from settlement or flotation during construction.
- 3.2.7. Notify Consultant prior to covering piping for interim inspection, as required.

3.3. BRACED SEWER PIPE JOINTS

- 3.3.1. Provide bracing across mechanical joint couplings for all sanitary and storm piping {150 mm} [6"] and larger. Follow manufacturers recommended practices or consult with factory prior to testing of piping.
- 3.3.2. Provide sway braces for all suspended sewer piping to prevent movement under hydraulic forces.
- 3.3.3. Refer to details on drawings for sample recommended bracing.

3.4. PIPE EXPANSION

- 3.4.1. Provide expansion compensators for all piping systems. Design with sufficient flexibility to prevent end thrust and movement caused by thermal expansion. For plastic piping systems refer to manufacturers recommended compensators and install in accordance with written directions.
- 3.4.2. Provide expansion compensators at building expansion joints.

3.5. TESTING

- 3.5.1. Carry out not less than the following tests:
 - 3.5.1.1. Ball test drains.
 - 3.5.1.2. Perform water tests on all soil, waste, vent and rainwater systems when rough-in of the system, or section thereof including fittings, branches, cleanouts and traps except fixture traps. When the system or section is filled, shut off the water, and allow to stand for one hour. There shall be no loss by leakage during this time.
 - 3.5.1.3. Pressure test domestic cold water, domestic hot water, and recirculation lines with water at 150% of maximum operating pressure, for 6 hours without loss of pressure.
 - 3.5.1.4. Pressure test pumped sewage lines including fittings, joints and piping with water at 150% operating pressure for 6 hours without loss of pressure.
- 3.5.2. Conduct additional tests required by the authorities having jurisdiction.
- 3.5.3. If tests are required by an authority having jurisdiction, perform tests in the presence of each governing authority's authorized inspector, and obtain certification.
- 3.5.4. Certify tests not required by the authorities having jurisdiction.
- 3.5.5. Perform tests before piping, drains or vents are covered or concealed.
- 3.5.6. Remove all components which will not withstand test pressure and replace after tests.
- 3.5.7. Eliminate leaks or remove and refit defective parts. Caulking of threaded or welded joints will not be permitted.
- 3.5.8. Repeat tests as often as necessary to obtain certification.
- 3.5.9. Set all fixtures and fill all traps with water after tests have been completed.

3.6. CLEANING AND FLUSHING SEWERS

- 3.6.1. On completion of construction of drains, flush all drains until the deposits of earth and other foreign material have been removed.

3.7. CLEANING, FLUSHING AND DISINFECTING WATER PIPING

- 3.7.1. Be responsible for care and cleaning of the piping system during and after construction. Plug all open ends during construction to prevent the entrance of foreign materials.
- 3.7.2. Flush all systems with clean, potable water to remove scale and sediment immediately upon filling.
- 3.7.3. Sterilize all potable water lines to meet local municipal requirements.
- 3.7.4. After completing satisfactory hydrostatic tests of the complete system, and flushing mains as outlined above, disinfect the mains in accordance with AWWA Standard C651-86. Repeat the flushing and disinfecting operation until the test results are satisfactory.
- 3.7.5. Ensure by operation of isolating valves or the installation of check valves, that the disinfecting solution does not flow back into street mains or other sections of piping in use.
- 3.7.6. Arrange and pay for water quality tests to be performed by a recognized independent testing laboratory. Obtain certificates confirming safety of potable water supply.

3.8. CONNECTIONS TO OWNER'S EQUIPMENT

- 3.8.1. Rough in and connect to Owner's equipment, as identified on drawings. Do not rough in prior to receipt of final approved layout of Owner's equipment.

3.9. CONNECTIONS TO LABORATORY EQUIPMENT

- 3.9.1. Provide rough-in and make final connections to laboratory equipment as shown on Drawings. Otherwise, valve and cap services in ceiling or walls as shown.
- 3.9.2. Do not begin rough-in work until supplied with a final set of dimensioned rough-in drawings from the laboratory equipment supplier.
- 3.9.3. All final connections shall include shut off valves on hot and cold water supplies and the installation of all vacuum breakers, check valves, backflow preventors, and other plumbing specialties as shown on Drawings and as required to meet authorities having jurisdiction.

3.10. SIGNAGE FOR NON-POTABLE WATER

- 3.10.1. A sign containing the words **NON-POTABLE WATER, DO NOT DRINK** shall be in letters at least 25 mm high with a 5 mm stroke and be posted immediately above a fixture that is connected to any non-potable water system.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply, install and test complete plumbing specialties indicated on the drawings and specified in this section of the Specifications.

PART 2 - PRODUCTS

2.1. GENERAL

- 2.1.1. Meet requirements of the accompanying product cutsheets.
- 2.1.2. All cast iron parts for floor drains, area drains, and cleanouts shall be duco or fusion bonded powdered epoxy coated.
- 2.1.3. All fixture carriers must be compatible with acceptable fixtures listed in Specification Section 22 40 00.
- 2.1.4. Provide reduced pressure principle backflow preventers where shown and where closed domestic water piping connections are made to heating and cooling process systems and makeup water systems.

2.2. CLEANOUTS

- 2.2.1. Stack cleanouts shall be cast iron tee type with gas-tight plug.
- 2.2.2. Line cleanouts shall be cast iron ferrule with threaded or bolted plug.
- 2.2.3. Access doors shall be stainless steel with friction fit door and recessed top to accept tile size. Acudor Series UF5000SS, CAN-AQUA CA-HD Series.
- 2.2.4. Floor cleanouts shall be cast iron construction with gas tight seal. Tops shall be round, heavy duty, scoriated nickel bronze, adjustable to finished floor. Provide nickel bronze recessed tops where required to suit floor finishes. In unfinished and heavy traffic areas, use heavy duty scoriated ductile iron tops.

2.3. BACKWATER VALVES

- 2.3.1. Backwater valves shall be cast iron body, bolted access cover, bronze seat and flapper assembly, stainless steel hardware.

2.4. BACKFLOW PREVENTERS

- 2.4.1. Provide CSA approved, reduced pressure principle bronze backflow preventers. Size preventer for required flow with a maximum pressure drop of {77 kPa}[11 psi].
- 2.4.2. Install preventers where shown on the drawings and including but not limited to the following locations:
 - 2.4.2.1. Chilled and heating system feeder assembly.
 - 2.4.2.2. Cooling tower make-up water line.

- 2.4.2.3. Condenser water pumps seal flushing.
- 2.4.2.4. Make-up water line to spray coil humidifiers.
- 2.4.2.5. Lab Sinks
- 2.4.3. Pipe relief lines to drain

2.5. TRAP PRIMING

- 2.5.1. Prime floor drain traps with cold water.
- 2.5.2. For individual traps provide bronze trap seal primers with integral vacuum breakers.
- 2.5.3. For installations with large numbers of traps in close proximity, provide electronic trap priming systems equivalent to Precision Plumbing Products Inc. Electronic Trap Priming Manifold PT-4 through PT-30. Select model to suit the number of traps to be primed (4 through 30). Provide for each assembly
 - 2.5.3.1. 24 hour timer - 120/1/60
 - 2.5.3.2. circuit breaker
 - 2.5.3.3. manual override switch
 - 2.5.3.4. manual isolation valve {20 mm}{3/4"} for supply
 - 2.5.3.5. solenoid valve - 120/1/60
 - 2.5.3.6. vacuum breaker
 - 2.5.3.7. calibrated distribution manifold
 - 2.5.3.8. internal power and control wiring
 - 2.5.3.9. internal piping
 - 2.5.3.10. NEMA 1 flush mount or surface mount cabinet constructed of 16 ga. steel

2.6. WATER HAMMER ARRESTORS

- 2.6.1. Provide shock arrestors on hot and cold water supplies to all faucets, valves, solenoids, fixture and group of fixtures.
- 2.6.2. Size units according to the following table:

Size Reference	Fixture Units	Size
A	1 - 11	{12 mm}{1/2"}]
B	12 - 32	{20 mm}{3/4"}]
C	33 - 60	{25 mm}{1"}]
D	61 - 113	{32 mm}{1-1/4"}]
E	114 - 154	{40 mm}{1-1/2"}]
F	155 - 330	{50 mm}{2"}]

- 2.6.3. Provide line size shock arrestors on top of domestic water risers.

2.6.4. Provide {10 mm}[3/8"] size arrestors on supply to one service sink or maximum 3 lavatories.

2.7. WATER MIX REGULATING VALVES

2.7.1. Provide thermostatic water mixing valve as scheduled on drawings.

2.7.2. Provide high and low thermostatic controllers, stainless steel pistons, check stops, pressure reducing valve and two pressure gauges, volume control, dial thermometer on mixed water and isolation ball valves.

2.7.3. Provide recessed/semi-recessed/surface mounted cabinets as shown on the drawings.

2.8. WATER METERS

2.8.1. Building incoming domestic service water meters will be supplied by the City of Toronto.

2.8.1.1. Make all arrangements and pay for meter.

2.8.1.2. Provide full line size valve on each side of meter, a check valve on leaving side of meter, a valved bypass and drain cock piped to floor drain, as detailed on drawing.

2.8.1.3. Provide a pressure gauge on each side of meter.

2.8.2. Provide electric impulse water meter where connected to BAS. Refer to Section 23 25 00 for details.

2.8.3. All water meters shall be Measurement Canada certified.

2.9. ACCEPTABLE EQUIPMENT SUPPLIERS

2.9.1. Where Nickel bronze or stainless steel drain tops are specified, the shank shall be of the same material.

2.9.2. Acceptable equipment suppliers are as follows:

Drainage Products	- J.R. Smith - Watts - Zurn

Backflow Preventers	- Conbraco - Watts - Zurn

Trap Primers and Water Hammer Arrestors	- P.P.P. - Zurn - J.R. Smith - Watts

Water Mix Regulating Valves	- Powers - Leonard - Haws - Encon - Symmons

Eyewash Station	- Bradley - Haws - Guardian

Fixture Carriers

- Encon
- Zurn
- J.R. Smith

PART 3 - EXECUTION

3.1. PROTECTION

- 3.1.1. Provide {0.15mm}[6 mil] polyethylene under each strainer to prevent dirt from entering the system during construction. Remove polyethylene prior to Substantial Performance.

3.2. COORDINATION

- 3.2.1. Coordinate all drain and clean out provisions with other Trades and Architect.
- 3.2.2. If water meter is not immediately available, provide spool pieces and filler connection. Remove filler pieces and install meter when available. Provide stanchion supports within {150 mm}[6"] of water meter inlet and outlet.
- 3.2.3. Coordinate installation of parking garage floor drains with General Contractor to ensure proper integration of membrane topping.
- 3.2.4. Refer to the dimensioned architectural washroom elevations and project shop drawings. Install all water closet flush valve sensors such that the seat and any grab bars or backrests do not impede operation.

3.3. TRAP PRIMING

- 3.3.1. Prime all traps as required by code.
- 3.3.2. When using electronic trap priming systems:
- 3.3.2.1. Locate trap primer in easily accessible location.
- 3.3.2.2. Division 20 00 00 shall provide all power wiring to trap primer. Coordinate with Division 26 00 00 for suitable power source to provide power to trap primer.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install the domestic water heaters indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

- 1.2.1. Units shall meet the applicable requirements of Section 20 04 00.

1.3. PACKAGED EQUIPMENT

- 1.3.1. Packaged equipment shall be factory assembled ready to accept single source power and piping connections.

PART 2 - PRODUCTS

2.1. INSTANTANEOUS ELECTRIC WATER HEATER(S)

- 2.1.1. Provide electric instantaneous water heater suitable for supplying lavatories/sinks at {1.5 L/min}[0.4 gpm] each, each with low flow, single temperature of {40.5°C}[105°F] faucet. Refer to schedules on drawings for individual unit performance.
- 2.1.2. Unit shall be stainless steel, suitable for internal pressure of {1035 kPa}[150 psig].
- 2.1.3. Electric element shall be 208 volt (220 volt) single phase, ni-chrome element coils, complete with SCR type controller to control the heating element is a number of stages equal to the number of lavatories being designed for.
- 2.1.4. Select heater to deliver water at not less than the design temperature. Provide an adjustment to increase or decrease supply temperature by {±2.5°C}[±5°F].
- 2.1.5. Heater assembly shall be mounted under counter. Provide shut off cock for incoming cold water line.
- 2.1.6. Provide ULC listing.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1. Provide each hot water heater system with a temperature and pressure relief valve piped to drain.
- 3.1.2. Pipe storage tanks and heaters as shown on the Drawings.
- 3.1.3. Comply with manufacturer's instructions for installation and clearances.
- 3.1.4. Set supply water temperature for {60°C}[140°F].
- 3.1.5. Provide contacts within each heater element circuit on electric water heaters for open/close relay and wire for remote EMCS actuation.

- 3.1.6. Include documentation of extended warranties with operating and maintenance manuals.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install the plumbing fixtures and trim indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

- 1.2.1. Provide fixtures and accessories which are CSA labelled and are new, free from cracks, flaws, and imperfections. **535744**
- 1.2.2. Provide vitreous china or vitreous glazed earthenware meeting CSA Standard CAN3-B45 Series.
- 1.2.3. Provide stainless steel fixtures meeting CSA B45.4.
- 1.2.4. Provide plumbing trim meeting CSA B125.
- 1.2.5. All fixtures and accessories shall meet the City of Toronto guidelines.

1.3. COORDINATION

- 1.3.1. Make fixture count from Architectural and Mechanical Drawings. Provide the higher fixture quantity including all services.
- 1.3.2. Contractor is to verify the handle placement (handing) on the tank to suit AODA standards in accordance with the washroom layout, prior to order

1.4. MATERIALS

- 1.4.1. Provide white fixtures, except where noted.
- 1.4.2. Provide chrome plated piping, valves, fittings and accessories where exposed to view in washrooms.
- 1.4.3. Equip hot and cold water supplies to each fixture with compression stops.

PART 2 - PRODUCTS

2.1. PRODUCTS

- 2.1.1. Refer to PDF formatted fixture cuts included on drawings.
- 2.1.2. Similar products are to be provided from the same manufacturer.
- 2.1.3. Electronic fixtures shall have a CSA listed transformer.
- 2.1.4. Provide local point of use lead free thermostatic mixing valves for each faucet supply unless indicated otherwise on the plumbing fixture cut sheets or plans.
- 2.1.5. Acceptable equipment suppliers are as follows:

2.1.5.1.	Valves	- Sloan - Emco - Zurn
2.1.5.2.	Plumbing Brass	- American Standard - Kohler - Sloan - Zurn - Chicago Faucets - McGuire
2.1.5.3.	Plumbing Fixtures (Vitreous China)	- American Standard - Kohler
2.1.5.4.	Plumbing Fixtures (Stainless Steel)	- Kindred - Aristaline - Kohler - Franke
2.1.5.5.	Water Closet Seats	- Centoco - Olsonite - Bemis - Kohler
2.1.5.6.	Showers	- Symmons - Powers Crane - Leonard
2.1.5.7.	Drinking Coolers	- Halsey Taylor - Filtrine - Aquarius - Haws
2.1.5.8.	Mop Sinks	- Stern Williams - Fiat
2.1.5.9.	Emergency Shower/Eye Wash	- Bradley - Haws - Encon - Guardian

PART 3 - EXECUTION

3.1. PROTECTION

- 3.1.1. Protect all fixtures and trim during construction period. Replace any fixtures that contain cracks, flaws or imperfections.

3.2. INSTALLATION

- 3.2.1. Connect fixtures complete with supplies and drains, separately trapped, supported level and square. Hot water faucets shall be on left side. Thermostatic controlled mixing valves shall include check stops on supplies.
- 3.2.2. Refer to Architectural Drawings for special mounting heights and spacing of fixtures.

3.2.3. Insulate exposed fixture piping in accordance with local plumbing and building codes.

3.3. CLEAN UP

3.3.1. After final installation of plumbing fixtures and trim, clean fixtures and trim, adjust trim and ensure that fixtures and trim are operational. Replace trim that does not perform satisfactorily.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install medical gas piping systems as indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

- 1.2.1. Perform all work in accordance with all applicable codes, specifications, standards and current editions of:
 - 1.2.1.1. Standard CAN/CSA Z7396.1-06 Medical Gas Pipeline Systems – Part 1: Pipelines for Medical Gases and Vacuum.

PART 2 - PRODUCTS

2.1. GENERAL

- 2.1.1. Provide material of first-class quality, free from defect and imperfections and be of the classification and grade specified.

2.2. PIPING

- 2.2.1. Provide seamless type K hard copper piping conforming to ASTM Standard B819, factory degreased and capped, suitable for medical gas service including the intake to medical air compressors.

2.3. FITTINGS

- 2.3.1. Provide wrought copper braze-joint fittings for medical gas systems. Do not use cast fittings. Clean fittings to oxygen service standards and protect from contamination. Appearance will be clean and bright with a maximum residue limit for interior surfaces of {0.037 grams per sq.m.} [0.0035 grams/sq.ft.] when tested as per ASTM-B-280 (ACR).

2.4. BRAZING ALLOYS

- 2.4.1. Provide silver type brazing alloys with a melting point of approximately {593°C} [1100°F] and a tensile strength of {621 MPa} [90,000 psi] minimum, cadmium free, requiring no flux for installation. Silver brazing alloy shall be Aircosil 45.

2.5. ZONE BOXES

- 2.5.1. Provide zone boxes with sliding, transparent polycarbonate door with pull handle and spring loaded release. Provide APS front cover or stainless steel solid cover with finger depressions.
- 2.5.2. Provide full flow, double seal ball type zone shutoff valves with bronze body, Buna-N seals and O-ring packing, chrome plated brass ball and designed for working pressures up to {4200 kPa} [600 psig]. Only 1/4 turn of the handle shall be required to operate valve from open to closed position. Valve handle in closed position shall protrude from the box to prevent door closure. Mount valve to back of zone box and equip with Type "K" copper tube extensions for pipe line connection. Valves shall be complete with pressure gauges.
- 2.5.3. Provide colour coded gas identification labels at each valve.

2.6. OUTLETS

- 2.6.1. Provide DISS Medaes III Series 0241 outlets for medical gas systems in single and multiple installations as shown on Drawings. Provide outlets suitable for pressures above {525 kPa} [75 psi].
- 2.6.2. Provide outlets which are gas specific and non-interchangeable.
- 2.6.3. Outlets shall be serviceable and have automatic secondary service valves designed to prevent gas flow when primary valve is removed.
- 2.6.4. Label outlets in accordance with NFPA and CSA requirements and supply clean and tested for the indicated service. Furnish outlets with protective covers to prevent plaster and other material from entering outlet boxes during construction.
- 2.6.5. Provide recessed mount or surface mount outlets to suit Architectural millwork details.

2.7. OUTLETS

- 2.7.1. Outlets for medical gas and vacuum services will be provided by Division 26 00 00. Coordinate with the Division 26 00 00 Contractor.

2.8. ALARMS

- 2.8.1. Multi-Signal Alarms
 - 2.8.1.1. Provide, a closed circuit self monitoring multi-signal alarm system, Medaes 0321-7635-984 with 15 signals. Panel shall be suitable for recessed installation.
 - 2.8.1.1.1. Provide the following alarm signals:
 - Evacuation Line Vacuum Abnormal
 - Vacuum Line Below Normal
 - Air Line Pressure High
 - Air Line Pressure Low
 - 2.8.1.1.2. Panel light buttons shall read:
 - Light "ON" Normal
 - Silence Audio
 - Test Circuit
 - 2.8.1.1.3. Provide auxiliary alarm contacts in each alarm panel to permit activation of repeater alarms in the building control centre. Wiring to the BMS shall be by the Controls Section of this Division.
 - 2.8.2. Area Line Alarm Pressure Panels
 - 2.8.2.1. Provide microprocessor controlled Medaes Area Line Pressure Alarm Panel, 321-7700 series for medical gas piping. Panel locations, and medical gases monitored in each panel shall be as indicated on Drawings.
 - 2.8.2.2. Provide alarm panels for six gas services, designed for recessed wall mounting.
 - 2.8.2.3. Provide panels with the following features:

- 2.8.2.3.1. full range pressure/vacuum gauges for each gas service
- 2.8.2.3.2. dry contact relays for connection of remote alarms
- 2.8.2.3.3. factory assembled and prewired
- 2.8.2.3.4. plug-in type connections between roughing-in and finishing assemblies
- 2.8.2.3.5. LED indicator lights for Normal/Abnormal conditions
- 2.8.2.3.6. 90 dBA audible warning device and silence switch
- 2.8.2.3.7. UL listed and CSA approved
- 2.8.3. Provide all necessary sensors and pressure switches (remote mounting) for alarm panel operation. Include emergency power supply connection. Provide DISS valves for remote sensors.

2.9. MEDICAL COMPRESSED AIR/DRYER SYSTEM

- 2.9.1. Provide an oil-less modular duplex air cooled compressor package incorporating Hitachi single stage reciprocating air compressors. Packages to be factory assembled on a steel sub-bases consisting of the following: 2 base mounted oil-less compressor each having a capacity of {24 L/s} [51.3 CFM] at {700 kPa} [100 psi], Control Panel/integral dual desiccant dryers complete with filtration, dewpoint monitor, and dual line regulating assembly; air receiver module. Each compressor shall be interconnected with type K or L copper pipe and include a temperature sensor on each cylinder head set to shut down the compressor at the manufacturer=s recommended temperature level. Each compressor shall be equipped with: discharge check valves, isolating ball valves, compressor safety relief valves, air unloading solenoid valve, 575v/3ph/60hz {11.2 kW} [15 Hp] NEMA high efficiency type ODP motor, be belt driven, and include an integral belt guard. Each compressor shall have cast aluminum cylinders with deep horizontal and vertical cooling fins for efficient heat removal during compression. Cylinder sleeves shall not be required. Units shall also include an air cooled aftercooler with pre-piped moisture separator and automatic timed solenoid drain valve. The compressor valves shall be a corrosion resistant reed type with stainless steel reeds. Both the compression rings and rider rings shall be made from a long life, fluoresein material designed for continuous duty operation. The crankshaft shall be constructed of a durable nodular graphite cast iron and be designed to be fully supported on both ends by heavy duty ball bearings permanently lubricated and sealed. The crankcase shall be constructed of gray cast iron, and not aluminum. Additionally, heat transmission from the piston wall to the piston pin needle bearing shall be minimized by an insulated Aheat cut@ piston pin. The connecting rod shall be of a one-piece design for maximum reliability.
- 2.9.2. System to include a U.L., c/U.L. pre-mounted triplex panel in a NEMA 12 enclosure with circuit breaker disconnect for each compressor, motor starters with overload protection, duplex 120 volt control circuit transformers, individual non-resettable run hour meters, pressure switches, hand-off-automatic selector switches mounted in cabinet, run lights, lag alarm and reset button, individual high temperature lights and reset buttons, resettable maintenance indicators that monitor the number of hours of operation for each compressor, and auxiliary dry contacts for wiring alarm conditions to remote master alarm panel. Control panel shall also serve the desiccant dryers and include both tower switching failure and low outlet pressure alarms complete with dry contact for external alarm monitoring.
- 2.9.3. Receiver module shall be a {760 litres} [200 US gallon] vertical CRN Registered, ASME approved {1400 kPa} [200 psi] W.P. receiver. Receiver accessories to include pressure gauge, safety relief valve set {875 kPa} [125 psi], automatic and manual tank drain, sight glass, and integral three valve bypass to allow complete receiver isolation.

- 2.9.4. The compressor system shall be wired in such a manner that should the capacity requirements exceed that of the lead compressor, the lag compressor will start. The lag alarm shall be activated on start of the lag compressor.
- 2.9.5. Provide audible and visual alarm indication as well as remote alarm contacts to signal lag compressor in use and high temperature shut down.
- 2.9.6. Modules shall be supplied with suitable provisions for site lifting. Maximum width for each module shall not exceed {900 mm} [36"].
- 2.9.7. The compressors shall have a pre-piped intake manifold complete with "hospital type@ inlet air filters, isolating ball valves, and threaded opening for remote intake connection.
- 2.9.8. Each compressor and motor shall be fully isolated by means of a four point, heavy duty, spring isolation system for a minimum 95% isolation efficiency.
- 2.9.9. The integral air drying system shall consist of fully duplexed desiccant type dryers with integral on-demand purge saving control. Each dryer shall be individually sized for peak calculated demand and capable of producing a {-12°C} [10°F] line pressure dewpoint. A prefilter rated for 0.01 micron shall be included with each dryer and include an automatic drain. duplexed final line filters rated for 0.01 micron shall be mounted and pre-piped. The dryers and filters shall include isolation valves to permit servicing without shutting down the medical air system. All filters shall have element change indicators. Downstream of the final line filters shall be a fully duplexed line regulating assembly including two line regulators, two pressure relief valves, two pressure gauges, and ball valves arranged so that isolation of one regulator will not affect the operation of the second regulator. Immediately upstream of this dual line regulator assembly shall be a piped and plugged tee to accommodate the connection of a reserve cylinder supply when required.
- 2.9.10. The air compressor/dryer package shall be delivered complete with an integral dewpoint monitor, installed such that it shall control the dryer purge economizing functions and monitor and provide the dewpoint (high humidity) alarm, complete with dry contacts for wiring to a remote alarm panel. The dewpoint sensor shall be located downstream of the dual line regulator assembly.
- 2.9.11. Units shall be supplied with the following alarm contact points to be wired to the master alarm panel by the mechanical contractor:
- 2.9.11.1. lag compressor in use
- 2.9.11.2. maintenance alarm
- 2.9.11.3. high dewpoint
- 2.9.11.4. compressor cylinder high temperature
- 2.9.11.5. desiccant dryer low discharge pressure
- 2.9.11.6. desiccant dryer switching failure
- 2.9.12. Supplier of system shall provide loose fittings to mechanical contractor so utilization of Medical Air Reserve Manifold is possible.
- 2.9.13. Medical air compressor/dryer package shall be equivalent to ESSEX LifeLine series located as per related drawings.

2.10. MEDICAL VACUUM SYSTEM

- 2.10.1. Provide a stack mounted quadraplex medical vacuum package incorporating Busch R5 direct driven, continuous duty rated, oil lubricated, air-cooled, multi-vane vacuum pumps, factory

assembled and tested prior to shipment. Each pump shall have a nominal capacity of {26 L/s} [56 SCFM] at {67 kPa} [20"] Hg when direct driven by 575 V/3ph/60 Hz 10 Hp high efficiency TEFC motors. Each pump shall be interconnected with galvanized or copper pipe. Vacuum pumps with metal vanes shall not be acceptable. pump accessories shall include a bourdon type liquid filled vacuum gauge, inlet check valve, stainless steel flexible bellows, inlet filter with 5 micron efficiency paper cartridge, exhaust filters to remove 99.9% of oil mist, exhaust back pressure gauge, an anti-suckback valve, a lubricant sight glass, a spin on automotive type lubricant filter, a pipe extension and ball valve on the oil drain port, temperature sensor, and rubber vibration isolation feet on the pump and motor.

- 2.10.2. Vacuum system shall include a pre-wired, pre-mounted CSA approved control panel suitable for five (5) pumps and consisting of a NEMA 12 enclosure with accommodations for one main disconnect switches, four magnetic motor starters with overload protection, duplex 120 volt control circuit transformers, individual non-resettable run hour meters, one vacuum transducer, one vacuum switch, hand-off automatic selector switches mounted in cabinet, run lights, lag alarm and reset button, and auxiliary dry contacts for wiring of all alarm conditions to remote master alarm panel. Operational functions shall be controlled by way of a Programmable Logic controller. Control panel shall include an 18 key touch pad keyboard and two line (20 character) LCD allowing the user the ability to monitor and/or change operational characteristics (i.e. pump cut-in/cut-out settings, variable sequencing of pumps, time clock, security password, English or French display, units of measure kPa or inches Hg) without system shut-down and opening of the panel door. In the event of PLC failure, the control panel shall be designed such that the system reverts to semi/auto mode and operation of the system is not affected.
- 2.10.3. Package shall include a 200 US gallon vertical corrosion resistant receiver complete with vacuum vent valve, manual tank drain, and sight glass. Receiver shall be pressure vessel approved and be identified with a C.R.N. registration number.
- 2.10.4. The system shall be wired such that the pumps operate automatically and alternate on successive start-stop cycles to equalize use times. Should the vacuum demand exceed that of the lead pump, the lag pump will start and the lag alarm will be activated. The lag alarm shall require manual reset.
- 2.10.5. The system=s control panel shall provide both audible and visual alarm indicators to signal lag pump in use.
- 2.10.6. The vacuum system shall be modular for final connections on-site. Work to include, wiring of pump modules to control panel and piping of pump modules to receiver. Interconnecting piping shall be provided loose by the manufacturer.
- 2.10.7. The vacuum system shall be supplied complete with suitable braided flexible connectors having NPT unions at both ends. Inner hose shall be corrugated tubing, outer sheath shall be heavy woven braid.
- 2.10.8. Low vacuum pressure switch shall be provided as part of the control panel.
- 2.10.9. Medical vacuum system shall be equivalent to ESSEX BR5-PLC series stack mounted quadraplex rotary-vane medical vacuum package, located as shown on related drawings.

2.11. MEDICAL VACUUM SYSTEM

- 2.11.1. Provide a base mounted modular triplex medical vacuum package with Busch Mink MI1352 oil-free, high efficiency, air-cooled, vacuum pumps, with each module being factory assembled and tested prior to shipment. Each pump shall have a capacity of 76 SCFM at 20" Hg when direct driven by 575V/3/60 Hz 15Hp motors. Each pump shall be interconnected with type K or type L copper pipe. The pump shall be direct driven (no belt and pulley driving accepted). The pump shall

be of a rotary claw (lobes) type with a non-catching, non-wearing compression. The compression chamber of each pump shall have oil-free operation.

- 2.11.2. Vacuum system shall include a pre-wired, pre-mounted CSA approved quadraplex control panel consisting of a NEMA 12 enclosure with fusible disconnect switches, magnetic motor starters with overload protection, a programmable logic controller (PLC), duplex 120 volt control circuit transformers, individual non-resettable run hour meters, pressure switches, hand-off-automatic selector switches mounted in cabinet, run lights, lag alarm and reset button, and auxiliary dry contacts for wiring alarm conditions to remote master alarm panel. Operational functions shall be controlled by way of a Programmable Logic Controller. Control Panel shall include an 18 key touch pad keyboard and two line (20 character) LCD allowing users the ability to monitor and/or change operational characteristics (i.e. pump cut-in/cut-out settings, variable sequencing of pumps, time clock, security password, units of measurement in either kPa or inches of Hg) without system shut-down and opening of the panel door. In the event of a PLC failure, the control panel shall be designed such that the system reverses to semi/auto mode and operation of the system is not affected.
- 2.11.3. Package to include a 200 gallon vertical corrosion resistant receiver complete with vacuum gauge, safety relief valve, and manual tank drain and sight glass. Receiver shall be pressure vessel approved and be identified with a C.R.N. approval.
- 2.11.4. The system shall be wired such that the pumps operate automatically and alternate on successive start-stop cycles to equalize use times. Should the capacity requirements exceed that of the lead pump, the lag pump(s) will start and the lag alarm will be activated. The lag alarm shall require manual reset.
- 2.11.5. Provide audible and visual alarm indication as well as remote alarm contacts to signal lag pump(s) in use.
- 2.11.6. Units shall be factory assembled in modules with suitable provisions for site lifting. Some on-site wiring and piping will be required upon installation due to module requirement. Work shall entail placement of modules, inter-connecting piping for vacuum pumps to receiver module, inter-connecting wiring for vacuum pump modules to control panel.
- 2.11.7. Provide discharge mufflers loose for site installation.
- 2.11.8. The vacuum system shall be supplied with suitable braided flexible stainless steel or bronze metal connector: Flexible connectors shall have NPT union=s at both ends. Inner hose shall be corrugated tubing, outer sheath shall be heavy woven braid.
- 2.11.9. Medical vacuum system shall be equivalent to ESSEX MI 1352-SIMPLC-TRP series stack mounted, modular triplex oil-less medical vacuum package, located as per related drawings.

2.12. MEDICAL GAS MANIFOLD

- 2.12.1. Provide Medaes Manifold, Model No. _____, designed for use with Oxygen, Nitrous Oxide, Medical Air, Carbon Dioxide, Helium, Argon Xenon, Nitrogen, Oxygen and Carbon Dioxide mixture, Oxygen and Helium mixture, and Oxygen and Nitrous Oxide mixture with two equal banks of cylinders for a total of cylinders. Manifold shall be suitable for floor/wall mounting. For floor mounted manifold provide two header support leg kits.

Manifolds shall meet CSA and NFPA standards for manifold cylinder gas source, oxygen compatibility and CGA V-1 compressed cylinder valve outlet and inlet connections.

- 2.12.2. Equip each manifold with the following:
 - 2.12.2.1. Removable, lockable housing for service access and installation.

- 2.12.2.2. Contents gauge and LED indicator lamps for “in use@ (amber), “empty@ (red) and “ready@ (green), for indicating switch over from primary to secondary supply and bank status. Manifolds without a “ready@ indicator and manifolds which use light bulb indicators are not acceptable.
- 2.12.2.3. Duplex line pressure regulators with four valve isolation and intermediate pressure service bypass.
- 2.12.2.4. Intermediate and line pressure relief valve pre-piped together for connection to a vent line.
- 2.12.2.5. CGA gas specific manifolds, blind glands, union nuts, header extensions and pigtails.
- 2.12.2.6. Non-return valves on each cylinder pigtail to permit change of cylinders without shutdown.
- 2.12.2.7. Dry electrical contacts for connection to master alarms.
- 2.12.2.8. Relief valves with capacities exceeding the maximum regulator flow capacity and reset pressure greater than the normal operating pressure of the line they protect.
- 2.12.2.9. Left and right bank pressure gauges.
- 2.12.2.10. Central delivery line capacity gauge for continuous indication.
- 2.12.2.11. Bank regulators and dome regulator.
- 2.12.2.12. Full duplex delivery line regulators with four isolation valves and intermediate pressure service bypass.
- 2.12.2.13. Soft seat hand tight pigtails and check valves.
- 2.12.3. All component materials shall be O₂ and N₂O compatible.
- 2.12.4. The capacity of each {385 kPa} [55 psig] manifold shall be {1.9 l/s} [30 scfm] with cylinders at standard switchover pressure of {1050 kPa} [150 psig] with a {70 kPa} [10 psi] delivery pressure drop or {5.7 l/s} [90 scfm] with a switchover pressure of {1750 kPa} [250 psig] and {105 kPa} [15 psi] drop. The capacity of each Nitrogen manifold shall be {4.4 l/s} [70 scfm] with cylinders at standard switchover pressure of {2100 kPa} [300 psig] with a {105 kPa} [15 psi] delivery pressure drop.

Each manifold shall be fully automatic and require no intervention by an operator to switch over to reserve supply. Manifold switchover shall be accomplished by dome loading of the operating supply pressure regulator. Manifolds which use shuttle valves or are manually switched are not acceptable. Manifold design shall be intrinsically safe in the event of electrical interruption or failure of the electric or pneumatic control circuitry. If a failure occurs, the manifold shall continue to operate and supply the system.
- 2.12.5. Provide a stepdown transformer with each manifold to power the solenoid, relays, LED's and switches. Transformer shall be 120 VAC to 24 VAC connected to the manifold circuit board. Install transformer in manifold cabinet or in remote location as shown on drawings.
- 2.12.6. Submit documentation matching specified design and performance requirements including delivery pressure and flow capacities.

PART 3 - EXECUTION

3.1. PROTECTION

- 3.1.1. Handle and store all pipe and fittings throughout the progress of the work in a manner to prevent contamination.

- 3.1.2. Do not use material which becomes contaminated in any way.

3.2. PIPE WORK

- 3.2.1. Cap, plug or cover open ends of all pipes, valves, etc., at all times until final connections are made. Wood, taped, or rag plugs are not acceptable and shall not be used. Plastic or Teflon-taped brass plugs are acceptable on oxygen, air and vacuum lines. Do not use material which becomes contaminated in any way.
- 3.2.2. Do not use tartaric acids in final cleaning or rinsing.

3.3. SYSTEM CONNECTIONS

- 3.3.1. Install all power wiring, control piping and mechanical piping for vacuum pump packages.
- 3.3.2. Provide all power wiring, control wiring, control piping and mechanical piping, which will be supplied loose by the equipment manufacturer, for the air compressors, in accordance with the manufacturer=s data and as follows:
- 3.3.2.1. Air compressor modules shall be manifolded together with the air dryer module and the air receiver with a {25 mm} [1"] dia. line. Provide a separate valved and capped connection for the future compressor.
- 3.3.2.2. Air compressor modules, dryer modules and the receiver shall be wired on site. Compressor modules require 575 volt to motors and 120 volt to controllers. A junction box shall be provided on air compressor modules. Electric drain on receiver shall be wired with 120 volts.

3.4. EMERGENCY LOW PRESSURE OXYGEN INLET

- 3.4.1. Obtain padlock from Owner and install on recessed enclosure.
- 3.4.2. Supply valve assembly shall be cleaned for oxygen service and capped.

3.5. ZONE BOXES

- 3.5.1. Flush mount and label all boxes as to type of gas and area served.
- 3.5.2. Secure zone boxes to wall structure.
- 3.5.3. Locate individual shut off valves in concealed areas where zone boxes are not required. Where lockable valves are specified, obtain padlocks from Owner and install on lockable valves.

3.6. OUTLETS

- 3.6.1. Secure wall outlet roughing to wall structure.
- 3.6.2. Mount outlets with spacing not less than {125 mm} [5"] on centres.
- 3.6.3. Provide rough-in and make final connections to medical gas and vacuum services as shown.

3.7. ALARM CONTROLS

- 3.7.1. All medical air alarm points shall be wired back and connected to Master Alarm Panel in Switchboard Room G-124.

- 3.7.2. All alarms shall be connected to the compressors and these points, along with high temperature
- 3.7.5.3. and maintenance points shall be wired back to the Central Building Management system in Plant Operations Room EC-B-311.
- 3.7.3. Air compressor alarm points shall be as follows:
- 3.7.3.1. Reserve air low
- 3.7.3.2. Reserve air in use
- 3.7.3.3. Line pressure abnormal
- 3.7.3.4. High dewpoint
- 3.7.3.5. Maintenance alarm
- 3.7.3.6. Lag alarm
- 3.7.3.7. High temperature alarm
- 3.7.3.8. Dryer low outlet pressure
- 3.7.3.9. Dryer switching failure
- 3.7.4. All medical vacuum alarm points shall be wired back and connected to Master Alarm Panel in Switchboard Room G-124 and to the Central Building Management System in Plant Operations Room Ec-B-311.
- 3.7.5. Vacuum pump alarm points are as follows:
- 3.7.5.1. Lag pump in use
- 3.7.5.2. Low vacuum
- 3.7.6. Monitor each compressor and vacuum pump start/stop and run times at the Building Automation System. Provide trend compatibility to indicate run times on a continuous basis. Coordinate with controls contractor/supplier.
- 3.8. AREA LINE PRESSURE ALARM PANELS**
- 3.8.1. Division 20 00 00 shall provide all wiring associated with alarm panels. Factory prewire panels so that only line voltage field connections are required.
- 3.9. MEDICAL COMPRESSED AIR/DRYER SYSTEM**
- 3.9.1. Medical air compressor shall be connected to emergency power on site. Coordinate connection with Division 26 00 00 Contractor.
- 3.10. MEDICAL VACUUM SYSTEM**
- 3.10.1. Medical vacuum system shall be connected to emergency power on site. Coordinate connection with Division 26 00 00.

3.11. FILLING UP

- 3.11.1. Fill all the lines with {3.5 kPa} [2 psig] of nitrogen after installation to prevent any oxidation from the time of installation to the time of use.

3.12. IDENTIFICATION

- 3.12.1. Identify all medical gas and vacuum piping. Install labels immediately after piping run is completed. Label each service valve. Install labels at intervals of {6m} [20'] before and after barriers, and behind access doors and inlet and outlet points.
- 3.12.2. Provide Iamacoild name plates at all medical gas alarm panels and zone valves.
- 3.12.3. Conform to CSA Z305.1 and Hospital Standards for colour coding of labels.

3.13. CONNECTION TO EQUIPMENT

- 3.13.1. Connect all process piping to equipment supplied under this Contract and equipment supplied by the Owner. Coordinate to ensure use of approved couplings at equipment.

3.14. CERTIFICATION TESTS

- 3.14.1. Provide all labour and materials required to support the tests required by the independent testing agency appointed by the Owner.
- 3.14.2. Provide as-built drawings, flow diagrams, details and shop drawing of all equipment. Make available a representative to be present and to witness the verification of the cross-connection tests and concentration tests during the entire testing procedure as mutually agreed with the testing agency.
- 3.14.3. Do not construe work done by this testing agency as site supervision. Provide written notification to the Owner that the medical gas systems are complete and ready for testing at least fourteen (14) days prior to the start of certification testing. If the systems are found to be not complete, and cannot be tested by the testing agency, then this Contractor shall pay all costs involved for abortive work.

3.15. CLEANING AFTER TESTING

- 3.15.1. Cleaning refers only to external surfaces of the work.
- 3.15.2. Thoroughly clean all parts of the installation upon completion of tests and all related work.
- 3.15.3. Clean all equipment, pipe valves, and fittings of grease, metal cuttings, waste, etc., which may have accumulated by operation of system during testing.

END OF SECTION

PART 1 - GENERAL

1.1. QUALIFICATIONS

- 1.1.1. The TAB Agency shall be a current member in good standing with either the Associated Air Balance Council or National Environmental Balancing Bureau.

1.2. SUBMITTAL REQUIREMENTS

- 1.2.1. Submit the following information with the Bid Form:
- 1.2.1.1. List of proposed equipment to be used for this project.
- 1.2.1.2. Proof of membership in the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB).
- 1.2.1.3. The names and qualifications of all personnel who will be assigned to this project. Use of other personnel will be grounds for contract termination.
- 1.2.1.4. A listing of references including project names, Consultant, Contractor and Owner references with telephone numbers.

1.3. WORK INCLUDED

- 1.3.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.3.2. Provide all labour, materials, products, equipment and services to test, adjust and balance all air and hydronic systems to verify conformance to specified quantities and to the design intent of the mechanical system.
- 1.3.3. Refer to Specification 01 91 00 for commissioning activities to be performed by others. Cooperate with the Commissioning Authority.
- 1.3.4. The following systems and/or equipment are included in the Scope of Work:
- 1.3.4.1. **Air Systems:**
- 1.3.4.1.1. Supply Fans
- 1.3.4.1.2. Exhaust Fans
- 1.3.4.1.3. Zone Branch and Main Ducts
- 1.3.4.1.4. VAV Systems
- 1.3.4.1.5. Diffusers, Registers and Grilles
- 1.3.4.1.6. Coils (Air Temperatures and Flow)
- 1.3.4.2. **Hydronic Systems:**
- 1.3.4.2.1. System Mains and Branches
- 1.3.4.2.2. Coils (Water Temperature and Flow)
- 1.3.4.2.3. Terminal Units
- 1.3.4.3. **Domestic Systems:**

- 1.3.4.3.1. Domestic Hot Water Recirculation
- 1.3.4.3.2. Domestic Hot Water Heaters
- 1.3.4.4. **Fire Protection:**
- 1.3.4.4.1. Pressure reducing valve testing
- 1.3.4.5. **Specialty Systems:**
- 1.3.4.5.1. Laboratory Supply and Exhaust System
- 1.3.5. Refer to Specification Section 23 31 00 for test openings in duct system. Provide additional openings to fulfill the work of this section.

1.4. REFERENCE STANDARDS

- 1.4.1. All work shall be in accordance with the latest edition of the AABC or NEBB National Standards. If these contract documents set forth more stringent requirements than the Reference Standards, these contract documents shall prevail.

1.5. REFERENCE DOCUMENTS

- 1.5.1. Obtain and pay for, a complete set of reviewed Shop Drawings of pumps, fans and control systems.
- 1.5.2. Obtain and pay for, a complete set of Mechanical Drawings and Specifications.

1.6. CAN/ULC-S1001 INTEGRATED LIFE SAFETY SYSTEMS TESTING

- 1.6.1. Participate in Integrated Life Safety Systems Testing per CAN/ULC-S1001 requirements and as directed by the associated commissioning agent. Refer to the PART 3 – EXECUTION section for further requirements.

PART 2 - PRODUCTS

2.1. TEST EQUIPMENT

- 2.1.1. When requested by the Consultant, provide current calibration certificates for test equipment.

PART 3 - EXECUTION

3.1. GENERAL

- 3.1.1. The specified systems shall be reviewed and inspected for conformance to design documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with AABC or NEBB Standards or 5%, whichever is more stringent.
- 3.1.2. Any deficiencies in the installation or performance of a system or component shall be reported in writing to the Contractor and Consultant.
- 3.1.3. Equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls and devices shall be physically marked to show final settings.

3.2. JOB SITE INSPECTION

- 3.2.1. Inspect the installation of the systems to be tested at least twice during the construction period. Ensure specified devices and components required for testing and balancing functions have been installed according to the manufacturer's recommendations.
- 3.2.2. Ensure all required balancing dampers are installed, functional, and accessible for use in testing and balancing procedures.
- 3.2.3. Provide a written report of inspection to the Contractor and Consultant identifying specific concerns and deficiencies affecting the testing and balancing procedures.

3.3. FANS AND AIR HANDLING SYSTEMS

- 3.3.1. Verify that all ductwork, dampers, grilles, registers and diffusers have been installed per design.
- 3.3.2. Balance air handling systems at minimum outdoor air quantities. On completion of TAB procedures, retest at maximum outdoor air quantities.
- 3.3.3. Test and adjust fan RPM to achieve design flow. Provide sheave and belt change if required to achieve the required CFM and performance.
- 3.3.4. Test and record motor voltage and amperage. Compare data with nameplate limits.
- 3.3.5. Perform pitot tube traverse at all main and branch ducts. Compare traverse total with measured outlet total to determine actual duct leakage.
- 3.3.6. Test and adjust minimum outdoor and relief air volumes.
- 3.3.7. Test and record system static pressure profile of each air handling system at minimum outdoor air volume. Note coil (i.e. wet/dry) and filter condition of time of testing.
- 3.3.8. Test and record entering and leaving air conditions for each heat transfer coil and device. Simulate conditions to achieve winter or summer design parameters.
- 3.3.9. Test and record settings of motor thermal overload devices. Adjust settings where required.

3.4. AIR DISTRIBUTION AND TERMINALS

- 3.4.1. Adjust duct distribution to obtain specified air quantities. At least one zone balancing damper shall be completely open. Multi diffuser/grille branch ducts shall have at least one volume damper completely open.
- 3.4.2. Test and adjust each air terminal to obtain specified flow. Adjust deflectors and pattern controllers to eliminate drafts.

3.5. VARIABLE AIR VOLUME SYSTEMS

- 3.5.1. Set air terminal control units to maximum and minimum flow. Test and record amplified velocity pressure signal and inlet static pressure.
- 3.5.2. Cooperate with the Automatic Controls Trade in testing and recording:
 - 3.5.2.1. Accurate supply and return fan tracking by total air flow measurements at 33%, 66% and 100% of maximum flow.
 - 3.5.2.2. Establish required system static pressure reference for satisfactory operation of system.

3.6. HYDRONIC EQUIPMENT

- 3.6.1. Test and adjust water flow to devices such as coils, chillers, heat exchangers and cooling towers to obtain the specified flow. Compare actual equipment water side pressure drops with manufacturer's published data.
- 3.6.2. Where equipment is used in heat transfer (i.e. Air/Water Coils), measure entering and leaving liquid/gas conditions and compare to manufacturer's published data.
- 3.6.3. Where possible, simulate design conditions for testing. If simulation is not practical, perform seasonal testing when design conditions can be achieved.

3.7. HYDRONIC PIPING AND DISTRIBUTION

- 3.7.1. Adjust water flow in distribution system to obtain specified flows.
- 3.7.2. Test and record flow and differential pressure systems to establish references for satisfactory operation.
- 3.7.3. Test and adjust system feeders to ensure adequate system static pressure is available under all operating conditions.
- 3.7.4. Test and adjust hydronic terminals to obtain specified flow.

3.8. DOMESTIC HOT WATER RECIRCULATION

- 3.8.1. Test and adjust distribution to obtain specified flow through each branch.

3.9. EXHAUST HOODS

- 3.9.1. Test total air flow by face velocity and pitot tube traverse. Adjust to obtain specified flow and equalize flow across face of hood.

3.10. PRELIMINARY TESTING

- 3.10.1. In the event preliminary testing reveals a deficiency in the system which cannot be corrected through the balancing process, advise the Contractor and Consultant in writing describing the conditions and suggested corrective action.

3.11. REPORTS

- 3.11.1. Provide four (4) copies of the TAB report for Consultant review.
- 3.11.2. Summarize all testing into logical sections, tabulated and summarized.
- 3.11.3. Identify system terminals and distribution on legible plan or schematic drawings depicting actual system arrangement. Label pitot tube traverse locations, terminal identification and equipment identification in a manner consistent with the contract documents.

3.12. REPORT VERIFICATION

- 3.12.1. Cooperate with the Consultant in field verification of the final reported values.
- 3.12.2. Specific and random verifications will be performed using the same procedures used in preparation of the reports.

- 3.12.3. Sufficient verifications will be performed to satisfy the Consultant that the reports accurately represent the actual system conditions.

3.13. GUARANTEE

- 3.13.1. Provide AABC National Project Performance Guaranty or NEBB Performance Bond for the work.
- 3.13.2. Include a copy of the guarantee in each copy of the Testing and Balancing Report.

3.14. CAN/ULC-S1001 COMMISSIONING ASSISTANCE

- 3.14.1. Assist the third-party commission agent through the Integrated Systems Testing of Fire Protection and Life Safety Systems per CAN-ULC-S1001 and Ontario Building Code Section 3.2.10. Provide support staff that are experienced and technically knowledgeable on the subject matter. Coordinate with the commissioning agent in advance of the testing dates and provide all input they may request. Make appropriate staff available for all testing dates and subsequent review periods.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply, install and test the heated water and chilled water piping systems indicated on the Drawings and specified in this Section of the Specifications.
- 1.1.3. Install all piping in accordance with CSA B214.07, Installation Code for Hydronic Heating systems.
- 1.1.4. Install sensor wells and other items required by Controls Section 25 30 00.

PART 2 - PRODUCTS

2.1. PIPING, JOINTS AND FITTINGS

- 2.1.1. Meet the following pipe requirements:
 - 2.1.1.1. Pipe: {12 mm} [½"] to {50 mm} [2"]
 - 2.1.1.1.1. ASTM A53, Standard wall (minimum Schedule 40) steel electric resistance weld for internal pressure up to {4100 kPa} [600 psi] and ASTM A106 where pressure exceeds {4100 kPa} [600psi]. Fittings and couplings shall be threaded malleable iron meeting ASA B16.3 for pressure classes {1035 kPa} [150 psi] and {2068kPa} [300psi]. Use cast iron meeting ASA B16.4 for pressures classes of {1206 kPa} [175 psi] or {2758 kPa} [400psi].
 - 2.1.1.2. Pipe: {65 mm} [2-1/2"] and larger
 - 2.1.1.2.1. Pipe as above, ends bevelled for welding. Fittings and line joints, wrought steel meeting ASA B16.9 for welding, or flanged fittings and slip on flanges meeting ASA B16.5. Select pressure classification to meet system working pressures.
- 2.1.2. Meet Section 20 05 00 requirements for pipe installation and equipment connection including union and flange provision.
- 2.1.3. Provide {1-1/2 mm} [1/16"] thick Cranite ring gaskets. Provide line joints, valves, fittings, flanges and in-line components for actual system operating pressures.
- 2.1.4. Provide ASA B16.18, Type L copper takeoffs from risers, runouts and horizontal distribution systems.
- 2.1.5. Grooved systems conforming to CSA B242/AWWA C606 may be used except for pipe enclosed in shafts. Follow grooved manufacturer's written installation instructions taken from Shurjoint or Victaulic literature. Grooved connections shall be rigid Shurjoint Z07 or Victaulic Style 107 couplings for sizes {50mm} [2"] to {300mm} [12"], Shurjoint Style Z07N (OGS) or W07 AGS rigid couplings for sizes {350mm} [14"] to {1525mm} [60"].
- 2.1.6. Contractors shall not "mix and match" groove systems in any project. If an existing piping system is being modified, that system's groove system must be used. If the project is new, supply all groove fittings from one supplier only.
- 2.1.7. Victaulic Vic-Press system may be used on piping {50 mm} [2"] and smaller instead of threaded, soldered or Victaulic joints. Where Vic-Press is used, meet the following requirements:

- 2.1.7.1. Pipe shall be Schedule 10 stainless steel, ASTM A312, Type (304/304L) (316/316L), Sch. 10S, pipe, dimensions conforming to ANSI/ASME B36.19M-1985.
- 2.1.7.2. Couplings/fittings shall be complete with self-contained O-ring seals in the coupling or fitting ends. Vic-Press (304) (316): ASTM A312 stainless steel housings with ASTM A276 and A312 outlets and austenitic stainless steel plain or grooved ends, Type 304/304L, complete with synthetic rubber Grade "H" (HNBR) O-rings rated for applicable services to {98°C}[210°F]. Gasket shall be UL classified in accordance with ANSI/NSF-61 for potable water service.
- 2.1.7.3. Vic-Press pipe shall be square cut {±0.76 mm} [±0.030"], properly deburred, cleaned, and marked to ensure leak-tight O-ring seal, in accordance with the latest Victaulic Vic-Press published information. Insertion depths shall be as follows:

	Pressfit Insertion Mark Depth				
Size	{15 mm} [1/2"]	{20 mm} [3/4"]	{25 mm} [1"]	{40 mm} [1-1/2"]	{50 mm} [2"]
Depth	{27 mm} [1-1/16"]	{27 mm} [1-1/16"]	{30 mm} [1-3/16"]	{35 mm} [1-3/8"]	{41 mm} [1-5/8"]

- 2.1.7.4. Pipe ends shall be marked at the required location, using a manufacturer-supplied gauge, to ensure full insertion into the coupling or fitting during assembly. Use a Victaulic "PFT-510" series tool with the proper sized jaw for pressing.
- 2.1.7.5. Meet hanger requirements in accordance with the manufacturer's recommendations as a minimum. Meet Section 20 05 00, Article 3.5 requirements where hanger requirements are greater than the manufacturer's.

2.2. VALVES

- 2.2.1. Gate and globe valves shall be Kitz to the following Kitz figure numbers:

To {1400 kPa} [200 psi] working pressure:

	Figure Numbers	
	Gate	Globe
{50 mm} [2"] and smaller Soldered	44	10
Screwed	24	09
{65 mm} [2-1/2"] and larger Flanged	72	76

To {2100 kPa} [300 psi] working pressure:

	Figure Numbers	
	Gate	Globe
{50 mm} [2"] and smaller Soldered	43	10
Screwed	42	09

	Figure Numbers	
	Gate	Globe
{65 mm} [2-1/2"] and larger Flanged, rising stem	300SCL	300SCJ

- 2.2.2. For pipe sizes {50 mm} [2"] and smaller, ball valves may be substituted for the above gate and globe valves. Provide ball valves with brass or bronze body, chrome plated solid ball, PTFE seats and seals and full port:
- 2.2.2.1. soldered - Kitz Figure 59
- 2.2.2.2. screwed - Kitz Figure 58
- 2.2.3. Check valves shall be non-slam type, selected for system operating pressures and temperatures. Shurjoint SJ900 or Victaulic 716 check valves may be substituted in c grooved end piping systems.
- 2.2.4. Butterfly valves shall be Apollo or DeZurik manufacture, full lug body style, with stainless steel shaft, supported by 3 bearings (top, bottom and actuator), replaceable EPDM seat to the following schedule. All flanges shall be ANSI rated, weld neck. Install spool pieces between valves and adjacent equipment. Equip valves to {100 mm} [4"] with 10 position lever operator. Equip valves {150 mm} [6"] and larger with gear box and handwheel operator. Each valve type shall hold line pressure with downstream flange removed to the full shutoff rating of the valve.
- 2.2.4.1. Shurjoint SJ300 grooved butterfly valve 2100 kPa} [300 psi].
- 2.2.4.2. Vic-300 MasterSeal grooved end valves {2100 kPa} [300 psi].
- 2.2.4.3. To {1225 kPa} [175 psi] working pressure, use Fig. 660L.
- 2.2.4.4. To {1575 kPa} [225 psi] working pressure, use Fig. 632-L648.
- 2.2.4.5. To {1750 kPa} [250 psi] working pressure, use Fig. Bhp-L1 meeting ANSI B16.5 as follows:
- 2.2.4.5.1. {1995 kPa} [285 psi] to {38°C} [100°F]
- 2.2.4.5.2. {1885 kPa} [265 psi] to {100°C} [212°F]
- 2.2.4.5.3. {1750 kPa} [250 psi] to {121°C} [250°F]
- 2.2.4.6. To {2100 kPa} [300 psi] working pressure, use Bhp-L2 meeting ANSI B16.5 as follows:
- 2.2.4.6.1. {5180 kPa} [770 psi] to {38°C} [100°F]
- 2.2.4.6.2. {3500 kPa} [500 psi] to {193°C} [380°F]
- 2.2.4.6.3. {2100 kPa} [300 psi] to {440°C} [725°F]
- 2.2.4.7. Provide high performance butterfly valves (BHP) in the appropriate pressure class, for modulating control applications in either two or three way configuration and where electric actuators are used.
- 2.2.5. Provide DeZurik plug valves for balancing applications except where circuit balancing valves are specified.

- 2.2.5.1. To {1225 kPa} [175 psig] provide Series 425/118 eccentric plug valve. Equip sizes {12 mm to 100 mm} [½" to 4"] with memory stop and drip cap. Equip valves over {100 mm} [4"] with handwheel gear.
- 2.2.5.2. To {1575 kPa} [225 psig] provide Series 118SX or 118FX eccentric plug valves. Equip sizes {12 mm to 65 mm} [1/2" to 2-1/2"] with lever and memory stop. Equip valves over {65 mm} [2-1/2"] with handwheel gear.
- 2.2.5.3. To {1995 kPa} [285 psig] provide Series 128 eccentric plug valves. Equip sizes {12 mm to 65 mm} [½" to 2-1/2"] with lever and memory stop. Equip valves over {65 mm} [2-1/2"] with handwheel gear. Meet ANSI B16.5 temperature and pressure requirements.
- 2.2.5.4. To {2100 kPa} [300 psig] provide Series Bhp-L2 high performance butterfly valves meeting previous specification.
- 2.2.5.5. Provide ball drain valves with cap and chain at base of all hydronic risers. Valve rating- {1750 kPa} [250 psi] at {121°C} [250°F].
- 2.2.5.6. Victaulic Series 377 'VIC-PLUG valves may be substituted in Victaulic piping systems up to {1225 kPa} [175 psi].

2.3. CIRCUIT BALANCING VALVES

- 2.3.1. Provide circuit balancing valves:
 - 2.3.1.1. on the common return pipe from each coil bank, heat exchanger, boiler and chiller
 - 2.3.1.2. on each return riser
 - 2.3.1.3. where shown on the Drawings
 - 2.3.1.4. for all locations where balancing valves are shown in pipe less than {65 mm} [2-1/2"] in size
- 2.3.2. For valves to {50 mm} [2"] provide Y pattern style, all metal, with soldered or screwed connections, built-in drain connection with shut off valve and protective caps, and integral valve insulation.
- 2.3.3. For valves from {65 mm} [2-1/2"] to {300 mm} [12"] provide Y pattern style, cast iron body, flat face flanges, or grooved end connections for grooved piping systems.
- 2.3.4. Provide, for each valve:
 - 2.3.4.1. vernier type handwheel settings for precision flow balancing
 - 2.3.4.2. positive shut off valve with no drip seat and plug type stem with teflon disc
 - 2.3.4.3. tamper proof hidden memory feature
 - 2.3.4.4. positive shut off metering valves with connections for portable meter
- 2.3.5. Provide two portable differential pressure meters for the project and, following their use by the balancing technician, turn over to Owner in good condition.
- 2.3.6. Balancing valves to be sized according to design flow. Select circuit balancing valve size to give a pressure drop at 100% open between {3.0 kPa} [1 ft] and {21 kPa} [7 ft]. Select valves located remote from the pumps in the circuit near minimum pressure drop and those located near the pumps at higher pressure drops.

2.4. SAFETY AND RELIEF VALVES

- 2.4.1. Provide safety and relief valves for all closed water systems. Pipe relief to nearest floor drain.
- 2.4.2. Provide valves rated at {1035 kPa} [150 psig] at {99°C} [210°F] ASTM rated, cast iron body bronze disc and seat, steel spindle assembly, carbon steel spring.

2.5. HYDRONIC TERMINAL UNIT VALVES

- 2.5.1. Provide bronze body, stainless steel ball isolation valves at inlet and outlet of each hydronic terminal unit. Valves shall be rated for the system pressure. Valves shall be line sized.

2.6. AIR VENTS

- 2.6.1. Select air vents to suit system operating pressures.
- 2.6.2. Provide automatic air vents, complete with isolating gate valves at all high points where mains are trapped, where shown in the Drawings and where shown on Typical Detail Sheets. Pipe outlet from each vent to a service sink, drip pan or floor drain.
- 2.6.3. Provide manual air vents, screwdriver or key type at each unit heater, cabinet unit heater, convector, wallfin section and fan coil unit.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1. Meet Section 20 05 00 requirements.
- 3.1.2. Use valves and strainers of the same size as pipe in which it is installed, unless otherwise indicated.
- 3.1.3. Provide globe, ball or plug valves for throttling or controlling flow in accordance with article 2.2.
- 3.1.4. Provide gate, ball or butterfly valves for shutoff in accordance with article 2.2.
- 3.1.5. Install reducing fittings so as not to trap air.
- 3.1.6. Provide long radius elbows.
- 3.1.7. Provide flanges or unions at connections to all equipment.
- 3.1.8. Provide screwed or flanged joints only in accessible locations. Provide access doors as required.
- 3.1.9. Do not use field fabricated fittings.
- 3.1.10. Equip low points with {20 mm} [3/4"] drain valve piped to floor drain. Provide, at high points on lines and on equipment connections, collection chambers and high capacity float operated automatic air vents.
- 3.1.11. The first hanger on branch take off piping from a riser shall be spring hung to reduce stress on riser and branch.
- 3.1.12. Connect branch pipe runouts to top of main distribution pipe.

3.2. TESTING

- 3.2.1. Meet testing requirements of all authorities having jurisdiction. Obtain certification and certify tests not required by authorities. Perform not less than the following tests.
- 3.2.2. Prove hydronic piping tight under a hydrostatic test of 150% of design working pressure but not less than {700 kPa} [100 psi]. Test without pressure drop for a period of not less than 4 hours.
- 3.2.3. Perform tests before piping is covered or concealed.
- 3.2.4. Remove all components which will not withstand test pressure and replace after tests.
- 3.2.5. Eliminate leaks or remove and refit defective parts. Do not caulk threaded or welded joints.
- 3.2.6. After work is completed, adjust and put all parts of the system into proper working order. Adjust all valves to achieve specified heating capacities. Leave the complete job ready for regular operation, all to the satisfaction of the Consultant.
- 3.2.7. After the testing period, drain the system, and before water treatment is introduced into the system, clean out all dirt pockets and strainers.
- 3.2.8. Provide lubricating oils, packing, and other accessories, for proper operation of the system.
- 3.2.9. The final test and acceptance shall not be made until the work is finally completed.

3.3. INSTALLATION OF CONTROL DEVICES AND INSTRUMENTATION

- 3.3.1. Install all control devices and instrumentation for the hydronic systems as shown on the drawings, specified in Section 25 30 00 for items supplied by the controls supplier.

3.4. PRESSURE CLASS DETERMINATION

- 3.4.1. Refer to the hydronic schematics, plan notes, schedules, and equipment specifications to determine the required pressure class. Where there is a conflict, provide products per worst case/highest rating.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install refrigerant piping systems as indicated on the Drawings and specified in this Section of the Specifications.
- 1.1.3. Installation shall be designed and installed by refrigerant piping system specialists.

1.2. SUBMITTAL DATA

- 1.2.1. Submit Shop Drawings of refrigerant piping systems and control systems for review prior to commencement of installation.
- 1.2.2. Drawings shall include the following:
 - 1.2.2.1. An isometric layout of refrigerant piping showing all piping and components required for the satisfactory operation and maintenance of systems, including but not limited to charging valves, isolating valves, sight glasses, strainers, driers, thermostatic expansion valves, solenoid valves, receivers, relief valves, mufflers, traps, oil separators, and water regulating valves.
 - 1.2.2.2. Control wiring interconnecting air conditioning equipment and refrigerant piping system components.
 - 1.2.2.3. A description of the sequence of operation of the refrigerant piping system.

1.3. REFERENCE STANDARDS

- 1.3.1. Meet Division 26 00 00 requirements for wiring methods and materials.
- 1.3.2. Refrigerant piping design and installation shall conform to the recommendations and requirements of the following:
 - 1.3.2.1. CSA Standard B52 - Mechanical Refrigeration Code
 - 1.3.2.2. Ontario Building Code
 - 1.3.2.3. Air Conditioning and Refrigeration Institute
 - 1.3.2.4. Air Conditioning Equipment Manufacturer

PART 2 - PRODUCTS

2.1. PIPING, JOINTS AND FITTINGS

- 2.1.1. Select pipe, fittings and components to suit systems test and operating pressures.
- 2.1.2. Refrigerant piping shall be factory cleaned and sealed, type ACR seamless copper piping. Use only silver brazed joints.
- 2.1.3. Use only long radius elbows.
- 2.1.4. Size refrigerant piping to attain air conditioning equipment manufacturer's listed cooling capacities.

PART 3 - EXECUTION

3.1. PIPING AND WIRING INSTALLATION

- 3.1.1. Keep piping runs and number of elbows and fittings to a minimum.
- 3.1.2. Reduce the effect of piping vibration with the use of flexible metal hose.

3.2. DEHYDRATION AND CHARGING

- 3.2.1. After installation of piping, a minimum test pressure of {2100 kPa} [300 psi] on the high pressure side and {1050 kPa} [150 psi] on the low pressure side shall be placed on the piping system with nitrogen. Pressures shall be maintained without loss for not less than four (4) hours. Repair or replace defective joints.
- 3.2.2. After joints have been proven tight under test pressures, achieve a vacuum of not less than {95 kPa} [28" Hg] using a separate vacuum pump. Maintain vacuum without change in pressure for at least twelve (12) hours.
- 3.2.3. System shall then be charged with dry refrigerant.
- 3.2.4. After charging, recheck all joints with a halide leak detector. Replace any joints found to leak and repeat the above dehydration testing and charging procedures.

3.3. START UP AND ADJUSTMENT

- 3.3.1. Provide necessary instruments, gauges and testing equipment required.
- 3.3.2. Adjust thermostats, valves and controls and demonstrate that design requirements and equipment manufacturer's ratings have been met.
- 3.3.3. Test and record equipment voltage and amperes and compare with motor nameplate data.
- 3.3.4. Set and adjust controls to achieve required sequence of operation.

3.4. GUARANTEE

- 3.4.1. Replace any refrigerant and oil lost during the warranty period.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install the sheet metal and ductwork systems as indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

- 1.2.1. Meet Standards described in the latest Edition of HVAC Duct Construction Standards handbook from Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- 1.2.2. Duct dimensions shown on Drawings are net, inside insulation and acoustic duct lining.
- 1.2.3. Combination fire and smoke dampers and fire dampers shall be ULC listed and labelled as a unit and meet requirements of Ontario Fire Marshall and NFPA-90A.
- 1.2.4. Fire rated duct wrap material shall be ULC listed for the application which it is intended for.
- 1.2.5. Combustible ducts shall meet the requirements of ULC S-110, Standard Methods of Test for Air Ducts.

PART 2 - PRODUCTS

2.1. DUCTWORK

- 2.1.1. Fabricate ductwork from galvanized sheet metal with a minimum coating of {1.83 grams/m²} [0.60 oz/sq.ft.] (G60 coating) unless other materials are specifically named. Duct installation shall conform to the following:
 - 2.1.1.1. Ductwork shall be smooth on the inside and free of obstructions, vibration and rattle.
 - 2.1.1.2. Fabricate ductwork, except as described in the next item, according to the following classifications:
 - 2.1.1.2.1. Class 1: All ducting subject to positive or negative static pressure of {250 Pa} [1 in w.g.] or less with maximum velocities of {13 m/s} [2500 fpm] shall be constructed in accordance with SMACNA construction standards for {250 Pa} [1 in w.g.] duct.
 - 2.1.1.2.2. Class 2: All ducting subject to positive or negative static pressure of more than {250 Pa} [1 in w.g.] up to {500 Pa} [2 in w.g.] with maximum velocity of {13 m/s} [2500 fpm] shall be constructed in accordance with SMACNA construction standards for {500 Pa} [2 in w.g.] duct.
 - 2.1.1.2.3. Class 3: All ducting subject to positive or negative static pressure of greater than {500 Pa} [2 in w.g.] up to {750 Pa} [3 in w.g.] with maximum velocity of {20 m/s} [4000 fpm] shall be constructed in accordance with SMACNA construction standards for {750 Pa} [3 in w.g.] duct.
 - 2.1.1.2.4. Class 4: All ducting subject to positive pressure greater than {750 Pa} [3" w.g.] up to {1000 Pa} [4 in w.g.] with maximum velocity of {20 m/s} [4000 fpm] shall be constructed in accordance with SMACNA construction standards for {1000 Pa} [4 in w.g.] duct.
 - 2.1.1.2.5. Class 6: All ducting subject to positive pressure greater than {1000 Pa} [4 in w.g.] up to {1500 Pa} [6 in w.g.] with maximum velocity of {20 m/s} [4000 fpm] shall be constructed in accordance with SMACNA construction standards for {1500 Pa} [6 in w.g.] duct.

- 2.1.1.3. Provide Class 2 pressure duct construction for:
 - 2.1.1.3.1. Ductwork between variable volume air handling units and air terminal control units.
 - 2.1.1.3.2. Ductwork used in smoke exhaust systems.
 - 2.1.1.3.3. Ductwork between airflow Venturi's and fans.
- 2.1.1.4. Provide duct transformation with expansion fittings having slopes not exceeding 1 to 7 and contraction fittings having slopes not exceeding 1 to 4.
- 2.1.1.5. Provide full radius tees, bends, and elbows for changes in direction except where square elbows are required due to space restrictions. Provide DuroDyne double thickness {0.8 mm} [24 gauge] turning vanes assembled in top and bottom rails in square elbows.
- 2.1.1.6. Provide balancing dampers free to move in either direction without binding or rattling. Construct dampers in ductwork from {1.2 mm} [18 gauge] galvanized sheet metal. Use manual quadrants on small ducts. On dampers longer than {375 mm} [15"] use push rods with DuroDyne Model SRP ball joints. Use two push rods on ducts wider than {600 mm} [24"]. Provide OBD balancing dampers where shown on the drawings or where required by the Balancing Sub Contractor.
- 2.1.1.7. Isolate equipment with DuroDyne neoprene {0.8 mm} [0.032"] thick flexible connectors with finished fabric width not less than {150 mm} [6"].
- 2.1.1.8. Provide {50 mm} [2"] insulated sheet metal blank off panels behind unused portions of exterior louvers.
- 2.1.1.9. Seal all joints in all ductwork with Transcontinental MP for low and medium pressure or DuroDyne S2 duct sealer for high pressure. Joints shall be sealed to conform to SMACNA standards.
- 2.1.1.10. Application of duct sealer to exposed duct shall result in visibly appealing finish. Where possible duct sealer shall be applied to inside of joints. Where duct sealer is applied to outside of duct, outside edge of seal shall be a straight line, perpendicular to duct edges.
- 2.1.2. Construct round ductwork to meet high pressure duct standards and as follows:
 - 2.1.2.1. Provide welded slip joint construction round duct fittings. Wipe pipe and fittings with DuroDyne S-2 duct sealer before assembly. Secure joints with self-tapping screws, and then brush again with thick coat of duct sealer.
 - 2.1.2.2. Provide dieformed round elbows through {200 mm} [8"] dia. constructed from {1.1 mm} [20 gauge] galvanized steel. Provide 5 section construction for larger elbows.
 - 2.1.2.3. Provide conical round tees.
- 2.1.3. Flexible Ductwork:
 - 2.1.3.1. Provide insulated flexible ductwork upstream and downstream of air terminal control units and/or other locations indicated on the Drawings. All flexible ductwork must be factory insulated.
 - 2.1.3.2. Construct ductwork from a tape of soft annealed aluminum sheet, spiral wound into a tube and spiral corrugated to provide strength and flexibility. Provide a triple mechanical lock to form a continuous secure air joint without the use of adhesives for pressures up to {3000 Pa} [12"]. Duct shall be factory insulated with fiberglass insulation covered with polyethylene vapour barrier. Duct construction shall be plenum rated.

- 2.1.3.3. Conform to the requirements of NFPA 90 and Underwriters Laboratories classification for round duct to specification UL 181.
- 2.1.3.4. Provide flexible ductwork in minimum lengths of {1500 mm} [5'-0"] and maximum lengths of {3000 mm} [10'-0"] Class 1 pressure systems. For Class 2 and higher pressure systems restrict minimum and maximum lengths to {1200 mm} [4'-0"].
- 2.1.3.5. Provide flexible acoustic ducting where shown. Duct shall be constructed of dead soft, perforated (20-25% open) aluminum tape, spirally wound and mechanically joined. Wrap duct with minimum {25 mm} [1"] fiberglass insulation, and cover with flame retardant non-toxic polyethylene sheet. Meet smoke and flame spread ratings of local building code. Duct shall meet ULC –S110 and U-181, Class 1
- 2.1.4. Provide fume exhaust systems as follows:
- 2.1.4.1. Ductwork shall be constructed from 316L {1.52 mm} [22 gauge] stainless steel.
- 2.1.4.2. Ductwork system shall be fully welded. Flanged connections to air valves are to have gaskets compatible with the fumes conveyor.
- 2.1.4.3. Provide stainless steel access panels as shown on drawings and as required to facilitate suitable inspection and cleaning of duct. Access panels shall be set in frames that do not weaken the ducts into which they are placed.
- 2.1.4.4. Provide access panel assembly complete with neoprene gaskets and quick opening/closing stainless steel latches. Gaskets shall be suitable for the application of the fume hood system they are installed in.
- 2.1.4.5. Minimize horizontal ductwork wherever possible. Where horizontal ductwork is used, slope duct back to fume hood.
- 2.1.4.6. Provide velocity cone and rain guard at the termination of the fume hood exhaust system to ensure 2000 fpm discharge velocity.
- 2.1.4.7. Exhaust is to be terminated 10' above roof unless indicated otherwise on drawings.
- 2.1.5. Provide flat-oval ducts for low pressure classification where shown on Drawings.
- 2.1.5.1. Construct ducts from galvanized steel conforming to ASTM A-527-67. Ducts shall be fabricated as Spiral duct through {500 mm} [20"] minor axis. For ducts with {550 mm} [22"] or larger minor axis provide longitudinal seam construction. Manufacture all fittings with continuous weld.
- 2.1.5.2. Construct ducts as follows:
- 2.1.5.2.1. Spiral Ducts Construction:

MAJOR AXIS	DUCT GAUGE
up to {600 mm} [24"] {675 to 1150 mm} [27" to 46"] {1225 to 1500 mm} [29" to 60"] {1775 mm} and over [71"]	{0.71 mm} [24"] {0.89 mm} [22"] {1.1 mm} [20"] {1.2 mm} [18"]

- 2.1.5.2.2. Longitudinal Seam Construction:

MAJOR AXIS	DUCT GAUGE

up to {900 mm} [36"] {925 mm to 1250 mm} [37" to 50"] {1275 mm} and over [51"]	{1.1 mm} [20"] {1.2 mm} [18"] {1.5 mm} [16]

2.1.5.2.3. Fittings:

MAJOR AXIS	DUCT GAUGE
up to {900 mm} [36"] {925 mm to 1250 mm} [37" to 50"] {1275 mm} and over [51"]	{1.1 mm} [20"] {1.2 mm} [18"] {1.5 mm} [16]

2.1.6. Provide "Vento Tubes" in size and length as shown on the Drawings, with airflow capacity per unit of length indicated on the Drawings.

2.1.6.1. Be responsible for the proper selection of shape, size and location of the orifices, to provide suitable diffusion pattern to suit duct layouts in Drawings.

2.1.6.2. Follow the manufacturer's installation instructions.

2.1.6.3. Construct Vento-Tubes of steel with satin coat finish to the following schedule:

SIZE	GAUGE
{100 mm} [4"]	{0.46 mm} [26]
{150 mm} [6"]	{0.46 mm} [26]
{200 mm} [8"]	{0.46 mm} [26]
{250 mm} [10"]	{0.46 mm} [26]
{300 mm} [12"]	{0.61 mm} [24]
{350 mm} [14"]	{0.61 mm} [24]
{375 mm} [15"]	{0.61 mm} [24]
{450 mm} [18"]	{0.61 mm} [24]
{500 mm} [20"]	{0.61 mm} [24]
{600 mm} [24"]	{0.76 mm} [22]
{650 mm} [26"]	{0.76 mm} [22]
{700 mm} [28"]	{0.76 mm} [22]
{750 mm} [30"]	{0.76 mm} [22]

2.2. ACCESS DOORS

2.2.1. Provide access doors for galvanized ductwork using {0.7 mm} [24 gauge] galvanized material with galvanized mounting frame and {25 mm} [1"] rigid insulation between panels. Provide fastening devices to give tight closure.

- 2.2.2. Provide access doors for stainless steel ductwork using {0.61 mm} [24 gauge] stainless steel with stainless steel mounting frame and {25 mm} [1"] rigid insulation between panels. Provide fastening devices to give tight closure.
- 2.2.3. Provide access doors for aluminum ductwork of {0.61 mm} [24 gauge] aluminum with aluminum mounting frame, and {25 mm} [1"] rigid insulation between panels. Provide fastening devices to give tight closure.
- 2.2.4. Provide access doors and removable panels in plenums and casings of {1.31 mm} [18 gauge] galvanized material with {50 mm} [2"] thickness fiberglass insulation. Equip doors with handles and hinges to open from either side (without risk of injury) as follows:
 - 2.2.4.1. for mandoor doors:
 - 2.2.4.1.1. handles - DuroDyne SP-20
 - 2.2.4.1.2. hinges - DuroDyne HB-3
 - 2.2.4.1.3. gaskets - DuroDyne GN-22
 - 2.2.4.2. for removable panels:
 - 2.2.4.2.1. sash locks - DuroDyne SL-1
 - 2.2.4.2.2. gaskets - DuroDyne GN-22
- 2.2.5. Construct all access doors with double panels.
- 2.2.6. Provide neoprene gaskets securely formed into door frames around the periphery of all duct access doors.
- 2.2.7. Equip door frames for plenums and casings with hollow tubular gaskets. Provide all doors complete with {300 mm x 300 mm} [12" x 12"] viewing ports.
- 2.2.8. Provide access doors at all fire dampers.

2.3. ACOUSTIC DUCT LINING

- 2.3.1. Provide {25 mm} [1"] thick acoustic duct liner where shown on drawings and as follows:
 - 2.3.1.1. Rectangular Duct Liner meeting ASTM C 1071 with air surface coated with acrylic coating treated with EPA registered anti-microbial agent proven to resist microbial growth as determined by ASTM G 21 and G 22.
 - 2.3.1.1.1. Noise Reduction Coefficient: .70 or higher based on "Type A mounting" and tested in accordance to ASTM C 423.
 - 2.3.1.1.2. Adhesive: meeting ASTM C 916.
 - 2.3.1.1.3. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
 - 2.3.2. Round Duct Liner: rigid preformed round liner, or with air surface coated with acrylic coating treated with EPA registered anti-microbial agent proven to resist microbial growth as determined by ASTM G 21 and G 22.
 - 2.3.2.1. Noise Reduction Coefficient of .70 as per ASTM C 423. (Type A mounting)

2.4. FIELD ASSEMBLED PLENUM AND CASING CONSTRUCTION

- 2.4.1. Provide metal partitions, plenums and casings of not less than {1.61 mm} [16 gauge] galvanized sheet metal suitably reinforced with rolled angle sections.
- 2.4.2. Provide metal partitions, plenums and casings with adequate strength for all operating conditions. Fabricate each sheet of material as a panel. Join panels by {40 mm} [1.5"] standing seams on outside of casings and secure with bolts at {300 mm} [12"] centres.
- 2.4.3. Provide closure baffles around banks of coils, filters and other inline components.
- 2.4.4. Provide {25 mm} [1"] minimum size rolled structural steel angles where casing meets floor. Caulk joints to prevent air and water leakage.
- 2.4.5. Flange and bolt casings on {150 mm} [6"] centres to coils, blankoff panels and filler panels.
- 2.4.6. Incorporate adjustable directional flow baffles into mixing plenums, to ensure complete mixing of outdoor and return airstreams with stratification not to exceed { $\pm 2^{\circ}\text{C}$ } [$\pm 4^{\circ}\text{F}$] across the coil face at winter outdoor design temperature.
- 2.4.7. Provide air blender section for air mixing plenums where shown on the drawings and as scheduled. Construct housing and blenders of {1.52 mm} [16 gauge] steel with corrosion resistant paint. Provide blank-off panels as required. Equip air blender with {50 mm} [2 "] flanges and line with {25 mm} [1"] {9 kg} [2 lb.] {1.4 kg} [3 lb.] available density fiberglass liner. Construct mixing section with mixing distances such that the maximum temperature standard deviation thru a plane parallel with blender at the discharge of the mixing section shall be {-14.4 $^{\circ}\text{C}$ } [6 $^{\circ}\text{F}$] when the difference between entering air streams is {33 $^{\circ}\text{C}$ } [60 $^{\circ}\text{F}$]. The variation coefficient governing the profile shall be no greater than 0.3 based on the equation (VARIATION COEFFICIENT = STANDARD DEVIATION/AVERAGE VELOCITY.) Provide full size access doors in each blender. Provide double wall construction.
- 2.4.8. Bottom of plenums shall be sloped towards exterior louvre and be tied into louvre back pan and framing such that any moisture which may accumulate inside the plenum will be drained to the exterior.

2.5. INSULATED PLENUMS AND CASINGS

- 2.5.1. Provide insulated metal sandwich panels for all exterior intake and exhaust air plenums consisting of prefabricated 18 gauge galvanized sheet metal panels and {50 mm} [2"] rigid fiberglass insulation with interlocking joints securely fastened.
- 2.5.2. Provide steel supports, joiner sections, floor channels, opening frames and sealing materials. Provide {1.31 mm} [18 gauge] minimum channel stiffeners at not greater than {800 mm} [32"] centres.
- 2.5.3. Connect corners and butt joints with {1.61 mm} [16 gauge] galvanized sections. Seal all joints with rubber mastic. Use angle joints to attach panel edges to walls.
- 2.5.4. Construct entire plenum to resist deflection and seal sufficiently to avoid air leakage when subjected to a pressure differential between inside and outside of up to {2500 Pa} [10 in. w.g.].
- 2.5.5. Provide access doors suitable for personnel pass through.

2.6. FIRE DAMPERS

- 2.6.1. Provide curtain or multi-blade type dampers to maintain fire rating integrity of membrane being pierced. Minimum rating to be 1-1/2 hours with {100 $^{\circ}\text{C}$ } [212 $^{\circ}\text{F}$] fusible link. Unless otherwise

noted, fire dampers shall be dynamic type. Provide multiple dampers where sizes exceed code limitation.

- 2.6.2. Provide fire dampers equivalent to the following Ruskin models, to suit application:

MODEL NO.	APPLICATION
DIBD2, Style B or C	Duct-mounted in 2-hour rated wall or floor.
DIBD2/OW, Style BC	Duct-mounted outside 2-hour rated wall or floor.
DIBD20G	Duct-mounted behind grille in a 2-hour rated wall.
DIBDT	Mounted in door or thin separation with 2-hour rating.
DIBD23	Duct-mounted in 4-hour rated wall.

- 2.6.3. Select dampers with air flow resistance not exceeding {13 Pa} [0.05 in. w.g.] at design flow rates.

- 2.6.4. For duct penetrations through fire rated ceilings, provide Ruskin CFD series ceiling fire dampers installed behind the ceiling-mounted air terminal.

2.7. COMBINATION FIRE AND SMOKE DAMPERS

- 2.7.1. Provide Class I dampers where indicated on the Drawings to maintain fire rating integrity of membrane being pierced. Minimum fire rating shall be 1-1/2 hours. Damper and actuator have to be supplied as a unit from the factory in order to maintain rating.

- 2.7.2. Provide parallel blade type dampers, suitable for horizontal or vertical mounting. Provide multiple dampers where sizes exceed code limitations.

- 2.7.3. Dampers shall be factory supplied with actuator.

- 2.7.4. Select dampers with air flow resistance not exceeding {13 Pa} [0.05 in. w.g.] at design flow rates.

2.8. SMOKE DAMPERS

- 2.8.1. Provide Class I smoke dampers where indicated on the Drawings.

- 2.8.2. Provide parallel blade type dampers, suitable for horizontal or vertical mounting. Provide multiple dampers where sizes exceed code limitations.

- 2.8.3. Dampers shall be factory supplied with actuator.

- 2.8.4. Select dampers with air flow resistance not exceeding {13 Pa} [0.05 in. w.g.] at design flow rates.

2.9. BACKDRAFT DAMPERS

- 2.9.1. Provide counter-balanced backdraft dampers suitable for use in temperatures from {-40°C to 93°C} [-40°F to 200°F].

- 2.9.2. Frames shall be 6063T5 extruded aluminum {2.3 mm} [.090"] wall thickness. Blades shall be formed aluminum, {.63 mm} [.025"] wall thickness. Bearings shall be molded synthetic and

linkage {12 mm} [1/2"] tie bars. Blade edge seals shall be extruded vinyl. Dampers shall be equipped with adjustable counter-balance weights attached to rear of blades.

2.9.3. Maximum system velocity of {12.5 l/s} [2,500 FPM] and start open pressure of {7.5 Pa} [0.03 in. w.c].

2.9.4. Refer to Drawings for locations, mounting direction and air flow direction.

2.10. FIRE RATED DUCT WRAP

2.10.1. Fire Rated Duct Wrap for Ventilation Ducts

2.10.1.1. Provide a ULC listed, fire-rated duct wrap system on 1 and 2 hour ventilation return, supply and pressurization duct(s), where shown on the drawings.

2.10.1.2. Duct wrap shall consist of one (1) layer of {38 mm} [1-1/2"] thick non- combustible, flexible fireproof blanket, fully encapsulated in a foil scrim and supplied in roll form for 1 and 2 hour ratings. The wrap material shall be applied directly onto the installed ductwork strictly in accordance with the manufacturer's instructions and ULC Listings, Design No. FRD-17 for 4-sided wrap applications, and Design No. FRD-23 for 2- & 3-sided applications, per ULC Guide No. 40 U21, Fire Resistant Ducts, as tested to ISO Standard 6944 for ventilation ducts.

2.10.1.3. All hangers, support rods, concrete anchors and fire stopping of duct penetrations through fire separations shall be in accordance with ULC listing FRD-17 or FRD-23 and the manufacturer's instructions.

2.10.1.4. The maximum duct size shall have a maximum area of {1.32 m²} [2046 in²] and no dimension exceeding {2160 mm} [85"], and shall be installed in accordance with the following:

2.10.1.4.1. Duct

2.10.1.4.1.1. minimum 24 ga. galvanized steel

2.10.1.4.1.2. meets NFPA 90A requirements

2.10.1.4.1.3. maximum {300 Pa} [1.25"] negative pressure

2.10.1.4.2. Insulation

2.10.1.4.2.1. 3M Fire Barrier Duct Wrap 615 {38 mm} [1½"] thick

2.10.1.4.3. Support Rods

2.10.1.4.3.1. threaded steel duct support rods

2.10.1.4.3.2. {13 mm} [½"] dia., non wrapped

2.10.1.4.3.3. Note: for ducts less than (≤) a duct perimeter of 3710 mm (146 in), {10 mm} [3/8"] dia., non-wrapped.

2.10.1.4.3.4. a minimum clearance of {89 mm} [3 1/2"] and a maximum clearance of {127 mm} [5"] is required between the vertical edge of the bare duct and each steel support rod, prior to the application of the wrap.

2.10.1.4.4. Spacing

2.10.1.4.4.1. {1525 mm} [60"] **maximum** O.C.

- 2.10.1.4.5. Cradle
 - 2.10.1.4.5.1. steel angle, {50 mm x 50 mm x 5 mm} [2" x 2" x 3/16" or Unistrut P5500.
 - 2.10.1.4.5.2. Note: for ducts less than ($\leq$) a duct perimeter of 3710 mm (146 in), steel angle, {38 x 38 x 4 mm} [1 ½ x 1 ½ x 3/16"] or Unistrut P2000 channel.
- 2.10.1.4.6. Joints/Seams
 - 2.10.1.4.6.1. all joints to be overlapped a minimum of {75 mm} [3"]
- 2.10.1.4.7. Foil Tape
 - 2.10.1.4.7.1. aluminum foil tape, {76 mm} [3"] wide
 - 2.10.1.4.7.2. cut ends of wrap to be sealed with foil tape prior to installing.
 - 2.10.1.4.7.3. taping of overlapped seams is optional
- 2.10.1.4.8. Insulation Pins
 - 2.10.1.4.8.1. copper coated steel
 - 2.10.1.4.8.2. {3 mm x 102 mm} [1/8" x 4"]
 - 2.10.1.4.8.3. welded to bottom of horizontal ducts greater than {305 mm} [12"] in width and on one of the widest surfaces on vertical runs
 - 2.10.1.4.8.4. spacing lengthwise {260 mm} [10 ½"] O.C. widthwise {300 mm} [12"] O.C.
 - 2.10.1.4.8.5. speed clips, galvanized steel, {63 mm x 63 mm x 0.5 mm} [2 3/8" x 2 3/8" x 1/64"]
 - 2.10.1.4.8.6. cup-head pins permitted
- 2.10.1.4.9. Banding
 - 2.10.1.4.9.1. size {0.4 mm x 13 mm} [0.15" x 1/2"]
 - 2.10.1.4.9.2. stainless steel to meet 2 hour ratings, carbon steel or stainless for $\leq$ 1 hour ratings.
 - 2.10.1.4.9.3. spacing {260 mm} [10 ½"] O.C. and within {38 mm} [1 ½"] of all joints.
- 2.10.1.5. When a duct penetrates a fire rated wall, ceiling or floor, an approved ULC listed firestop assembly shall be provided as per the requirements and using firestop materials stated in the ULC duct listing.
- 2.10.1.6. A representative of the duct wrap manufacture shall review the installation in order to confirm that the installation complies with the correct ULC Listing design and their installation requirements. A single site review may be sufficient for small projects while a large, long-term project may require multiple site reviews.

2.11. FIRE RATED DUCTING AND ENCLOSURES

- 2.11.1. Where indicated on the drawings, provide fire rated non-combustible sheeting consisting of fibre cement composite with mechanically bonded galvanized steel facing sheets. Provide inner liner of galvanized steel. Ensure that the duct construction meets the fire rating requirement.

- 2.11.2. Duct material construction and installation methods shall meet NBCC 2005 3.2.6.2 and 3.2.6.6 and shall be ULC listed and labeled. Fabricate and install the ductwork according to the manufacturers written instructions and in accordance with the UL listing. Use hangers, support rods and firestopping in accordance with the UL listing.
- 2.11.3. Where the required duct size exceeds rated sized, provide special inspection or rating to meet requirements.

PART 3 - EXECUTION

3.1. SHEET METAL INSTALLATION

- 3.1.1. Provide acoustic insulation on supply air ductwork from discharge side of mechanical air terminal control units (including but not limited to VAV boxes and fan powered boxes) and attenuators as follows:
 - 3.1.1.1. {3000 mm} [10 ft.] for straight duct run box or
 - 3.1.1.2. {1500 mm} [5 ft.] downstream of 1st elbow or
 - 3.1.1.3. {1500 mm} [5 ft.] for each branch downstream of 1st tee.
- 3.1.2. Provide final duct connections to all fume hoods and other individual canopies or hoods provided by Division 11 00 00, as designated on the drawings.
- 3.1.3. Frame and install motorized dampers. Unless shown otherwise, attach each motorized damper module to the channel framing.
- 3.1.4. Provide frames in ductwork for airflow stations.
- 3.1.5. Provide test openings in all ducts entering and leaving air handling equipment. Install test openings at {150 mm} [6"] intervals across the long dimension of rectangular ducts, and at 90 degree intervals around circular ducts. In insulated surfaces, provide extension to suit insulation thickness. Provide additional test ports in ductwork where required for air balancing. Submit drawings to indicate proposed locations.
- 3.1.6. Make provisions in ductwork and plenums for installation of duct type smoke detectors and other control devices.
- 3.1.7. Provide a stainless steel skirting around kitchen exhaust ductwork between hood connection and ceiling line where top of hood is below ceiling.
- 3.1.8. Slope ductwork down to exhaust hoods and other equipment connections. Provide drains at low points and pipe to nearest floor or funnel drain.
- 3.1.9. Extend fume hood exhaust ducts a minimum of 10'-0" above the roof which it penetrates and 10'-0" above any adjacent roof/air intake within 30'-0" in plain view of fume hood exhaust.
- 3.1.10. Provide neoprene isolation gaskets and nylon bolts at connections required for dissimilar metals.
- 3.1.11. Seal water tight bottom and sides of intake and exhaust ducts connected to exterior louvers as follows:
 - 3.1.11.1. Intake - from louvre to air handling unit.
 - 3.1.11.2. Exhaust - from louvre to {2 metres} [6'-6"] upstream of louvre.

3.2. ACOUSTIC DUCT LINING INSTALLATION

- 3.2.1. Seal all leading and trailing edges and repair all rips or tears of acoustic duct liner with a suitable sealing compound similar to Johns-Manville Superseal.
- 3.2.2. Provide a tapered sheet metal nose piece to hold the leading edge of acoustic duct liner and direct the air over the edge.

3.3. BURIED DUCTWORK INSTALLATION

- 3.3.1. Install buried ductwork per manufacturer's recommendations.
- 3.3.2. Coordinate installation with other buried services and trades (electrical, plumbing, etc.).
- 3.3.3. Ductwork shall be sloped to low point complete with drains which are indirectly drained to a sump pit or floor drain. Refer to drawings for layout.

3.4. TESTING

- 3.4.1. Pressure test all ductwork in accordance with the outlines and classification described in the SMACNA, HVAC Duct Leakage Test manual.
- 3.4.2. The leakage amount shall not exceed the allotted amount for the pressure class. The test pressures shall be based on the static pressure for each fan.

DUCT CONSTRUCTION CLASS	LEAKAGE CLASS Rectangular	LEAKAGE CLASS Round
{2500 Pa} [10" w.g.]	6	3
{1500 Pa} [6" w.g.]	6	3
{1000 Pa} [4" w.g.]	6	3
{750 Pa} [3" w.g.]	12	6
up to {500 Pa} [2" w.g.]	24	12

- 3.4.3. Repair duct and retest where air leakage exceeds the specified limits.
- 3.4.4. Make good all audible leakage, whether test is within limit specified or not.
- 3.4.5. Provide calibrated tester, connection hoses, temporary plugs, etc., as required.

3.5. INSTALLATION OF FIRE DAMPERS, SMOKE DAMPERS AND COMBINATION FIRE AND SMOKE DAMPERS

- 3.5.1. Coordinate smoke and combination fire damper actuator voltage with Division 26 00 00 prior to offering.
- 3.5.2. Install dampers with fire resistance ratings in accordance with OBC Table 3.18.4 (but no less than 1-1/2 hour rating).
- 3.5.3. Install dampers in approved manner suitably anchored to building structure in locations indicated on the Drawings.

- 3.5.4. Install fire dampers complete with sleeve and full perimeter steel angle on both sides of barrier being pierced. Provide manufacturers recommended minimum clearance between masonry or non-combustible frame and sleeve. Sleeve shall accept actual size of damper with blades pocketed outside of air stream.
- 3.5.5. Divide openings into smaller openings using fire resistant structures where openings to be protected require dampers larger than maximum UL listed sizes.
- 3.5.6. Inspect and test all fire, smoke, and combination fire/smoke dampers in accordance with the requirements of NFPA 80.
- 3.5.7. In addition to where shown on mechanical drawings, contractor shall review architectural rating drawings and provide fire dampers at all rated wall assemblies and through rated floors where ducts are not located in a rated shaft assembly or are otherwise rated (i.e. rated ducts or firewrapped ductwork).

3.6. CLEAN UP

- 3.6.1. Vacuum clean the inside of all air handling systems, including fans, plenums, ducts, coils and terminal units to ensure that they are free from debris and dust.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to clean all existing rigid ductwork.

1.2. REFERENCE DOCUMENTS

- 1.2.1. Obtain and pay for, a complete set of Mechanical Drawings and Specifications.

PART 2 - EXECUTION

2.1. SCOPE OF WORK

- 2.1.1. Scope: This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.
- 2.1.2. The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.

2.2. HVAC SYSTEM INSPECTIONS AND SITE PREPARATIONS

- 2.2.1. HVAC System Evaluation: Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project.
- 2.2.2. Site Evaluation and Preparations: Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the project.

2.3. GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

- 2.3.1. Contaminant: Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the HVAC system during the cleaning process.
- 2.3.2. Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3 micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain Debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.
- 2.3.3. Controlling Odours: All reasonable measures shall be taken to control offensive odours and/or mist vapours during the cleaning process.
- 2.3.4. Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean as defined in applicable standards (see NADCA Standards). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.

- 2.3.5. Air Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.
- 2.3.6. Service Openings: The contractors shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection:
- 2.3.6.1. Contractor shall utilize the existing service openings already installed in the HVAC system where possible.
- 2.3.6.2. Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards.
- 2.3.6.3. Closures must not significantly hinder, restrict, or alter the airflow within the system.
- 2.3.6.4. Openings must not compromise the structural integrity of the system.
- 2.3.6.5. Construction techniques used in the creation of openings should conform to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards.
- 2.3.6.6. Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.
- 2.3.6.7. Rigid fibre glass ductboard duct systems shall be resealed in accordance with NAIMA recommended practices. Only closure techniques which comply with UL Standard 181 and UL Standard 181a are suitable for fibre glass duct system closures.
- 2.3.6.8. All service openings capable of being reopened for future inspection or remediation shall be clearly marked and shall have their location reported to the owner in project report documents.
- 2.3.7. Air distribution devices (registers, grilles & diffusers): The contractor shall clean all air distribution devices.
- 2.3.8. Air handling units, terminal units (VAV, Dual duct boxes, etc.), blowers and exhaust fans: The contractor shall ensure that supply, return and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies. All visible surface contamination deposits shall be removed in accordance with NADCA Standards. Contractor shall:
- 2.3.8.1. Assure that a suitable operative drainage system is in place prior to beginning wash down procedures.
- 2.3.9. Duct Systems: Contractor shall:
- 2.3.9.1. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.
- 2.3.9.2. Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Testings (see NADCA Standards).

2.4. HEALTH AND SAFETY

- 2.4.1. Safety Standards: Cleaning contractors shall comply with all applicable federal, state, and local requirements for protecting the safety of the contractors' employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.

2.4.2. Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.

2.4.3. Disposal of Debris: All debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state and local requirements.

2.5. MECHANICAL CLEANING METHODOLOGY

2.5.1. Source Removal Cleaning Methods: The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the contractor's responsibility to select Source Removal methods which will render the HVAC System Visibly Clean and capable of passing cleaning verification methods (see applicable NADCA Standards) and other specified tests, in accordance with all general requirements. No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC System or negatively alter the integrity of the system:

2.5.1.1. All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment is assured.

2.5.1.2. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet vacuums.

2.5.1.3. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.

2.5.1.4. All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

2.5.2. Methods of Cleaning Fibrous Glass Insulated Components:

2.5.2.1. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.

2.5.2.2. Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).

2.5.3. Damaged Fibrous Glass Materials:

2.5.3.1. If there is any evidence of damage, deterioration, delamination, friable material, mould or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.

2.5.3.2. When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.

- 2.5.4. Cleaning of Coils:
- 2.5.4.1. Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer, or erosion of the coil surface or fins, and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.
- 2.5.5. Biocidal Agents and Coatings:
- 2.5.5.1. Biocidal agents shall only be applied if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing.
- 2.5.5.2. Application of any biocidal agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris.
- 2.5.5.3. Only biocidal agents registered by the US Environmental Protection Agency (EPA) specifically for use within HVAC system shall be used.
- 2.5.5.4. Biocidal agents shall be applied in strict accordance with manufacturer's instructions.
- 2.5.5.5. Biocidal coating products for both porous and non-porous surfaces shall be EPA registered water-soluble solutions with supporting efficacy data and MSDA records.
- 2.5.5.6. Biocidal coatings shall be applied according to manufacturer's instructions. Coatings shall be sprayed directly onto interior ductwork surfaces, rather than "fogged" downstream onto surfaces. A continuous film must be achieved on the surface to be treated by the coating application. Application of any biocidal coating shall be in strict accordance with manufacturer's minimum millage surface application rate standards for effectiveness.

2.6. CLEANLINESS VERIFICATION

- 2.6.1. General: Verification of HVAC system cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- 2.6.2. Visual Inspection: The HVAC system shall be inspected visually to ensure that no visible contaminants are present:
- 2.6.2.1. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the owner reserves the right to further verify system cleanliness through gravimetric or wipe testing analysis testing.
- 2.6.2.2. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subject to reinspection for cleanliness.

2.7. POST-PROJECT REPORT

- 2.7.1. At the conclusion of the project, the Contractor shall provide a report to the owner indicating the following:
- 2.7.1.1. Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.
- 2.7.1.2. Areas of the system found to be damaged and/or in need of repair.

2.8. APPLICABLE STANDARDS AND PUBLICATIONS

- 2.8.1. The following current standards and publications of the issues currently in effect form a part of this specification to the extent indicated by any reference thereto:
- 2.8.1.1. National Air Duct Cleaners Association (NADCA): NADCA 1992-01, "Mechanical Cleaning of Non-Porous Air Conveyance System Components" 1992.
 - 2.8.1.2. National Air Duct Cleaners Association (NADCA): "Understanding Microbial Contamination in HVAC Systems" 1996.
 - 2.8.1.3. National Air Duct Cleaners Association (NADCA): "Introduction to HVAC System Cleaning Services" 1995.
 - 2.8.1.4. National Air Duct Cleaners Association (NADCA): NADCA Standard 05 "Requirements for the Installation of Service Openings in HVAC Systems" 1997.
 - 2.8.1.5. Underwriters Laboratories (UL): UL Standard 181.
 - 2.8.1.6. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE): Standard 62-2010, "Ventilation for Acceptable Indoor Air Quality".
 - 2.8.1.7. Environmental Protection Agency (EPA): "Building Air Quality" December 1991.
 - 2.8.1.8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): "HVAC Duct Construction Standards - Metal and Flexible" 1985.
 - 2.8.1.9. North American Insulation Manufacturers Association (NAIMA): "Cleaning Fibrous Glass Insulated Air Duct Systems" 1993.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install all fans indicated on the Drawings and specified herein.

1.2. REFERENCE STANDARDS

- 1.2.1. Fans to be standard products, selected from published literature of manufacturer.
- 1.2.2. Ratings to AMCA for sound and air delivery performance. Provide AMCA seal on each fan.
- 1.2.3. Fans shall be factory balanced, statically and dynamically to AMCA Standards.

1.3. SUBMITTAL DATA

- 1.3.1. Provide sound and air delivery performance ratings for fans where inlet vanes are provided. Include sound and power data at 100%, 66% and 33% capacity.

1.4. PERFORMANCE REQUIREMENTS

- 1.4.1. Refer to Fan Schedule and Drawings for fan sizes, arrangements and capacities.

1.5. GENERAL REQUIREMENTS

- 1.5.1. Provide V-belt drives, unless noted otherwise, selected for 200% service factor, based on motor nameplate data. Provide variable pitch motor pulley for motors up to {3.7 kW} [5 HP]. For motors larger than {3.7 kW} [5 HP] provide for at least one drive change to adjust fan speed for site conditions.
- 1.5.2. Equip exhaust fans with backdraft dampers unless motorized dampers are provided in Section 25 30 00 or 25 50 00.
- 1.5.3. Scheduled motor horsepower and fan efficiencies are minimum acceptable. Select motors for direct driven fans to ensure non-overloading on any part of the fan curve. Meet Section 20 09 00.

PART 2 - PRODUCTS

2.1. INLINE CENTRIFUGAL BLOWER

- 2.1.1. Provide belt driven airfoil centrifugal inline blowers with aluminum backward inclined blades and open motors. Provide square design housing constructed of heavy gauge steel. Paint all steel components with enamel primer and a final enamel coat.

2.2. EXHAUST FANS

- 2.2.1. Provide exhaust fans as indicated on the Drawings and in accordance with the fan schedule. Fans shall be tested in accordance with AMCA standards. A certified performance curve shall be provided for each fan.
- 2.2.2. Both fan wheel and housing shall be constructed of UV stabilized polypropylene material. The fan wheel shall consist of a totally encapsulated steel hub with backward curved blades having

non-overloading HP characteristics. The blades shall be single thickness airfoil shaped. The fan shall provide constantly rising pressure characteristics.

- 2.2.3. The fans shall be Arrangement 4 direct drive from the motor shaft. Fan speed shall be as outlined in the fan schedule.
- 2.2.4. The fan housing shall have a shape to allow flexibility and rotational freedom. The fan housing shall include a drain opening and be fitted with a specially designed inlet bell to provide for aerodynamic air entry into the fan inlet. The housing internals shall be fitted with a cutoff divider to provide the traditional centrifugal fan shape.
- 2.2.5. The fan housing and motor shall be mounted on a heavy-duty hot dipped galvanized steel base frame.
- 2.2.6. Fans shall be fitted with rubber-in-shear vibration isolation pads along with a flexible connector on the fan inlet for ease of mounting to the ductwork. The fan outlet shall be fitted with a zero-loss stack that extends the fan discharge point at least 7 feet above the base level.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1. Locate units to enable servicing to all sides in compliance with manufacturer's recommendations.
- 3.1.2. Meet OSHA and WHMIS standards for motor drives, bases and belt guards required for each fan.
- 3.1.3. Supply one extra set of matched V-belts for each fan, properly tagged with the equipment designation.

3.2. STARTUP AND TESTING

- 3.2.1. Manufacturer shall inspect installed equipment for proper alignment and lubrication at time of startup and shall verify on startup report if acceptable.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply, install and test the air terminal control units indicated on the Drawings and specified in this Section of the Specification.
- 1.1.3. Provide sizes and capacities shown in the Schedules and on the Drawings.
- 1.1.4. Products provided by Titus will not be allowed.

PART 2 - PRODUCTS

2.1. VARIABLE VOLUME AIR TERMINAL CONTROL UNITS – DIGITAL

- 2.1.1. Ensure that all wiring in the air stream within each VAV terminal and all wiring on the exterior of each VAV terminal is protected so as to meet the flame spread and smoke developed criteria for materials in air streams in compliance with the Building Code and the requirements of the authorities having jurisdiction. Provide plenum-rated cabling and/or enclose the wiring in approved metallic conduit.
- 2.1.2. Provide single duct, pressure independent variable/constant air volume control assemblies, complete with discharge attenuator and factory installed electronic digital controls supplied by the controls equipment manufacturer. Installation costs of these controls will be carried by the terminal control unit manufacturer. Terminal unit sizes are shown on the drawing schedules.
- 2.1.3. Provide transformers, relays, flow sensor, actuator and protective cabinets to house DDC control package. VAV terminal supplier shall coordinate with the controls supplier and install the controls, including actuator, supplied by the controls equipment manufacturer, in accordance with the controls manufacturer's instructions.
- 2.1.4. Construct unit enclosure from {0.89 mm} [22 gauge] hot dipped galvanized steel with heavy zinc coating. Internally line with minimum {20 mm} [3/4"], dual density acoustical thermal insulation conforming to NFPA 90A and UL181.
- 2.1.5. Provide cross flow sensor located at the inlet to the box and with multi pickup points connected to central averaging chamber.
- 2.1.6. Provide integral damper having a peripheral neoprene gasket and capable of shut-off with leakage less than 2% of nominal box rating at {750 Pa} [3 in. w.g.] static pressure. Provide self-lubricating nylon bearings.
- 2.1.7. Specified maximum and minimum air volumes shall be factory pre-set to air quantities shown on Drawings and Schedules and shall be field adjustable without changing components.
- 2.1.8. Air terminal control units shall not exceed maximum discharge sound power levels, in decibels, of 71, 68, 64, 54, 49 and 47 in the octave bands 2 to 7 respectively, at specified air quantities and {370 Pa} [1.50 in. w.g.] entering static pressure with attenuator. Provide discharge attenuator minimum {915 mm} [36"] in length. Provide certified sound test data in accordance with the latest version of AHRI Standard 880.

- 2.1.9. Do not exceed {50 Pa} [0.20 in. w.g.] static pressure drop through the control box and discharge attenuator with inlet velocity of {10 m/s} [2000 fpm] or less. Do not exceed {75 Pa} [0.20 in. w.g.] static pressure drop when reheat coils are used.
- 2.1.10. Where indicated on the Drawings, provide assembly complete with reheat coils to capacities shown in the Schedule.
- 2.1.11. Hot water reheat coils shall be 1, 2, 3 or 4 row {12 mm} [1/2"] copper tube, rippled aluminum fin, with galvanized steel casing. Refer to Schedule for heating capacities.
- 2.1.12. Provide factory installed and wired electric heating coils according to the schedule on the drawings with electrical input power at 208/3/60.
- 2.1.12.1. Construct heating elements of highest grade Type A 80% nickel and 20% chromium wire and held in place with floating seatite ceramic bushings. Type C alloy element wire is not acceptable.
- 2.1.12.2. Stagger heating elements to provide uniform, efficient heat transfer and to eliminate hot spots and temperature stratification.
- 2.1.12.3. Construct frame and NEMA 1 terminal box of heavy gauge corrosion resistant steel with corrosion resistant brackets and supports to assure structural integrity of entire heater.
- 2.1.12.4. Provide thermal safety devices including a disc type automatic reset thermal cut-out for primary overtemperature protection and manual reset, thermal cutouts for secondary thermal protection. All safety devices shall be accessible through the terminal box without removing the heater from the duct.
- 2.1.12.5. Provide the following components factory assembled and wired into a complete heater to accept power connections and control input connection:
- 2.1.12.5.1. Door interlocked disconnect switch
- 2.1.12.5.2. Differential pressure air flow switch
- 2.1.12.5.3. Magnetic (mercury) contactors
- 2.1.12.5.4. Control circuit fuses
- 2.1.12.5.5. Control transformer
- 2.1.12.5.6. Terminal block
- 2.1.12.5.7. Incoming power fuses

2.2. VENTURI AIR VALVE – GENERAL

- 2.2.1. The airflow control device shall be a Phoenix Controls mechanically pressure independent venturi valve.
- 2.2.2. The venturi valve manufacturer's Quality Management System shall be registered to ISO 9001:2015.
- 2.2.3. Venturi valve shall be OSHPD tested and certified per 2013 CBC, 2012, IBC, ASCE 7-10, and ICC-ES-AC-156.

- 2.2.4. Venturi valve shall be HCAI (formerly OSHPD) Certified to Preapproval per 2013 CBC, 2012 IBC, ASCE 7-10, and IEC-ES-AC-156. HCAI Special Certification number OSP-0290.
- 2.2.5. All components of the venturi valves, their controllers, and wiring shall be RoHS compliant.
- 2.2.6. The venturi valve shall be mechanically pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change (within product specifications) or quantity of airflow controllers on a manifolded system.
- 2.2.7. The airflow control device shall maintain accuracy within $\pm 5\%$ of signal to set point over an full airflow range turndown ratio 20:1
- 2.2.8. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.
- 2.2.9. No rotational/axial orientation requirements shall be required to ensure accuracy and/or pressure independence.
- 2.2.10. The venturi valve shall maintain pressure independence regardless of loss of power. "Electronically pressure independent" devices will not be acceptable.
- 2.2.11. Airflow control devices utilizing ASHRAE 130 minimum operating pressure as a rating for minimum design pressure at required flow will not be acceptable on basis on minimum operating pressure alone. Valve manufacturer will provide minimum required differential pressure in writing for each size valve they offer.
- 2.2.12. Airflow control device shall be able to achieve its maximum turndown ratio at its stated minimum operating differential pressure; i.e., if minimum operating pressure is 0.6" wc dp, a 10" air valve must be able to achieve its minimum of 50cfm and its maximum of 1000 cfm at stated 0.6" wc dp. Devices that require duct static pressure to be increased to achieve maximum flow shall not be acceptable.
- 2.2.13. The airflow control device shall be a venturi valve and shall be constructed of one of the following types:
- 2.2.13.1. Class A—The airflow control device for non-corrosive airstreams, such as supply and general exhaust, shall be constructed of 16-gauge aluminum. The device's shaft and internal "S" link shall be made of 316 stainless steel. The shaft support brackets shall be made of galvaneal (non-shutoff valves) or 316 stainless steel (shutoff valves). The pivot arm shall be made of aluminum (for non-shutoff valves) and 303/304 stainless (for shutoff valves). The pressure independent springs shall be a spring-grade stainless steel. All shaft bearing surfaces shall be made of a PP (polypropylene) or PPS (polyphenylene sulfide) composite. 6" valves will have cone made of industrial grade material (PPS) with bearings integrated into cone. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used. 6" valves will have cone made of industrial grade composite material (PPS) with bearings integrated into cone.
- 2.2.13.2. Class B—The airflow control device for corrosive airstreams, such as fume hoods and biosafety cabinets, shall have a baked-on, corrosion-resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal "S" link

shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring-grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of PP (polypropylene) or PPS (polyphenylene sulfide) composite. 6" valves will have cone made of industrial grade composite material (PPS) with bearings integrated into cone.

- 2.2.13.3. Class C—The airflow control device for highly corrosive airstreams shall be constructed as with Class B and shall have in addition no exposed aluminum or stainless steel components. Shaft support brackets, pivot arm, and pressure independent springs shall have a baked-on, corrosion-resistant phenolic coating in addition to the materials defined in Class B valves. The internal "S" link, nuts, bolts, and rivets shall be epoxy phenolic coated stainless steel. Only devices clearly defined as "high corrosion resistant" on project drawings will require this construction. 6" valves will have cone made of industrial grade composite material (PPS) with bearings integrated into cone.
- 2.2.13.4. Class D—The airflow control device for extremely corrosive airstreams, such as acid digestion fume hoods, shall have a PVDF (polyvinylidene fluoride fluoropolymer) coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel with PVDF coating. The pivot arm and internal mounting link shall be made of 316 or 303 stainless steel with PVDF coating. The pressure independent springs shall be a spring-grade stainless steel with Teflon (PTFE) coating. The internal nuts, bolts and rivets shall be stainless steel with PVDF coating. All shaft bearing surfaces shall be made of Teflon or PPS (polyphenylene sulfide) composite. Only devices clearly defined as "extremely corrosion resistant" on project drawings will require this construction.
- 2.2.13.5. Class E—The airflow control device body shall be constructed of 18 gauge stainless steel. Internal cone shall have a baked-on, corrosion-resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal "S" link shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring-grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of PP (polypropylene) or PPS (polyphenylene sulfide) composite. Available in sizes 8", 10", 12", 14" only.
- 2.2.13.6. Class F—The airflow control device body shall be constructed of 18 gauge stainless steel. In addition, these devices shall have no exposed aluminum or stainless steel components. Shaft support brackets, pivot arm, and pressure independent springs shall have a baked-on, corrosion-resistant phenolic coating in addition to the materials defined in Class E valves. The internal "S" link, nuts, bolts, and rivets shall be epoxy phenolic coated stainless steel. Available in sizes 8", 10", 12", 14" only.
- 2.2.14. Constant Volume Airflow Control Device:
- 2.2.14.1. The airflow control device shall maintain a constant airflow setpoint. It shall be factory characterized and set for the desired airflow. It shall also be capable of field adjustment for future changes in desired airflow.
- 2.2.14.2. Constant volume valves must be 100% mechanically pressure independent, and require no actuation to maintain set point.
- 2.2.14.3. Constant volume valves shall have no required electronics to maintain setpoint.
- 2.2.14.4. Airflow Control suppliers not employing constant volume venturi airflow control valves shall provide pneumatic tubing or electrical wiring as required for their devices.

- 2.2.15. The Warranty shall commence upon the date of shipment and extend for a period of 84 months for all venturi valves and 60 months for all other control system components.
- 2.2.16. Certifications:
 - 2.2.16.1. The venturi valve provider shall be an entity that designs, develops, manufactures and sells products and services to control the environment and airflow of critical spaces using a Quality Management System registered to ISO 9001:2015.
 - 2.2.16.2. The venturi valve provider shall be RoHS compliant in all its products
 - 2.2.16.3. The venturi valves shall be calibrated on NVLAP accredited air stations
 - 2.2.16.4. The venturi valves shall be preapproved for HCAI seismic certification

PART 3 - EXECUTION

3.1. COORDINATION

- 3.1.1. Install terminal units clear of light fixtures and ceiling components to enable full maintenance access, removal of light fixtures and supply air troffers.
- 3.1.2. Coordinate the supply of DDC controller package and actuator by controls contractor to the air terminal manufacturer.

3.2. INSTALLATION

- 3.2.1. Provide minimum of four diameters of straight circular duct at inlet of air terminal units for VAV boxes.
- 3.2.2. No straight duct requirement for venturi valves.

3.3. FACTORY TESTS

- 3.3.1. Conduct laboratory tests designed to support performance data in accordance with the latest version of AHRI 880.

3.4. ACOUSTIC LINING

- 3.4.1. Provide acoustic lining for fan powered air terminal unit discharge ductwork as shown on the drawings.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to provide air terminals as indicated on the Drawings and specified in this Section of the Specifications.

1.2. REFERENCE STANDARDS

- 1.2.1. Provide equipment performance rated in accordance with ADC (Air Diffusion Council) Equipment Test Code 1062GRD 84, ISO Standard 5135 and ISO Standard 5219.
- 1.2.2. Meet the noise criteria levels specified in Section 20 05 48.

1.3. SHOP DRAWINGS

- 1.3.1. As part of air terminal shop drawing submittal, submit a light troffer shop drawing showing method of connection and compatibility with the light fixture.

1.4. SAMPLES

- 1.4.1. Submit air terminal samples when requested by Consultant.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- 2.1.1. Unless otherwise specified, provide all grilles, registers and diffusers from one manufacturer. Products manufactured or provided by Titus shall not be allowed.
- 2.1.2. Refer to Specification Section 20 25 00 for instructions for the proposal of alternative manufacturers.

2.2. GRILLES, REGISTERS AND DIFFUSERS

- 2.2.1. Refer to the air terminal device schedules for descriptions of terminal types, sizes, materials of construction and finishes.
- 2.2.2. Equip each supply air terminal with a volume control damper and an equalizing grid.
- 2.2.3. Provide mitred corners and end borders for linear diffusers' terminations, except those that terminate flush with walls and partitions, in which case provide flush-fitting end caps.

2.3. LIGHT TROFFER AIR DIFFUSERS

- 2.3.1. Air troffers connected to light fixtures shall be constructed from galvanized steel, painted matte black. Provide separate adjustable air pattern controllers operable through the diffuser discharge for full 90 degree air pattern selection.
- 2.3.2. Physical height of light troffer shall not exceed that of model number specified.
- 2.3.3. Coordinate and select the physical dimension of the air troffer to suit light and ceiling grid. Coordinate the light troffer dimensions with the light manufacturer.

- 2.3.4. When requested by Consultant, provide mock-up of light troffer and light fixture combination to ensure compatibility before proceeding to order troffer.

2.4. AIR BOOTS

- 2.4.1. Air boots shall be constructed from galvanized steel, painted matte black. Provide separate adjustable air pattern controllers, operable through the diffuser discharge, for full 90 degree air pattern.
- 2.4.2. Coordinate and select physical dimension of air boot to suit installation in accordance with Architect's details.
- 2.4.3. Physical height of air boot shall not exceed that shown on the plans.
- 2.4.4. Obtain sample of proposed light fixture, build air boot to suit and demonstrate acceptable construction to Owner, Architect and Consultant.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1. Provide air terminals in strict accordance with manufacturer's recommendations and final reflected ceiling plans.
- 3.1.2. Suspend air boots independently from structure at 2 points.
- 3.1.3. Provide plaster frames for units installed in plaster finishes. Fit frames tightly to prevent leakage and smudging.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install the direct expansion air conditioners indicated on the drawings and specified herein.

PART 2 - PRODUCTS

2.1. SPLIT HEAT PUMP SYSTEMS – DIRECT EXPANSION, AIR COOLED

- 2.1.1. Provide split air-to-air heat pump system(s), each consisting of indoor fan coil unit and outdoor air cooled heat pump condensing unit piped and wired to form complete heating and cooling system.
- 2.1.2. Provide indoor fan coil unit(s), as scheduled, each consisting of cabinet and frame, supply fan, motor and drive, air filter(s), direct expansion coil and factory installed electronic expansion device. Provide self contained unit completely factory assembled.
 - 2.1.2.1. Provide steel cabinet, phosphate treated, factory painted and insulated with glass fibre material.
 - 2.1.2.2. Provide direct driven supply fan with factory balanced impeller.
 - 2.1.2.3. Provide filter mounting frame and {25 mm} [1"] disposable filters.
 - 2.1.2.4. Construct indoor coil from copper tubing with mechanically bonded aluminum fins.
 - 2.1.2.5. Provide connections for refrigerant piping to a remote outdoor heat pump unit.
 - 2.1.2.6. Factory wire the indoor unit for field connection to single power source and control connection to the outdoor heat pump unit. Provide overload protection for the fan motor. Provide terminal connections for remote controller and outdoor unit.
- 2.1.3. Provide air cooled heat pump unit(s), as scheduled, each consisting of cabinet and frame, compressor(s), condenser coil(s), fan(s), motor(s) and controls.
 - 2.1.3.1. Provide fully weatherproof cabinet for outdoor installation. Provide galvanized steel casing, zinc phosphate coated with an enamel finish.
 - 2.1.3.2. Provide compressor(s) of hermetic design with vibration isolators. Provide unloading capability in response to suction pressure down to 50% capacity for partial load operation.
 - 2.1.3.3. Construct outdoor coil of copper with mechanically bonded aluminum fins. Provide condenser unit with direct driven propeller type fan(s) suitably guarded for safety.
 - 2.1.3.4. Factory wire the air cooled heat pump unit for field connection to a single power source and control connection to the indoor unit. Provide overload protection individually for the compressor motor and condenser fan motor(s). Equip the refrigeration circuit with high and low pressure protection and reset capability.
 - 2.1.3.5. Provide head pressure controls as required by manufacturer to vary condenser fan operation in response to operating conditions.
 - 2.1.3.6. Provide factory installed reversing valve to permit heating and cooling operation.

- 2.1.3.7. Provide factory installed defrost controls to permit automatic defrost operation during heating mode.
- 2.1.3.8. Provide controls to allow low ambient operation down to an outside temperature of {-29°C} [-20°F].
- 2.1.4. Provide indoor unit(s), outdoor air cooled heat pump unit(s), refrigerant piping, refrigerant accessories, controls and all necessary components as recommended by manufacturer to give complete operating heating and cooling system(s). Indoor unit(s) and outdoor heat pump unit(s) shall be supplied by the same manufacturer and matched for integral operation. Controls shall provide for automatic capacity modulation.
- 2.1.5. Provide indoor unit(s) and outdoor unit(s) designed and built for variable capacity operation with automatic compressor capacity control. Provide internal controls for discharge air temperature with adjustable setpoint.
- 2.1.6. Provide manufacturer's standard control system for connection of remote controller. Provide controller(s) with selector switch for Off, Fan, Heating and Cooling modes.
- 2.1.7. Provide short cycle timer circuit to prevent compressor short cycling.
- 2.1.8. Provide winter start package(s) to allow compressor start and operation under low ambient conditions as recommended by manufacturer.
- 2.1.9. Provide equipment as indicated on schedules on Drawings. System performance rated in accordance with manufacturer's published data for both cooling and heating modes.
- 2.1.10. Warranty compressor units for 5 years.
- 2.1.11. Provide units which do not require licensed operators under the Operating Engineers Act.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1. Install indoor and outdoor units where shown on the drawings. Provide refrigerant piping in accordance with Section 23 23 00 and install in accordance with unit manufacturers recommendations.
- 3.1.2. Refer to section 20 09 00 for remote disconnect requirements.
- 3.1.3. Install all accessories specified herein.
- 3.1.4. Provide condensate drain piping from indoor unit to floor drain in accordance with Section 22 11 00.
- 3.1.5. Arrange for manufacturer's authorized representative to provide supervision and startup service. Check alignment of bearings, drives and motors after installation and make any necessary alignment adjustments prior to startup.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to provide radiant ceiling panels, wallfin, radiators, convectors, unit heaters, element and enclosures and forced convector radiation units indicated on drawings and specified in this Section of the Specification.

1.2. DESIGN CRITERIA

- 1.2.1. Select equipment capacities for the average water temperature and entering air temperature specified in the equipment schedule.
- 1.2.2. Refer to Drawings for piping and valve locations.

PART 2 - PRODUCTS

2.1. RADIATORS

- 2.1.1. Provide radiators to the sizes and outputs as indicated in Schedules.
- 2.1.2. Construct radiator component parts of low carbon steel. Provide headers on either end of the flatten tubes with all necessary inlet, outlet, venting and draining connections and internal baffles required to ensure even heating and proper output.
- 2.1.3. Standard working pressure for the units shall be {600 kPa} [85 psi] tested at {770 kPa} [110 psi].
- 2.1.4. Rate and test units in accordance with the International Standards Organization ISO 3147-3150. Capacities have been adjusted for {18°C} [65°F] entering air temperature and 20% heat effect.
- 2.1.5. Provide standard connections for air vents {3 mm} [1/8"] and {12 mm} [½"] NPT tapered threads.
- 2.1.6. Radiator expansion shall not exceed {0.40 mm} [1/64"/foot] at {102°C} [215°F].
- 2.1.7. Clean and etch all units for good paint adhesion. Units shall be primed and baked at {160°F} [320°F] for 20 minutes. Provide baked enamel final coat. Colour shall be selected from Runtal's Standard Colour Chart by Architect.
- 2.1.8. Mounting hardware shall be wall brackets with adjustable hold-off screws.
- 2.1.9. Provide manual air vents with the radiators.
- 2.1.10. Provide continuous mounting strap welded to the back side of the radiator.
- 2.1.11. Provide continuous low surface temperature front panels mounted on exterior surface of radiators. Include brackets for mounting. Panel shall be one tube higher than active panels.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1. Install all hydronic terminal units to allow free air venting.
- 3.1.2. Field measure wall-to-wall wall-fin enclosures.

- 3.1.3. Provide end panels and filler pieces for wall-fin to complete a neat, workmanlike installation.
- 3.1.4. Provide gaskets at the rear of each wall-mounted hydronic terminal unit.
- 3.1.5. Install all enclosures horizontal and level.
- 3.1.6. Support units top and bottom, on wall mounted brackets.
- 3.1.7. Wall-fin cabinets running wall-to-wall or column-to-column shall have each end screwed to a piece of {20 mm} [3/4"] plywood formed to the cabinet cross section and securely fastened to the wall. Provide plywood. Alternatively provide factory-fabricated steel mounting brackets for the same purpose.
- 3.1.8. Select unit heaters for required mounting height.
- 3.1.9. Mount unit heater thermostats {1.5 m} [5 ft.] above floor level.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to supply and install fan coil units as indicated on the Drawings and specified in this Section of the Specification.

1.2. REFERENCE STANDARDS

- 1.2.1. Units shall bear AHRI labels certifying conformance to AHRI-440.
- 1.2.2. NC levels of fan coil units shall not exceed NC40 at high fan speed or NC35 at medium fan speed, assuming a room effect not greater than 8 db.

1.3. PROTECTION

- 1.3.1. Factory equip fan coil units with protective covers which shall remain in place immediately after installation, prior to startup, to protect coils, fans, bearings and motors from damage due to dust infiltration during construction.

PART 2 - PRODUCTS

2.1. DIRECT DRIVE FAN COIL UNITS

- 2.1.1. Provide direct drive, fan coil units fabricated from heavy gauge premium steel. Recessed and semi-recessed unit casings shall be coated with an electrostatically applied baked grey enamel primer. Concealed units shall utilize galvanized steel. Cabinets shall be lined with a {25 mm} [1"] neoprene coated insulation. Provide condensate pans lined with rubber insulation and equipped with a drain connection. Provide auxiliary drain pan extension below valves for chilled water applications.
- 2.1.2. Provide fan coil units in styles and capacities as indicated in the schedules. Cooling and heating capacities shall be based on medium speed fan operation.
- 2.1.3. Equip casing with an integral piping pocket, removable front panel and hinged access door to an electrical junction box.
- 2.1.4. Provide a recessing frame for recessed models.
- 2.1.5. Provide heating and cooling coils consisting of aluminum fins mechanically bonded to {12 mm} [2"] copper tubes. Provide rippled fins with galvanized steel coil casing. Copper sweat coil connections shall be accessible from the piping pockets.
- 2.1.6. Factory test coil, prior to installation in cabinet, at {2100 kPa} [300 psi].
- 2.1.7. Equip units with double width, double inlet, galvanized steel, forward curved centrifugal fans. Fans shall be balanced for quiet vibration free operation.
- 2.1.8. Factory install all internal wiring between fan motor, controls and unit mounted accessible junction box. Provide terminals for single point field connection.
- 2.1.9. Motors shall be direct drive permanently lubricated, electronically commutated variable speed motors (ECM) with variable speed control. Three speed switches or split capacitor type motors will not be accepted.

- 2.1.10. Provide unit mounted heating and cooling thermostat with control transformer. Connect to control valves provided by controls supplier.
- 2.1.11. Factory install disposable filters with each unit. Provide one set of spare media.

2.2. EXISTING FAN COIL UNITS

- 2.2.1. Remove and reinstall existing fan coil units as shown on Drawings. Provide new isolation valves and control valves for relocated units.
- 2.2.2. Lubricate motors for all units within space, including fan coils that remain in existing location. Report any deficiencies.
- 2.2.3. Chemically clean coils in existing fan coil units including units to remain in place.
- 2.2.4. Provide new filters for all units.
- 2.2.5. Provide new remote 3 speed recessed switch with off for each unit.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1. Position units per manufacturer's requirements. Suspend ceiling mounted units from slab above with isolation hangers. Provide flexible duct connections for ducted units.

3.2. EXISTING FAN COIL UNITS

- 3.2.1. Relocate existing fan coil units as shown on the Drawings. Provide new piping and connections to existing mains as shown.

3.3. DRAIN PANS

- 3.3.1. Provide auxiliary insulated drain pans under valving for belt driven fan coil units. Attach pan to side of unit and locate valves over pan. Include a drain connection from pan.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. Provide all labour, materials, products, equipment and services to demonstrate to the Owner and the Consultant that the equipment, networks, installations, programs and services supplied, installed and tested under this Contract meet the requirements of the Contract Documents in all respects.

1.2. SPECIAL TESTING AND USE OF EQUIPMENT PRIOR TO ACCEPTANCE TESTING

- 1.2.1. The Owner/Consultant reserves the right to use any piece of equipment, device or material installed under this Contract for such reasonable lengths of time and at such times as they may be required to make complete and thorough tests of same before undertaking the final acceptance testing. Do not construe such tests as evidence of acceptance of any part of the contract. No claim for damage will be made by the Contractor for any injury or breakage to any parts of the above due to the aforementioned tests where caused by weakness or inaccuracy of the parts or by defective materials or workmanship of any kind whatsoever.
- 1.2.2. Conduct such operation following prior agreement between the Owner/Consultant and the Contractor as to the format and scheduling of the tests.
- 1.2.3. Arrange work to enable the Owner to change over local AHU control systems to the new system for extended operating periods to ensure proper functioning of software and hardware.
- 1.2.4. Do not withhold consent to the execution of such operation when reasonably requested by the Owner/Consultant.
- 1.2.5. Make EMCS available for the use of the Owner once the individual work items are such that they can be used for their intended function(s) as detailed herein.
- 1.2.6. The warranty period shall not commence until the Owner's Certificate of Substantial Completion is issued.
- 1.2.7. The Owner and/or Consultant reserve the right to defer acceptance testing on any item until all work included in this Contract has been completed by the Contractor or can be fully tested.
- 1.2.8. Draft documentation must be provided before acceptance testing will commence.

PART 2 - PRODUCTS

2.1. TEST PROVISIONS

- 2.1.1. Provide all equipment, software, consumable items, personnel and facilities as required to reasonably execute any factory or site acceptance tests, including any signal simulation equipment.

2.2. DOCUMENTATION

- 2.2.1. Submit preliminary as-built drawings and documentation at least 4 weeks prior to the commencement of final acceptance testing. The intent is that this documentation may be used by the Owner and Consultant during the execution of the final acceptance testing.

- 2.2.2. Submit data relevant to point index, functions, limits, sequences, interlocks, software routines and associated parameters and other pertinent information for the operating system and data base.
- 2.2.3. Submit point log sheets to the Consultant at least 4 weeks prior to the test. Submit sample point log sheets for Consultant review prior to completion and final data entry.
- 2.2.4. Submit for acceptance by the Consultant, a total demonstration test plan before commencement of each test/inspection. All hardware and software system components and all other work items shall be fully tested/inspected during the demonstration.

PART 3 - EXECUTION

3.1. SITE ACCEPTANCE TESTING

- 3.1.1. Perform a complete demonstration of the EMCS realtime responsibilities of surveillance and command prior to online operation.
- 3.1.2. Advise the Consultant and Owner, in writing, at least 2 weeks in advance of readiness to perform tests.
- 3.1.3. Note deficiencies and correct before starting and continuing tests. Perform calibration and operational checks prior to the commencement of final acceptance testing for all relevant system parts.
- 3.1.4. Perform final acceptance testing at the following defined levels:
 - 3.1.4.1. per point basis
 - 3.1.4.2. per system basis
 - 3.1.4.3. software functions and packages basis
 - 3.1.4.4. per building basis
 - 3.1.4.5. total EMCS basis
- 3.1.5. Make available on site for the duration of these tests, all installation, engineering, software, system and personnel, required to enable test completion.
- 3.1.6. Demonstrate the specified performance of the EMCS software and hardware, at all levels from individual end devices through to total system operation and the proper operation/undertaking of all other items of work performed under this Contract.
- 3.1.7. Specifically orient acceptance test procedures to demonstrate the satisfactory operation of aspects of the operator interface terminals.
- 3.1.8. Perform a complete and detailed calibration and operational check for each individual EMCS point and control function contained within the supplied system. Check to ensure that all equipment, software, network elements, modules and circuits provided are functioning to meet the Specification and record on log sheets.
- 3.1.9. Repeat acceptance testing until acceptable performance has been established.

3.2. FACTORY TESTING

- 3.2.1. Factory testing of hardware or software shall not replace, in whole or in part, site acceptance testing as detailed in this Section.
- 3.2.2. Provide factory test for thermal storage software. Demonstrate software compliance with Specification prior to site installation.
- 3.2.3. Submit for Consultant review, proposed format of factory tests.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements
- 1.1.2. Provide labour, materials, products, equipment and services to supply, install, wire, calibrate and test the electronic control and monitoring system instrumentation indicated on the Drawings, the Control Drawings, and specified in this Section.
- 1.1.3. Coordinate instrumentation provisions with the EMCS equipment specified in Section 25 50 00. Make compatible without conversion at the DDC System Controller.
- 1.1.4. Provide sensor transmitter output of 4 to 20 mA or 0-10VDC unless otherwise specified.
- 1.1.5. Refer to legend sheet on the control drawings or Part 3 of this Section for sensor codes.
- 1.1.6. All instrumentation provided under this Section of the Specification shall be native BACNet compliant and shall utilize BACNet communications protocol.

1.2. ADDITIONAL INSTRUMENTATION

- .1 Where the application of any software package requires additional instrumentation to meet the requirements specified, provide such instrumentation at no additional cost.

PART 2 - PRODUCTS

2.1. ELECTRONIC TEMPERATURE SENSORS (THERMISTORS)

- 2.1.1. Provide precision thermistors with linear characteristics over the complete sensor range.
- 2.1.2. Provide sensor ranges consistent with the system requirements.
- 2.1.3. Sensor accuracy as determined by BAS reported value shall be $\pm 0.25^{\circ}\text{C}$ to 48°C and $\pm 0.5^{\circ}\text{C}$ above 48°C .
- 2.1.4. Provide general purpose duct mount elements, Instrument Code A1 with the following additional requirements:
 - 2.1.4.1. copper sheathed construction
 - 2.1.4.2. standard conduit box termination, complete with screw terminal connector block
 - 2.1.4.3. length, such that the sensing element is no less than 1/3 of the duct width or diameter from the duct wall
- 2.1.5. Provide spring loaded thermowell mount elements, Instrument Code A2 with the following additional requirements:
 - 2.1.5.1. stainless steel sheath
 - 2.1.5.2. spring loaded construction complete with compression fitting for 20 mm NPT well mounting unless otherwise indicated
 - 2.1.5.3. length suitable for application

- 2.1.5.4. provide stainless steel or chrome plated brass thermowells of size to suit relevant sensor and pipe.
- 2.1.6. Provide averaging element, Instrument Code A3 in mixing plenums and for duct temperatures in ducts over 1500 mm in width with the following additional requirements:
 - 2.1.6.1. copper sheathed construction. Standard conduit box termination complete with screw terminal connector block.
 - 2.1.6.2. minimum immersion length of 4000 mm
 - 2.1.6.3. field formable probe to a minimum radius of {100 mm} [4"] at any point along the probe length, other than within {200} [8"] mm of the connector box, with no degradation to performance
- 2.1.7. Provide multiple sensors where single averaging element is unable to be positioned for complete duct or plenum traverse.
- 2.1.8. Provide shrouded outside air sensing elements, Instrument Code A4 with the following additional requirements:
 - 2.1.8.1. waterproof seal
 - 2.1.8.2. total probe length of {100 mm to 150 mm} [4" to 6"]
 - 2.1.8.3. stainless steel sheath
 - 2.1.8.4. complete with non-corroding outdoor shield designed to minimize solar heating effect on the element
 - 2.1.8.5. Locate outdoor sensors as directed in the field.

2.2. ROOM TEMPERATURE SENSORS

- 2.2.1. Provide wall mounted room temperature sensors, Instrument Code A5, housed in plastic or metal enclosure. There shall be no manufacturer's logo, name or temperature indication on the cover. The sensor casing shall include a plug in connection port (RS 232) suitable for portable operator terminal
- 2.2.2. The temperature sensor shall be a 1000 ohm thermistor type sensor complete with all signal conditioning devices.
- 2.2.3. Mount sensor 1370 mm above finished floor in locations shown on Drawings. Where temperature sensor allows for adjustment of space temperature set point, mount sensor 1200 mm above finished floor.
- 2.2.4. On typical floors and in unfinished retail spaces, connect to 15 m of plenum rated control cable and leave coiled in ceiling space for future mounting by others.

2.3. TEMPERATURE SWITCHES

- 2.3.1. Provide temperature switches Instrument Codes A6 (Low Level) and A7 (High Level) with the following:
 - 2.3.1.1. SPST contacts
 - 2.3.1.2. manual reset
 - 2.3.1.3. repeatability +/- 1% of range

- 2.3.1.4. adjustable differential of at least 0.22°C to 1.7°C.

2.4. ELECTRONIC HUMIDITY SENSORS AND TRANSMITTERS

- 2.4.1. Provide duct mounted electronic humidity transmitters Instrument Code B1 with the following minimum specifications:
- 2.4.1.1. sensing range - 10% to 90% RH
- 2.4.1.2. transmitter output - 0-5 Vdc or 4-20mA
- 2.4.1.3. accuracy - 2% RH from 10 to 90% RH, including non-linearity, hysteresis and repeatability
- 2.4.2. Output signal as suitable for interfacing to the analog to digital converter input of the DDC controller.
- 2.4.3. Dust and moisture proof enclosure.

2.5. COMBINED ELECTRONIC HUMIDITY AND TEMPERATURE SENSORS

- 2.5.1. Where temperature and humidity are indicated to be measured in the same airstream, provide a single measuring unit incorporating capacitive thin film sensor technology for humidity and platinum sensor for temperature. **Instrument Code B2.**

2.6. OUTSIDE AIR DEWPOINT TEMPERATURE SENSOR

- 2.6.1. Dewpoint monitor range of -40°C to +40°C, 5 to 90% RH non-condensing. **Instrument Code B3.**
- 2.6.2. Output signal 4 -20 mA, proportional to dew point temperature.
- 2.6.3. Stainless steel sheath construction, integral adjustment at transducer.
- 2.6.4. Mount sensor within a weatherproof housing, designed to minimize the effects of wind and incident solar radiation.
- 2.6.5. Provide software to calculate outside air relative humidity from dewpoint temperature and dry bulb temperature.

2.7. PRESSURE TO CURRENT TRANSMITTERS

- 2.7.1. Provide pressure to current transmitters **Instrument Code C1** having the following minimum specifications:
- 2.7.1.1. Internal materials of the transducer suitable for continuous contact with industrial standard instrument air.
- 2.7.1.2. Input pressure range as required by application
- 2.7.1.3. Output signal of 4-20 mA proportional to input pressure.
- 2.7.1.4. Output variation of less than 0.2% full scale for supply voltage variations of +/- 10%.
- 2.7.1.5. Combined non-linearity, repeatability and hysteresis effects not to exceed plus/minus 0.5% of full scale output over entire range.
- 2.7.1.6. Integral, accessible zero and span adjustments.

- 2.7.1.7. Operating temperature range of -10°C to 50°C with 5% to 90% RH non-condensing.
- 2.7.1.8. Temperature effect of 1.5% full scale 50°C or less.
- 2.7.1.9. Over pressure input protection to a minimum of twice maximum working input pressure.
- 2.7.1.10. Output short circuit and open circuit protection.
- 2.7.1.11. Dustproof housing.
- 2.7.1.12. Shock and vibration protection.

2.8. ELECTRONIC PNEUMATIC TRANSDUCERS

- 2.8.1. Provide current to pneumatic transducers **Instrument Code C2** with the following minimum specifications:
 - 2.8.1.1. Input range as suitable for interfacing to the digital to analog converter output of the DDC controller.
 - 2.8.1.2. Directly proportioned output range as appropriate for modulation of the controlled device.
 - 2.8.1.3. Output air capacity of 0.27 L/s.
 - 2.8.1.4. Combined non-linearity repeatability and hysteresis effects not to exceed 2% of span.
 - 2.8.1.5. Span adjustment of 14 to 140 kPa.
 - 2.8.1.6. Short circuit protection.
 - 2.8.1.7. Response time 60 seconds for final stability.

2.9. STATIC PRESSURE SENSOR

- 2.9.1. Provide static pressure sensor **Instrument Code C3**. Solid state piece resistive silicon chip featuring low hysteresis, excellent repeatability and long term stability - all 15% full scale. Chip connected to four active element bridge circuit. Signal conditioning and temperature compensation utilizing industrial quality IC. Zero and span trimmers are field adjustable.
 - 2.9.1.1. Pressure range - 0 to 500 Pa
 - 2.9.1.2. Output - 4-20 mA
 - 2.9.1.3. Input - 24V
 - 2.9.1.4. Accuracy - 1% of actual reading
 - .2 Temperature range -5°C to 45°C.

2.10. PRESSURE ELECTRIC SWITCHES

- 2.10.1. Provide CSA approved SPDT snap acting switch **Instrument Code C4** rated for 16 amperes at 120V.
- 2.10.2. The pressure range as required by application.
- 2.10.3. Provide adjustable set point and differential.

2.11. CONTROL RELAYS

- 2.11.1. Provide start/stop control relays **Instrument Code D1** in NEMA 1 housing. All relays shall be UL listed
- 2.11.2. Provide pick up rating and time and hold rating as required for individual applications. Provide field interchangeability to either momentary or maintained latching switch action.
- 2.11.3. Provide plug in relays on a circuit board with field wiring connecting to screw terminals or a mass termination assembly.
- 2.11.4. Provide motor control relays from one manufacturer.
- 2.11.5. Provide input operating voltage to be compatible with the EMCS digital output equipment.
- 2.11.6. Where hand/off/auto switches are provided on the MCC, co-ordinate with the EMCS digital output such that control of the motor is from the EMCS in the auto position.
- 2.11.7. Do not override other interlocks providing safety control, i.e. shutdown on low temperature/high temperature/vibration detection, etc., either with the EMCS control relay or the installation of the control relay.
- 2.11.8. Provide shock and vibration protection.
- 2.11.9. Provide required wiring interconnections between the motor control relays and the motor starters.

2.12. CURRENT TRANSFORMERS AND RELAYS

- 2.12.1. Provide current transformers and relays **Instrument Code D2** to indicate motor status.
- 2.12.2. Provide SPDT output relay suitable for sensing by the EMCS digital input subsystem.
- 2.12.3. Provide output relay with trip adjustment, provided by an accessible field adjustable means, over 0-100% of range. Deadband adjustment shall be to, at maximum, 10% of range.
- 2.12.4. Long term setting drift of current transformer and relay combination not to exceed 5% full range/6 months.
- 2.12.5. Provide current transformer and relay with over current and over voltage protection. Submit for Consultant review.
- 2.12.6. Operating ambient temperature range of -10oC to plus 50oC with 5% to 90% RH non-condensing.

2.13. MOTOR STATUS CONTACTS (CURRENT SENSITIVE)

- 2.13.1. Provide status inputs **Instrument Code D3** for selected motors using auxiliary contacts from motor starters where available or from auxiliary relays wired into the motor starter circuit.
- 2.13.2. Relays shall be current sensitive type, with adjustable trip set point. Set relay trip point at a current 25% higher than unloaded current draw of the motor. Provide proof of operation to BAS via this relay.

2.14. DIFFERENTIAL PRESSURE SWITCHES

- 2.14.1. Provide differential pressure switch for equipment required to signal operating condition to CACF. Select the differential pressure range of the switch to suit the application. **Instrument Code D4.**
- 2.14.2. Provide switch with adjustable set point and differential.
- 2.14.3. Provide switch with SPDT contacts rated at 9 amperes at 120V AC and be CSA approved.
- 2.14.4. Mount the switch with diaphragm in a vertical plane.
- 2.14.5. Indicate waterflow for pumps, where specified by means of a differential pressure switch which opens an electrical contact as differential pressure falls below preadjusted pressure range setting.
- 2.14.6. Provide differential pressure sensing devices for fan status indication as specified.

2.15. AIRFLOW MEASURING DEVICES

- 2.15.1. **Instrument Code K3** - Ebtron (www.ebtron.com) or equivalent, airflow measuring stations shall be provided in VAV system, typical floor fresh air inlet and where shown on the drawings and as specified and shall be sized to suit duct dimensions and air flow. Sensors shall be the thermistor type, relying on thermal effects to sense flow. The sensor shall provide a flow signal as well as a temperature signal.
- 2.15.2. Flow stations shall have linear signals of 4-20ma or 0-5vdc type. Provide output to BAS
- 2.15.3. Performance shall be as follows;
 - 2.15.3.1. Accuracy +/- 2% of reading over entire range.
 - 2.15.3.2. Temperature range -29°C to 127°C
 - 2.15.3.3. Humidity Range - 0 - 99% RH non condensing
 - 2.15.3.4. Velocity Range 0- 25 m/s
 - 2.15.3.5. Power requirement 24 Vac
 - 2.15.3.6. Repeatability +/- 0.2% of scale
- 2.15.4. Calibrate sensor assembly to standards that are traceable to National Institute of Standards and Technology (NIST).
- 2.15.5. Provide the types recommended for the application and install units in strict accordance with manufacturer's recommendations.
- 2.15.6. Specified Product: Ebtron GTA116P

2.16. WATERFLOW MEASURING DEVICES

- 2.16.1. Provide waterflow measuring devices **Instrument Code K1** consisting of an averaging pitot tube flow elements having the following minimum specifications.
- 2.16.2. Select the instrument for the operating flow range, pipe size and fluid temperature.
 - 2.16.2.1. Accuracy - 2%

- 2.16.2.2. Repeatability - 0.2%
- 2.16.2.3. Pressure drop - 1.5 kPa maximum
- 2.16.2.4. Operating temperature rating - 4°C to 95°C
- 2.16.2.5. Operating pressure rating - 1725 kPa
- 2.16.3. Provide weld couplers for installation by the heating contractor.
- 2.16.4. Provide {25 mm} [1"] carbon steel coupling with MPE stainless steel cap for future corrections.
- 2.16.5. Install the flow device in accordance with the manufacturer's recommendations and located with sufficient upstream and downstream straight pipe without obstructions.
- 2.16.6. Provide two portable meter packages, with range to suit project.
- 2.16.7. Turbine type water flow measuring device, **Instrument Code K2** Onicon or equivalent, impedance based sensing device, with single or dual turbines, as required by application.
- 2.16.8. Wetted material electroless nickel plated brass, or 316 stainless steel, as required by application. Pressure rating 2750 kPa, maximum/minimum continuous temperature rating 93.3 C, -10°C.
- 2.16.9. Sensing accuracy +/- 2% of reading with fluid velocity between 0.2 and 6.0 M/s.
- 2.16.10. Pulse 0 -10 VDC or 4-20mA output, proportional to flow, with integral digital totalizer. Supply voltage 24 4 VDC.
- 2.16.11. Insertion type probe, bi-directional, suitable for the system flow, temperature and pressure.
- 2.16.12. Install sensor through a {25 mm} [1"] full port ball valve for easy removal.

2.17. WATER METER

- 2.17.1. Provide Neptune or equal municipal type water meter **Instrument Code K7** of the sizes shown on the drawings and meeting City of Oshawa requirements for accuracy and repeatability
- 2.17.2. Provide dry contact type pulsed output with one pulse every 10 Litres.
- 2.17.3. Water meters shall be Measurement Canada certified

2.18. CARBON DIOXIDE SENSOR

- 2.18.1. Provide Carbon Dioxide sensors as shown on drawings. Sensors shall be manufactured by Optinet as CO₂, particulates, relative humidity and volatile organics. **Instrument Code K6.**
- 2.18.2. Sensors shall be based on a distributed, network, multipoint sensing device. The sensors shall be furnished as a complete, self-contained unit housing all electronics, sensing card, sampling manifolds, flow regulators, pressure regulators, firmware, and software.
- 2.18.3. Sensors shall provide communications between the Router network and the Server over an isolated RS-485 network. Sensors shall support communications with a sub network of Routers and an Information Management Server.
- 2.18.4. As a minimum, the Sensor Suite shall support the following Application Groups.

	Carbon Dioxide (DCV) Control
<u>Sensors</u>	SAG - C2
Particulates	
Element	Laser scatter sensor
Range	PM2.5 - 0.3 - 2.5µm particles
Accuracy	± 0.25% of reading
Resolution	±10% of reading
Response	30 seconds
Carbon Monoxide	
Element	Electrochemical sensor
Range	0-150 PPM
Accuracy	±0.5% of reading
Resolution	1 PPM
Response	60 seconds
Carbon Dioxide	
Element	Dual wavelength, Non-Dispersive Infrared sensor
Range	0 – 3000 PPM
Accuracy	± 2% of reading
Resolution	1 PPM
Response	30 seconds
Dew Point Relative Humidity(RH)	
Element	RH capacitive sensor
Range	10-90% RH
Accuracy	RH @ 65°F, ±0.5%
Resolution	1% RH
Response	30 seconds
Total Volatile Organic Compounds (VO	
Element	Metal Oxide Sensor

Range	0-125+ ppm (as Toluene)
Accuracy	± 25% (as Toluene)
Resolution	1 PPM
Response	30 seconds

2.18.5. Sensor shall operate in an ambient temperature environment of 0°C to +50°C, 10-90% RH.

2.18.6. Sensor shall operate on 24vac power.

2.19. LEAK DETECTOR

2.19.1. Provide Raychem tracetek TT1000 sensing cable to detect the presence of water. **Instrument Code C9.**

2.19.2. Provide type TTC sensing and relay module to monitor leak detection cable. Provide separate contacts for leak detection and cable break.

2.20. POWER METER

2.20.1. Provide digital meters, conforming to ANSI C 12.1 metering accuracy standard. **Instrument Code K10.** Meter and current transformers shall be calibrated together as a system over a temperature range of 0 – 50°C. Internally isolate meter to 2500 VAC.

2.20.2. Meters shall derive their power from the metering connection, separate power supply shall not be required. Meters shall automatically correct for phase reversal.

2.20.3. Provide pulsed output with selectable output rates of 0.10, 0.25, 0.5 or 1.0 kWh /pulse. Provide RS 485 communications with BAS network.

2.20.4. Provide the following information in the form of digital display on the meter as well as at the BAS;

2.20.4.1. Current – per phase and three phase total.

2.20.4.2. Voltage - per phase and three phase total, phase to phase and phase to neutral.

2.20.4.3. Real Power (kW) per phase and three phase total.

2.20.4.4. Reactive Power (kVAR), three phase total.

2.20.4.5. Apparent Power (kVA), three phase total.

2.20.4.6. Power Factor, per phase and three phase total.

2.20.4.7. Real Energy (kWh), three phase total.

2.21. ENERGY METER

2.21.1. Provide energy meters **Instrument Code K5** where specified. Accuracy of overall meter to be ± of actual reading.

2.21.2. Combination of flow and temperature differential, consisting of sensor **A2 and K2**. Temperature and flow sensors to be provided as a complete calibrated package.

- 2.21.3. Provide software to calculate and totalize energy consumption on daily, weekly or monthly basis.
- 2.21.4. Provide both BACNet and pulsed output connections on all energy meters.
- 2.21.5. Provide Measurement Canada certified meters.

2.22. GAS DETECTOR

- 2.22.1. Provide electronic gas sensor suitable for either CO gasses in air. **Instrument Code K6.**
- 2.22.2. Sensor shall produce an out put signal to BAS proportional to concentration of gas sensed. Sensor range shall be at minimum 0.01 ppm to 1000 ppm for CO sensing. Output signal shall be 4-20 mA. Output shall be repeatable to 0.5% of reading.
- 2.22.3. Provide power wiring or control cable in conduit to BAS.
- 2.22.4. Provide calibration gas to enable span check and adjustment. Span and Zero adjustment shall also be provided.
- 2.22.5. Where a number of sensors are connected in parallel to the BAS, provide facility for high/low select or to average any number of sensor readings.

2.23. MOTORIZED DAMPERS

- 2.23.1. Provide control dampers of the type and size shown on drawings. For those dampers not supplied under this section, obtain information required to interface with BAS from the supplier.
- 2.23.2. The normal position of the device (N.O. or N.C.) shall be the failure position which the device goes to if power, control signal or pneumatic signal is lost.
- 2.23.3. Supply opposed blade dampers for two position control and parallel blade dampers for mixing control of outdoor and return air.
- 2.23.4. Provide dampers with air foil blades for all applications involving comfort air handling. Damper blades shall not be less than 16 gauge galvanized steel or extruded aluminum.
- 2.23.5. Damper frames shall be formed channels of not less than 13 gauge galvanized steel or extruded aluminum, with mounting holes for enclosed duct mounting.
- 2.23.6. Ensure tight seal when dampers are closed. Provide fire resistant synthetic seals on damper blade edges and on top and bottom. Provide stainless steel jamb seals. Leakage shall not be more than 1/2% of the maximum airflow rate specified for the application when subjected to 1000 Pa differential pressure. Pressure drop shall not exceed 13 Pa at 5m/s face velocity for a 600 mm x 600 mm unit.
- 2.23.7. Provide insulated dampers where exposed to outdoor conditions, complete with thermally broken frame.
- 2.23.8. Provide dampers suitable for operation within the temperature range of 0°C to 93.3°C.
- 2.23.9. Provide corrosion resistant zinc plated steel and brass linkage hardware. Secure blades to zinc plated shafts with stainless steel nuts and bolts.
- 2.23.10. Dampers for relief, intake and smoke exhaust shall be ultra low leakage, extruded aluminum. Leakage shall not exceed 0.07% of maximum flow. Damper shall bear AMCA Air Leakage Seal. SPECIFIED PRODUCT: Ruskin CD50, Tamco 1000 or AMI ACD 300.

- 2.23.11. Where combination control and fire dampers are required, provide factory mounted actuator, linkage and fusible link as a listed unit. Fusible link may be EFL type and shall be re-openable as required by the sequence or dynamic smoke management systems. Meet NFPA 90A. Leakage shall not exceed ULC 555S, Class 1. SPECIFIED PRODUCT: Ruskin FSD37 or AMI FSD-111

2.24. DAMPER ACTUATORS - ELECTRIC

- 2.24.1. Provide damper actuators manufactured by Belimo, for all motorized dampers, including those supplied under other sections of this specification, including smoke, factory fabricated air handling units, exhaust fans and terminal control units. Combination fire and control dampers may have actuators other than Belimo.
- 2.24.2. All actuators shall operate on 0-10 VDC, 4-20 mA DC, 120 volt or an increase/decrease signal. Provide power to actuators from the nearest source of emergency power. All actuators shall be gear type mechanism with rotary spring return, either clockwise or counter clockwise operation. Linear actuators shall be spring return to retracted position. Provide proportional control for all applications, with position feedback on all modulating dampers to indicate damper % open to the BAS
- 2.24.3. Where required for interfacing with the CACF, provide damper operators which will accept contact closure of an external relay to drive the operator fully open or closed.
- 2.24.4. Securely mount each damper actuator on a rigid bracket. Mount each damper actuator outside of the airstream in a readily accessible location. Provide direct coupled actuators, clamped to damper shaft. Crank arms or linkages are not acceptable.

2.25. DAMPER STATUS SWITCH

- 2.25.1. Provide magnetic reed switch, damper status switches activated by the damper blade. Mount securely on frames, Instrument Code C6. Provide SPDT switches with contact rating of not less than 6 amperes at 120 V AC. Provide separate switches for open and for closed position as required by the sequence.

2.26. CONTROL VALVES

- 2.26.1. The normal position of the device (N.O. or N.C.) shall be the failure position which the device goes to if power, control signal or pneumatic signal is lost.
- 2.26.2. Provide control valves suitable for the operating pressures and temperatures of the systems. Ensure tight shut off against system operating differential pressures.
- 2.26.3. Select valves with characteristics to suit the application.
- 2.26.4. Straight through two way valves shall have equal percentage flow characteristics.
- 2.26.5. Three way valves shall have linear flow characteristics, to give constant total flow.
- 2.26.6. All valves shall have stainless steel stem and packing to suit application.
- 2.26.7. Refer to Control Diagrams for location of normally open/closed and common ports. Where normally open or closed ports are defined, provide a valve which will fail to that position if control signal, power or pneumatic pressure is lost.
- 2.26.8. Sizing Criteria
- 2.26.8.1. Water Valves:

- 2.26.8.1.1. Two Position – Line size unless shown otherwise.
- 2.26.8.1.2. Two-way Modulating – Pressure drop equal to twice the pressure drop through the load, 50% of the pressure difference between supply and return mains, or 35kPa, whichever is greater.
- 2.26.8.1.3. Three Way Modulating – Pressure drop equal to twice the pressure drop through the load (coil or heat exchanger) or 35kPa, maximum.
- 2.26.8.2. Steam Valves:
 - 2.26.8.2.1. Two Position Service – 10% of inlet steam pressure
 - 2.26.8.2.2. Modulating service, up to 100 kPa inlet pressure – 80% of inlet pressure
 - 2.26.8.2.3. Modulating service, up to 101-350 kPa inlet pressure – 50% of inlet pressure
 - 2.26.8.2.4. Modulating service over 350 kPa inlet pressure – 25% of inlet pressure or as shown on plans.
- 2.26.9. For FCU, radiation and Fan powered VAV terminals, control valves 50 mm or less shall be Delta or Belimo quarter turn ball valve, nickel plated bronze body, stainless steel ball and stem with glass filled teflon seals and Viton 'O' rings. Valves shall be rated ANSI class 600 with operating temperature to 120°C. Provide thermal isolator between valve body and actuator. Actuator shall be direct coupled to valve. Valve shall have true equal percentage flow characterized by means of a characterized teflon disc, mounted on the upstream side of the ball.
- 2.26.10. Control valves over {50 mm} [2"] diameter, 2 or 3 way, mixing or diverting. Provide Delta ball valve with stainless steel body and ball. Reinforced teflon seal and minimum rating in water of 2750 kPa or 1034 kPa steam. Above {65 mm} [2-1/2"] provide flanged ends.
- 2.26.11. For butterfly and plug valves refer to Section 23 21 13.

2.27. VALVE ACTUATORS - ELECTRIC

- 2.27.1. Provide actuators for all motorized valves, coordinated with the valve body and intended service. Coordinate supply with the Mechanical Contractor.
- 2.27.2. Control valve actuators shall be Belimo, ensure that valve actuators are of the correct size and capacity required to ensure tight shut off of the valve under all operating and static differential pressure conditions. All actuators shall be gear type mechanism with rotary spring return, either clockwise or counterclockwise operation. Linear actuators shall be spring return to retracted position. Provide position feedback on all modulating valves to indicate percentage open to the BAS. Valve actuators for FCU, radiation, etc., less than 50 mm diameter may be non-spring return.
- 2.27.3. Select actuators for ease of field replacement and for rotation through 360 degrees for wiring alignment.
- 2.27.4. Select actuators to operate on 0-10 VDC, 4-20 mADC, or an increase/decrease signal. Provide emergency power to each actuator. Where normally open or normally closed valves are specified, ensure the valve fails to that position when power, control signal or pneumatic signal is lost.

2.28. MOTOR STARTER TERMINAL STRIP

- 2.28.1. Provide a terminal strip within the starter enclosure or within a separate enclosure, mounted alongside the starter, to facilitate monitoring and control of the motor by the BAS, and to facilitate overriding control by the Fire Alarm System.
- 2.28.2. This Contractor shall wire the motor starter to the terminal strip to enable the BAS to perform the required control and monitoring functions:
 - 2.28.2.1. ON/OFF control and status
 - 2.28.2.2. Speed Control
 - 2.28.2.3. High/Low Speed, plus status
 - 2.28.2.4. Damper Interlock
 - 2.28.2.5. Damper Control
- 2.28.3. The motor side load shall not exceed 10 amps at 120 volts for any signal to the BAS.

PART 3 - EXECUTION

3.1. INSTALLATION OF INSTRUMENTATION

- 3.1.1. Meet applicable codes, each manufacturer's recommended installation procedures and Division 26 00 00 requirements.
- 3.1.2. All installations to be performed by skilled and certified technicians.
- 3.1.3. Install instrumentation to be mechanically stable. Fix as necessary to wall or floor. Provide anti-vibration mounted where required to properly isolate the equipment.
- 3.1.4. Install instrumentation for easy maintenance access and to not interfere with access to adjacent equipment and personnel in the surrounding space.
- 3.1.5. Install instrumentation in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation, without condensate traps.
- 3.1.6. Permanently identify each wire, cable, conduit and tube at each point of connection.
- 3.1.7. Protect all components placed in areas of high humidity or potentially high humidity.
- 3.1.8. Provide complete drawings for Consultant review before any field installation is started giving complete description of all control elements and showing complete schematic piping and wiring diagrams, including functional description.
- 3.1.9. Review proposed location of any instrumentation with Consultant prior to its installation.
- 3.1.10. Install averaging type RTD's in serpentine configuration with adequate provision for the mechanical protection of the sensor. Support along its entire length.
- 3.1.11. Modifications to existing plenum and ductwork to achieve the intent of the Contract Documents shall adhere to the following:
 - 3.1.11.1. Mount sensors with extension necks such that access to sensors is not restricted by insulation.
 - 3.1.11.2. Keep cutting to a minimum and perform in a neat and workmanlike manner.

- 3.1.11.3. Provide patches and access covers of the same material and thickness as adjoining ductwork. Provide necessary reinforcing and fastening materials.
- 3.1.11.4. Provide gaskets, seals and insulation to restore to, or exceed as found conditions in areas where this Contractor has made modifications.
- 3.1.12. Wire instrumentation which is part of the same control loop to the same field panel.

3.2. EXISTING INSTRUMENTATION

- 3.2.1. Remove and dispose of existing instrumentation which becomes redundant in accordance with the Owner's direction.
- 3.2.2. Reuse existing thermowells where possible.

3.3. NAMEPLATES

- 3.3.1. Provide for each piece of instrumentation and end device, a 50 mm x 75 mm plastic nameplate embossed to indicate the following:
 - 3.3.1.1. mnemonic for point
 - 3.3.1.2. remote field panel and PIU termination
 - 3.3.1.3. English language description
 - 3.3.1.4. field panel
- 3.3.2. Affix the nameplate to the instrumentation, valve, etc., via a plastic cable tie or other similar device.
- 3.3.3. Submit specimen nameplate and cable tie to Owner for approval prior to installation.

3.4. WARNING NOTICES

- 3.4.1. Place warning notices at the MCC Panel, local starter and on or close to all motors under BMS control.

3.5. EMCS INSTRUMENTATION LEGEND

- 3.5.1. The following codes are referenced in this specification and are repeated on the Control Diagrams included with the Drawings.

CODE	DESCRIPTION
A1	Temperature Sensor Duct Mounted
A2	Temperature Sensor Pipe Mounted
A3	Temperature Sensor Averaging Type
A4	Temperature Sensor Outside Shielded
A5	Temperature Sensor Room Type
A6	Temperature Switch Low Limit
A7	Temperature Switch High Limit
B1	Humidity Transmitter Duct Mounted
B2	Combined Humidity/Temperature Sensor
B3	Outdoor Dewpoint Sensor
C1	Pressure/Current Transmitter
C2	Pneumatic/Current Transducer

C3	Static Pressure Sensor	
C4	Pressure/Electric switch	
C5	Waterflow Switch	
C6	Damper Status Switch	
C7	Output to Variable Speed Drive	
C8	Pulsed Output	
C9	Leak/Moisture Detector	
C10	Output to VIV	
D1	Motor Control Relay	
D2	Current Transformer and Relay	
D3	Motor Status Contacts (Current Sensitive)	
D4	Differential Pressure Switch	
D5	Float Switch	Tank Mounted
D6	Float Switch	Pit Mounted
D7	Differential Pressure Transmitter	
D8	Current Sensitive Relay	
D9	Continuous Level Sensor (Ultrasonic)	
D10	Conductivity Controller	
F1	Interface Contact to CACF	
F2	Vibration Detector	
F3	not used	
F4	Lighting Control Contact	
F5	Occupancy Sensor (Motion)	
K1	Waterflow Measuring Device	Pitot Tube Type
K2	Waterflow Measuring Device	Turbine Type
K3	Airflow Measuring Device	Heated Thermistor Type
K4	Energy Meter, Flow and Temp. Diff	Air Type
K5	Energy Meter, Flow and Temp. Diff	Water Type
K6 & K9	Gas Detector (CO or CO ₂)	
K7	Pulsed Output Water Meter	
K10	Power Meter	

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements.
- 1.1.2. Provide Electric/Electronic Control and Monitoring system (EMCS) to serve the building systems. EMCS may also be referenced in the specifications or on the drawings as the Building Management System (BMS) or the Building Automation System (BAS).
- 1.1.3. Provide labour, materials, tools, incidentals, equipment and services to supply, install, and commission a complete electronic control and monitoring system.

1.2. GENERAL SYSTEM ARCHITECTURE

- 1.2.1. Provide an Electronic Control and Monitoring System (EMCS) which uses a communication architecture consisting of at least two tiers. Each tier will utilize local area networks with totally open protocols based on industry leading standards. All controllers at every level must use BACnet communications protocol. Every controller must be certified by BTL. No proprietary communications protocol will be acceptable at any level of the network architecture.
- 1.2.2. The first tier of the EMCS network (level 1) will be based on BACnet I/P communications, providing a high speed local area network for reliable peer-to-peer communications. It is intended that the level 1 network provide the backbone for future implementation of BACnet I/P (ANSI/ASHRAE BACnet Standard 135-1995) and which will support future connection of BACnet gateways or routers for other independent digital control systems. Future connected systems will have compatibility specifications to provide communication with the first tier LAN. The operator workstations will also be supported on the high speed LAN level 1.
- 1.2.3. The level 1 network shall provide communication to other third party control systems via the ANSI/ASHRAE BACnet standard 135-1995 or via a web browser. BACnet devices on this network shall be Conformance Class 3, support the BACnet functional groups for change-of-value, event initiation and response, support the BACnet standard application services of Read Property, Write Property and support the standard BACnet object types of Analog Input, Analog Value, Binary Input, Binary Output and Binary Value at a minimum. The described functionality shall provide reading and writing of all analog or digital inputs and outputs between BACnet devices on the network and provide for change-of-value initiation and reporting.
- 1.2.4. The lower tiers of the EMCS network will be based on using open control networks which provide the interconnection of BACnet Building Controller B-BC and the BACnet Advanced Application Controllers (B-AAC) on a peer-to-peer open, ring bus, or star topology. Peer-to-peer means the units exist and speak equally on the same bus. Controllers can utilize each others data without assistance from the workstation. Plugging a portable terminal into any B-AAC allows access to any other B-AAC on the EMCS. Each B-AAC shall utilize direct digital control (DDC) and the control module network must operate at a minimum speed of 156 kbps. DDC is defined to be where the B-AAC contains its own microprocessor and control algorithms to control the points without the need for communication with other panels.
- 1.2.5. The intent of this specification is to provide a complete distributed direct digital control (DDC) system. The network controllers and individual local controllers shall be selected so that each mechanical system operation is completely standalone. Each system operation, such as central chillers, air handling units, packaged cooling units or terminal devices such as VAV boxes and fan coil units, will be controlled by a single standalone DDC controller.
- 1.2.6. The EMCS shall consist of modular microcomputer controllers providing distributed processing capability and allowing future expansion of both input/output points and processing control

functions. The system shall have capabilities to expand and control a 25% increase in points without any degrading of system performance.

- 1.2.7. In no circumstance shall multiple application controllers be employed to control a single piece of equipment.
- 1.2.8. Provide network interface modules or connections to third party controllers which are supplied with ANSI/ASHRAE BACnet standard 135-1995 interoperability as part of their equipment (e.g. chillers) to achieve the level of interface specified in the control diagrams on the drawings. Provide interface software, coordinated with the third party protocols, to achieve the specified interface communication across the full EMCS. Input and output with third party controllers shall have real time interoperability with EMCS software features such as control software, energy management, alarm management, historical data and trend analysis, totalization and LAN communications.
- 1.2.9. Fixed operator workstations are specified herein to provide the interface to the EMCS and these are located in the Central Control Centre.
- 1.2.10. It is intended that the Central Control Centre have access to all systems and information in the entire complex through the System Access Control (see Article 2.3) or through web browsers.
- 1.2.11. The EMCS shall effectively manage the facility and its activities to optimize the operation of HVAC systems to minimize energy consumption and extend equipment life during variations in occupancy, loads, schedules and weather conditions.
- 1.2.12. The EMCS shall operate on a management by exception concept, enabling automatic operation and requiring minimal manual intervention and supervision.
- 1.2.13. The modular design of the system software and hardware shall ensure easy maintenance and repairability. Self diagnostic programs shall report errors without the need for operator interrogation. Maintenance on one module shall not affect the operation of other system components.
- 1.2.14. Backup and fail safe criteria shall be inherent. Any failure shall not place the system in a hazardous condition.
- 1.2.15. Output current and historical data on energy, building loads, equipment operation and control status.
- 1.2.16. Provide efficient interfaces (Workstations) between the Operator and EMCS. The interface shall be user friendly, so as to promote the training and turnover of the EMCS to the building owner and operators. It shall be possible to add three more workstations to the system if the owner so requires, without degrading the systems specified performance.
- 1.2.17. Provide an operator interface based on Microsoft Windows Vista, XP or NT, Linux or Solaris. The system shall be capable of multitasking to provide normal system monitoring while running simultaneously with other programs such as Microsoft Word or Microsoft Excel.
- 1.2.18. Provide communications software and hardware to allow offsite monitoring and control of the system via the web. The offsite terminal shall appear to be locally connected and the modem shall appear transparent. With the correct password all system functions shall be available to the offsite operator.
- 1.2.19. Provide English language operator interface using readily understood English language abbreviations and mnemonics.
- 1.2.20. Provide a Windows based Graphic User Interface to manage all operator interfaces with the EMCS.

1.3. QUALITY ASSURANCE

- 1.3.1. EMCS work shall be performed by one firm specializing in the manufacture and installation of control systems for building environmental control.
- 1.3.2. Products referenced under this Section establish the minimum acceptable standards of product quality, features and performance.
- 1.3.3. The equipment and software provided by the supplier shall be the latest version currently in manufacture. No custom products shall be allowed. All products shall be supported for a minimum of 5 years, including spare parts, board repairs and software revisions.

1.4. RELATED WORK

- 1.4.1. Provide all control devices and instrumentation, specified in Section 25 30 00, to meet the points and sequences shown on the drawings.
- 1.4.2. Provide all damper operators, damper end switches, relays, etc. for interface with the Central Alarm and Control Facility (CACF). Wiring of these devices will be by Division 26 00 00.
- 1.4.3. Provide wells for immersion temperature sensors. Provide half couplings for installation of flow sensors.
- 1.4.4. Coordinate the work of this Section with that of other Sections and Divisions. Avoid interference of this work with other work.
- 1.4.5. Meet the requirements of Section 25 08 00, EMCS Inspection and Acceptance Testing.

1.5. SHOP DRAWINGS

- 1.5.1. Meet Section 20 04 00 requirements.
- 1.5.2. Submit all shop drawings for review before proceeding with procurement or site specific software development and according to a schedule to be established with the consultant.
- 1.5.3. Submit Shop Drawings for all equipment to be provided, including but not limited to:
 - 1.5.3.1. Software packages.
 - 1.5.3.2. Workstation central equipment.
 - 1.5.3.3. Specification data sheets of each hardware component or software module.
 - 1.5.3.4. Schematic diagrams showing system configuration and interconnection of workstations and all field panels in accordance with the specified level 1 and level 2 networks.
 - 1.5.3.5. Schematic diagrams for all building systems showing control devices, instrumentation, product interconnection, panel wiring, interlocking and component tag identification as well as written sequence of operation. Show panel spare capacity.
 - 1.5.3.6. Descriptive data of all operating, user and application software including complete operator's manuals, programmer's manuals, and alphanumeric mnemonic point name convention sheet.
 - 1.5.3.7. Other drawings as appropriate. General advertising type literature is only acceptable as additional support information.

- 1.5.4. Submit 6 sets of final as-built documentation including the above items and complete with troubleshooting procedures.
- 1.5.5. Provide final documentation to serve the diverse needs of personnel concerned with instruction, operation, procurement, installation and maintenance.
- 1.5.6. Shop drawings and final documentation will be reviewed to ensure that such documents are in keeping with the intent of this specification and fully meet the requirements in terms of content and format. Make all required changes to this documentation at no additional cost.
- 1.5.7. Delivery of the final approved documentation, in hardcover 3-ring binders with index page and index tabs, is required before the Certificate of Substantial Completion will be issued.
- 1.5.8. Maintain a complete and current copy of all reviewed Shop Drawings at the job site.

1.6. TECHNICAL PROPOSAL

- 1.6.1. With the tender, submit a detailed technical proposal in compliance with the format and requirements hereafter. Submission of vendor standard literature to satisfy this article is not acceptable.
- 1.6.2. Provide a description of the proposed system, along with a block diagram, to describe the system architecture, workstation computers and all peripheral equipment, communication interfaces, LANs, LAN cards, all active hubs and repeaters, network layout, all bus layouts, panels and controllers. The intention is to provide a written system description along with architecture diagram to show the vendors proposal to meet this specification without necessarily showing each and every control panel and local controller required for the entire project.
- 1.6.3. Provide a compliance checklist which shows, paragraph by paragraph, the level of compliance with the exact paragraph wording. Provide the checklist in the following format and show explanations for conditional or non-compliance.

Paragraph	Comply	Conditionally Comply	Non Comply	Explanation
e.g. 1.2.1	X	--	--	--
	X	--	--	--

- 1.6.4. Provide a description, with illustration, of the interactive operator interfaces, graphical and text based including the dynamic system graphics.
- 1.6.5. Provide a description and examples of the various reports specified.
- 1.6.6. Provide a technical description of all hardware components.
- 1.6.7. Provide a description of the vendor/contractor showing organization and location of staff, recent related experience with references, local facility description and address, local servicing capability and hardware parts availability, training staff.
- 1.6.8. Provide vendors standard specification literature for hardware included.

1.7. REFERENCE STANDARDS

- 1.7.1. Meet Division 26 00 00 electrical requirements.

- 1.7.2. Provide electrical material and installation in accordance with the appropriate requirements, and in accordance with applicable sections of the current edition of the applicable local codes for electrical work and signalling systems. Install wiring in conduit or approved totally enclosed raceways. Do not use cable raceways or troughs. Approved ceiling plenum cable is acceptable where permitted by the local Authorities.
- 1.7.3. Provide electrical and electronic equipment which is CSA and ULC or UL approved.
- 1.7.4. Provide (ASCII) American Standard for Communication and Information Interchange coded input/output devices with standard (EIA) Electronic Industry Association interface.
- 1.7.5. Provide an EMCS system which will support the ANSI/ASHRAE BACnet Standard 135-1995 to the extent detailed in Article 1.2.
- 1.7.6. Provide field processing units having the capability for accommodating inputs and outputs meeting ISA Instrument Society of American standards.
- 1.7.7. Modem interfacing provisions shall meet EIA RS232C. Modems shall comply with the local required communication protocol with minimum transmission rate of 1 Mb and be FCC approved.
- 1.7.8. All equipment and systems installed under this Contract shall meet all required performance specifications when subjected to VHF, UHF, FM, AM or background RFI as generated by commercial or private, portable or fixed transmitters that meet regulatory codes.
- 1.7.9. Meet FCC Rules and Regulations, Part 15, Subpart J for Class A computing devices.
- 1.7.10. Components installed within motor control devices shall be designed to operate within transient electrical fields within these devices.
- 1.7.11. Provide equipment which functions and meets all detailed performance criteria when operating in the following minimum ambient condition ranges:
 - 1.7.11.1. Temperature {- 0°C to 32.2°C} [32°F to 90°]
 - 1.7.11.2. Relative Humidity 10% to 90% non-condensing
 - 1.7.11.3. Electrical power service of single phase, 125V AC +/- 10%, 60 Hz nominal
 - 1.7.11.4. The limits above are minimums and shall not take precedence over ranges detailed in this or the manufacturer's specification.

1.8. CAN/ULC-S1001 INTEGRATED LIFE SAFETY SYSTEMS TESTING

- 1.8.1. Participate in Integrated Life Safety Systems Testing per CAN/ULC-S1001 requirements and as directed by the associated commissioning agent. Refer to the PART 3 – EXECUTION section for further requirements.

PART 2 - PRODUCTS

2.1. OPERATING SYSTEM

- 2.1.1. Provide an operator interface operating system based on the latest edition of Microsoft Windows with multi-tasking, multi-user capability and full compatibility with all other software, generally comprised of:
 - 2.1.1.1. Remote communications software
 - 2.1.1.2. Graphical and other operator interface software
 - 2.1.1.3. Commercial software packages as specified below
 - 2.1.1.4. Plant specific software
- 2.1.2. A proprietary operating system will not be acceptable.
- 2.1.3. All third party software, such as operating systems, and commercial packages, shall be supplied together with its original documentation and original diskettes or CD ROM.
- 2.1.4. All Workstations shall be connected to the Level 1 high speed communication LAN and at minimum, meet the requirements for Conformance Class 3 of the BACnet standard. They shall communicate with each other using either the Ethernet or Arcnet topology as previously specified.
- 2.1.5. The operator shall be able to perform all normal operating functions through a web browser on any PC.
- 2.1.6. Future independent digital control systems will be connected to the Level 1 LAN directly or using routers or gateways as appropriate. The operating system must have the capability to accept future software to communicate with these systems on a BACnet complaint basis.
- 2.1.7. It shall be possible to run commercially available software such as Microsoft Word or Microsoft Excel concurrent with the EMCS application program without affecting its ability to monitor the system and advise that an alarm has occurred.

2.2. WORKSTATIONS

- 2.2.1. Provide two workstations as desktop units to the following specifications. Locate these workstations where shown on the drawings.
 - 2.2.1.1. Intel Core i5 760, (2.8 GHz/ 8MB Cache)
 - 2.2.1.2. 4GB DDR3 SDRAM at 1333 MHz
 - 2.2.1.3. 500 GB SATA hard drive at 7200 rpm
 - 2.2.1.4. ATI (AMD) Radeon HD 54650 1GB DDR3
 - 2.2.1.5. 20x DVD Writer
 - 2.2.1.6. Minimum 6 USB ports
 - 2.2.1.7. Windows 7 Professional x64 bit edition
 - 2.2.1.8. Microsoft optical mouse
 - 2.2.1.9. Enhanced Microsoft keyboard
 - 2.2.1.10. 22 inch LCD/LED monitor (resolution 1920X1080), VGA and DVI input

- 2.2.1.11. Internal 56K baud minimum speed auto dial/auto answer fax/data modem, FCC approved
- 2.2.1.12. Samsung ML-2851ND laser B/W printer – 30ppm mono, 1200X1200 dpi – USB fast ethernet
- 2.2.2. Provide one workstation as portable, battery operated notebook units to the following specifications. These will be known as portable terminals.
 - 2.2.2.1. Intel i5 5th generation or newer (minimum 2.8 GHz)
 - 2.2.2.2. 15” or greater display
 - 2.2.2.3. 500 GB hard drive (SSD recommended)
 - 2.2.2.4. 8GB of RAM
 - 2.2.2.5. Minimum 3 USB ports
 - 2.2.2.6. Windows 10 64 Bit
- 2.2.3. In addition to the EMCS operator interface software, provide the following software for each computer:
 - 2.2.3.1. Operating system
 - 2.2.3.2. Microsoft Office Suite, latest release
 - 2.2.3.3. Remote communication software package (desktop units only)
- 2.2.4. The EMCS software shall be capable of communication to all Workstations and all controllers, featuring high-resolution colour graphics, alarming, reporting, and be user configurable for all data collection and data presentation functions. On the Level 1 network, all Workstations shall be equal and there shall be no need for any dedicated server.
- 2.2.5. Desktop workstations shall be connected directly to the high speed Level 1 LAN and have communication access to all levels of the EMCS.
- 2.2.6. Portable workstations shall be capable of connecting to individual Network Control Units or Local Control Units and communicating with all levels of the EMCS in similar fashion to the desktop workstations.
- 2.2.7. All Network Control Units and Local Control Units are to be equipped to enable transmission of all input and output information to any workstation.
- 2.2.8. Include all additional hardware and software necessary to fully integrate required workstations into the EMCS. Fully install and commission the workstations in accordance with this specification.
- 2.2.9. All workstations shall be capable of running the EMCS operator interface software as specified in the next article as well as the commercial software packages, all in a multi-tasking environment.

2.3. WORKSTATION EMCS SOFTWARE

- 2.3.1. Software shall allow EMCS to incorporate the specified points and sequences including spare capacity, without degradation the EMCS performance described.

- 2.3.2. EMCS software shall be modular, object oriented. Software maintenance and updating of any one such module shall be possible without affecting other modules. Those basic functions required to accomplish a properly functioning plant shall form a basic software module. It shall be possible to add modules at any time.
- 2.3.3. All EMCS software shall allow the operator to interface via the mouse.
- 2.3.3.1. Acknowledgement of alarms
- 2.3.3.2. Menu selection
- 2.3.3.3. Start and stop of connected equipment
- 2.3.3.4. Altering setpoints in the colour graphics displays
- 2.3.3.5. Override digital and analog outputs
- 2.3.3.6. Design of dynamic colour graphics
- 2.3.4. Basic Software Module - The Basic Software Module shall consist of the following:
 - 2.3.4.1. System access control
 - 2.3.4.2. Man Machine Interface
 - 2.3.4.3. Help functions
 - 2.3.4.4. Dynamic Colour Graphics
 - 2.3.4.5. Alarm Handling
 - 2.3.4.6. Time control
 - 2.3.4.7. Safety backup
 - 2.3.4.8. Reports
 - 2.3.4.8.1. All points listing with descriptions split into functional sections.
 - 2.3.4.8.2. Alarm history - total and by functional section.
 - 2.3.4.8.3. Operator activity by functional section.
 - 2.3.4.8.4. Controller current alarms and alarm history.
- 2.3.5. System Access Control - Before accessing the system, each Operator shall successfully specify both their name and personal password. Every entered character in the password shall be echoed by a * sign on the screen. The password shall be stored in encrypted form.
 - 2.3.5.1. Log-on and log-off: A record of the time, date and Operator's identification of each log-on and log-off by Operators shall be recorded on the printer.
 - 2.3.5.2. Every individual password shall be matched with user profiles unique for each Operator and those profiles will determine the extent of system access. System access control shall be defined in three dimensions:

- 2.3.5.2.1. Category - determines which sections of the entire system to which that Operator will have access. The EMCS will be categorized into functional sections; Hotel Mechanical Systems; Office Building Mechanical Systems; Podium Area Mechanical Systems; Central Plant Mechanical Systems; and other systems using the Level 1 LAN.
- 2.3.5.2.2. Authority - determines which points that Operator will have access to view and command.
- 2.3.5.2.3. Control - determines which functions, or choices the operator will have access to enter.
- 2.3.5.3. Colour Graphics and Menu selections shall be limited to only those items defined by the access level of the password used to log-on. If a Colour Graphic has points or objects from higher access levels, only those points or objects matching the Operators access shall be displayed. Operators shall be able to perform only those commands available for their respective passwords.
- 2.3.5.4. Minimum requirements are as follows:
 - 2.3.5.4.1. Number of Operators: No limitation by the system
 - 2.3.5.4.2. Operators Name: 4 to 30 alphanumeric characters in any mix
 - 2.3.5.4.3. Operators Password: 4 to 30 alphanumeric characters in any mix
 - 2.3.5.4.4. Operator Categories: 30 levels
 - 2.3.5.4.5. Operators Authority: 99 levels
 - 2.3.5.4.6. Operators Control: 3 levels
- 2.3.6. Should the Workstation be left unattended it shall be automatically logged-off within a preset user-defined time period. The System Manager shall be able to log-off an Operator from another Workstation. Stand-by mode shall also be an alternative to log-off.
- 2.3.7. Man Machine Interface - The system shall provide the ability to simultaneously view different types of system displays in overlapping or tiled windows to speed up and enhance EMCS analysis.
- 2.3.8. Help functions - The system shall include an on-line Help function to look up information. Help information shall be available for the Operator even before he has logged on.
 - 2.3.8.1. Depending on the Operators need, Help information shall be available on different levels:
 - 2.3.8.1.1. Single line help, for all menus, buttons, and dialogue boxes or
 - 2.3.8.1.2. Context sensitive help in separate help windows, for all menus, buttons and dialog boxes in the system.
 - 2.3.8.2. The Help function shall include a glossary and a search function.
- 2.3.9. Point Designation - Each field point, shall have the possibility of free format text designation.
 - 2.3.9.1. Up to 80 alphanumeric characters shall be provided to allow direct access to the field point concerned.
- 2.3.10. Dynamic Colour Graphics - Colour graphic display shall be provided with minimum 48 basic background/foreground colours. Include both static and dynamic information.

- 2.3.10.1. It shall be possible to define all elements of a picture as dynamic. Present all field points in the system dynamically and by shape and colour changes, symbols for fans, pumps, etc. shall change colour depending on status of a point value.
- 2.3.10.2. The colour graphics shall be operated by a mouse, e.g. presenting another colour graphic is done by pointing in the graphic display on a link area. Operators shall be able to alter setpoints and start/stop equipment in the graphic by using the mouse pointer. Setpoint values displayed on graphics, if varied at the NCU by a portable terminal, should be up line loaded such that the revised set point is then displayed.
- 2.3.10.3. It shall be possible to provide an indication on a graphic of any item manually set, e.g. valve position, damper position. Fans, pumps etc. shall show this as a change of colour.
- 2.3.10.4. The total number of colour graphics shall be limited only by the size of the Workstations memory
- 2.3.10.5. Dynamic information shall be continuously updated with a minimum of 1 point per second.
- 2.3.11. Alarm Handling - Alarm prioritization is paramount. All alarms shall be grouped into priority levels.
 - 2.3.11.1. Alarms shall be generated on the following conditions:
 - 2.3.11.1.1. Defined alarm limits are exceeded
 - 2.3.11.1.2. Change of state
 - 2.3.11.1.3. Messages from the system
 - 2.3.11.1.4. Time intervals reached
 - 2.3.11.2. Provide the following features:
 - 2.3.11.2.1. Programming time delays (0 seconds to 99 minutes, in one second intervals) for every alarm.
 - 2.3.11.2.2. Disabling of any alarm to prevent nuisance alarms, Blocked alarms shall be displayed on command.
 - 2.3.11.2.3. Programming of time interval (1 minute to 99 minutes, in one minute intervals) for which repeated alarms from the same point are automatically blocked.
 - 2.3.11.3. Signal all alarms to the Central Control Room workstation
 - 2.3.11.4. For each alarm, a unique alarm message shall be printed, and simultaneously be presented in an alarm overview window. Alarms shall also result in the activation of a specific colour graphic or the printout of a customized report (called a chained graphic or report). Alarms shall be transmitted to other connected units, such as paging devices, fax machines, electronic mail, or other workstations.
 - 2.3.11.5. Limit monitoring alarms shall include the current limit value.
 - 2.3.11.6. In the event of communication problems on the lower level buses there shall be an alarm at the appropriate Workstation that includes identification of the affected units.
 - 2.3.11.7. Each alarm shall have time and date of occurrence, its own descriptor of up to 80 characters and a chain graphic or report. For selected high priority alarms, the screen

shall display a customized colour graphic showing e.g. where in the building(s) the alarm originates from. Multiple alarms may be blocked.

- 2.3.11.8. The alarm overview screen shall use different user selectable foreground and background colours for the following:
 - 2.3.11.8.1. tripped and unacknowledged alarms
 - 2.3.11.8.2. acknowledged but not reset alarms
 - 2.3.11.8.3. reset and unacknowledged alarms
 - 2.3.11.8.4. disabled alarms
 - 2.3.11.8.5. interlocked alarms
- 2.3.12. Time control - Provide Time Scheduling function, for start and stop of equipment.
 - 2.3.12.1. The system shall have provisions for automatic scheduling of holidays. It shall be possible to define which days, day or part of a day is to be a holiday.
 - 2.3.12.2. Provide schedule adjustment for leap year and daylight savings time.
 - 2.3.12.3. The system time shall be expressed as date, weekday, hour, minute, and second,
 - 2.3.12.4. The system shall include an automatic synchronization with recognized standard time signal.
 - 2.3.12.5. The system shall have capability to schedule groups of equipment with one change, rather than creating new schedules for each piece of equipment.
- 2.3.13. Safety backup - Provide a backup system capable of hourly backup of all data. Backup shall be stored on CD for permanent storage.
- 2.3.14. Trend Logging Module - The Trend logging module shall be for the collection and storage of data at defined intervals.
 - 2.3.14.1. Both short (seconds and minute intervals) and long (day, week and month intervals) processes can be measured. Logged points can be numerical variables or logical variables. Logged values shall be date and time stamped. It shall be possible to define the log interval. It shall be possible to program for cyclical storage,
 - 2.3.14.2. Logging may take place after the definitions of which points to be logged, during what period and in which way. Start and stop of logging can be controlled by several different conditions,
 - 2.3.14.3. The storage format shall be such that at least 65,000 values can be stored within 1 MB of disk space.
 - 2.3.14.4. It shall be possible to export logged data to a spreadsheet program for display and manipulation.
- 2.3.15. Historical Logging Module - The Historical logging module shall collect and store information relating to events.
 - 2.3.15.1. The Historical Logging shall at least include the following functions:
 - 2.3.15.1.1. collection of data

- 2.3.15.1.2. initiation of logging
- 2.3.15.1.3. storing of logged data
- 2.3.15.2. The Historical Logging can be started by a manual order, time control or event control. Information type to be collected shall be selectable.
- 2.3.16. Report Generator Module - Reports shall be used to put together and present information about the plant.
 - 2.3.16.1. Report printouts can be initiated either manually or automatically
 - 2.3.16.2. The Report Editor shall be a flexible tool allowing the user to create his own reports.
 - 2.3.16.3. When transferring values from trend log, selection shall be made based on criteria to limit the information.
 - 2.3.16.4. The Report Editor shall include a number of templates for reports and overviews.
- 2.3.17. Colour Graphics Editor Module - Colour Graphics Editor Module shall allow creation and editing of dynamic colour graphics and shall include all required drawing tools and editing capabilities.
 - 2.3.17.1. All tools for building, modifying and adding colour graphics shall be provided. To simplify drawing of graphics, the same program and display shall be used for both static and dynamic information. Graphics for the system must be designed by a factory certified designer and must be consistent from system to system and project to project.
 - 2.3.17.2. It shall be possible to import e.g. AutoCAD drawings (.DXF-files) and bit-mapped photos and illustrations (.BMP-files) to serve as components of colour graphic displays.
 - 2.3.17.3. It shall be possible to copy or move picture elements between different colour graphics. It shall also be possible to magnify any part of a colour graphic.
 - 2.3.17.4. Provide a Symbol Library with at least 30 HVAC symbols, designed in accordance with the ASHRAE standards. Provide a Symbol Editor to create new symbols or modify existing symbols.
- 2.3.18. Program Editor Module - Provide a module for the creation and editing of application programs for control units,
 - 2.3.18.1. The Programming Editor shall include the following functions:
 - 2.3.18.1.1. Program editing of text files
 - 2.3.18.1.2. Conversion of text file into executable program code
 - 2.3.18.1.3. Program downloading
 - 2.3.18.2. The Programming Editor can be used after selection of software file. The conversion shall include debugging with on-screen reporting.
 - 2.3.18.3. The programming tools shall be available at the Operators Workstation. Programming shall be in one format on-line via the Workstation.
 - 2.3.18.4. It shall be possible to download programs to the control units from the Workstations data base or up- load from the control units to the Workstation.

- 2.3.18.5. The systems alarm function shall not be affected when the Programming Editor is being used.
- 2.3.18.6. Application program modifications may be carried out without having the Workstation physically connected to the plant.
- 2.3.19. Data Base Generator Module - The Data Base module shall be used for programming entire systems, with the capability of reusing existing plant data from other systems.
 - 2.3.19.1. It shall be possible to copy parts of a plants data in such a way that all links and references are retained. Parameters from one control unit can be copied and reused in another control unit. All data or parts thereof from the plants data base may be converted into a text file.
 - 2.3.19.2. The Data Base Generator shall at least include the following functions:
 - 2.3.19.2.1. data import from a text file to the data base
 - 2.3.19.2.2. data export from the data base to a text file
 - 2.3.19.2.3. upload parameters from a control unit to the data base
 - 2.3.19.2.4. download parameters and program from the data base to a control unit.
 - 2.3.19.3. After alterations, the content of the file shall be checked, with on-screen reporting including error messages. During data import to the data base, syntax control shall take place automatically.
 - 2.3.19.4. Context sensitive help information shall be available in the Data Base Editor.
- 2.3.20. Maintenance Manager
 - 2.3.20.1. Provide as an integral part of the EMCS a software driven maintenance management system. The system shall provide for the scheduling of Preventive Maintenance and generation of work orders, for defined mechanical and or electrical apparatus and subsystems that make up the physical plant of the building. Maintenance management systems that operate as standalone systems in their own separate PC environment will not be accepted.
 - 2.3.20.2. Work orders shall be automatically generated from an alarm condition within the EMCS. Each work order shall list the parts, tools, craftspeople, and define the task to be performed. The work order generated shall be used to schedule a repair or preventive maintenance routine. The work order shall be used to track the completion of the work, the parts used and the total cost of the repair.
 - 2.3.20.3. The maintenance manager data base shall include an inventory tracking system. Work orders generated shall automatically update the inventory data base to show the quantity of tools, repair parts and expendables used for a work order or PM routine.
 - 2.3.20.4. All work orders and preventive maintenance schedules shall be printed on the workstation printer.
- 2.3.21. Plant Specific Software - The plant specific software shall be modular and written in a user-friendly, high-level language.
 - 2.3.21.1. The same types of interlocking, control functions, etc. shall consistently be solved in similar ways throughout this project.

- 2.3.21.2. Documentation: A document for every control unit must be able to be printed comprising preset values and parameters, alarm texts and application programs. It shall also be possible to print out complete and up to date documentation of the application software on site at any time by a simple command or a menu selection. The documentation shall comprise the following as a minimum:
- 2.3.21.2.1. All parameters printed out in plain language such as:
- 2.3.21.2.1.1. Set values
- 2.3.21.2.1.2. Alarm levels]
- 2.3.21.2.1.3. Alarm delays
- 2.3.21.2.1.4. PID parameters
- 2.3.21.2.2. All code for logic sequencing etc., with explanatory text in plain language.
- 2.3.22. Power Failure - The EMCS shall automatically shut itself down in an orderly and predefined manner. On stable power restoration, the EMCS shall automatically resume normal operation in an orderly and predefined manner without operator intervention. Startup times for all HVAC equipment shall be programmable with variable intervals. The times of system startup shall be logged on the workstation printer.

2.4. NETWORKS

- 2.4.1. Provide a high speed first tier (Level 1) network using Ethernet ISO8802-3/IEEE 802.3 or Arcnet ATA/ANSI 878.1 topology which will conform to BACnet standard ANSI/ASHRAE 135-1995. At minimum, this LAN will connect all fixed operator workstations and provide capability for future connection of BACnet compliant digital controllers.
- 2.4.2. Provide network interface modules as required for all connections to the Level 1 LAN.
- 2.4.3. Provide lower level networks for connection of Network Control Units and Local Control Units. Provide full and complete communication capability between the Level 1 LAN and all lower level networks such that all EMCS specified downloading, uploading, data transmission, control commanding, alarm handling, programming, etc. is achieved smoothly and transparently.

2.5. NETWORK CONTROL UNITS (NCU)

- 2.5.1. Provide an EMCS with tiered networks as specified above. For the network level below Level 1, provide network Control Units, microprocessor based digital controllers with power supplies, battery backup and cabinets.
- 2.5.2. Provide the number of NCUs required to support the EMCS system to ensure any, and all input and output field points connected to individual Local Control Units (LCUs) are able to be networked and may be monitored, changed or commanded anywhere throughout the EMCS. The number of field points supported by an NCU controller shall not exceed the recommended maximum stated in the manufacturer's literature. This limit is imposed to maximize system distribution and speed and to minimize data loss if any network control unit communication fails.
- 2.5.3. Provide Network Control Units (NCU) which are 16 bit multi-processor based, allowing a multi-tasking, multi-user operating system. The NCU controllers shall permit the simultaneous operation of all control, communication, facilities management and operator

interface software, as programmed by the Contractor or User. Modification of the onboard NCU controller database shall be performed online.

- 2.5.4. All programming defining the functions to be performed by the NCU, including but not limited to application programs and point database within each NCU, shall be protected from loss due to power failure for a minimum of 500 hours. Systems providing non-volatile memory for these functions are preferred. Systems not providing non-volatile memory shall provide a rechargeable battery backup system sufficient to provide protection for the specified 500 hour period. Systems not in compliance shall provide for uninterrupted power to each NCU.
- 2.5.5. Equip NCU controllers with a minimum of one service port. The service port shall be either a built-in RS-232 t or an RJ-11 type jack which connects to the laptop computer. Connection of a service device, to a service port, shall not cause the NCU controller to lose communications with its peers or other networked device controllers. The service port shall allow utilization of the same laptop computer from any location.
- 2.5.6. Provide modular designed NCUs with UL listing and software facilities to:
 - 2.5.6.1. receive signals from system sensors, meters, transmitters and other pertinent equipment where required without the use of LCUs
 - 2.5.6.2. use peer-to-peer communication to transmit to, receive from and check the integrity of data and other information received from other system NCUs
 - 2.5.6.3. provide power fail safe, automatic restart facilities.
- 2.5.7. Provide sufficient NCUs in approved locations to:
 - 2.5.7.1. equalize total system processing load, provide the specified spare capacity and to limit the field points supported by each as previously specified
 - 2.5.7.2. minimize installation of long signal wire and cables
 - 2.5.7.3. enhance system modularity, sectionalized reliability, availability and maintainability.
- 2.5.8. Provide sufficient NCUs and LCUs to meet the specified functionality and point count as determined from the control diagrams and requirements shown on the drawings. Locate these to permit convenient access for operator interfacing in all mechanical equipment rooms. Provide all NCUs with operator interfacing capabilities to permit status interrogation, set point and schedule adjustments. Obtain approval for location of all NCU panels.
- 2.5.9. The NCU shall be capable of having data loaded from a desktop Workstation or a portable terminal workstation. It shall perform all specified control functions without interaction to other field panels or to a Workstation. Systems that rely only upon processing control functions in a Workstation will not be acceptable.
- 2.5.10. The NCU shall have the capability to communicate with a remote Workstation and allow monitoring of every supported sensing point and controlled point data indicated on the drawings and/or input/output schedules.
- 2.5.11. Failure of an NCU or NCUs shall not prevent other NCUs on the same network from communicating with each other.
- 2.5.12. Printed circuit boards shall be removable without having to disconnect any field wiring.
- 2.5.13. To facilitate fault finding, provide the following:

- 2.5.13.1. Comprehensive diagnostics programs. These routines shall continuously monitor the operation of the NCU and report faults to a Workstation.
- 2.5.13.2. Indication that the NCU processor is functioning via LED or similar.
- 2.5.13.3. Indicator on the communication section of the NCU to show that communication with the network is active.
- 2.5.14. Each NCU must contain a real time clock providing time in the form of date (day, month, year), day of the week (e.g. Monday), hour, minute and second. Accuracy should be a minimum of + or - 5 minutes per year. Leap years are to be automatically catered for over a minimum of the next 25 years. Clocks which utilize the mains power supply as their reference are not acceptable.
- 2.5.15. Battery backup of the clock during continuous mains failure should not be less than 500 hours.
- 2.5.16. Each NCU shall provide an alarm at the Workstation should the battery maintaining the clock and RAM be considered close to the end of its charge. The method of determining this can be based on either low battery voltage or time usage.
- 2.5.17. For each NCU it shall be possible to declare alarms on every supported input, digital as well as analog. Alarming of points shall be operator definable on a per point basis and shall comprise of at minimum:
 - 2.5.17.1. high/low limits
 - 2.5.17.2. high/low differential from set point limits
 - 2.5.17.3. eng. units and timed dead bands
 - 2.5.17.4. special and interlocked alarms
- 2.5.18. NCUs must be capable of handling the following energy management functions:
 - 2.5.18.1. Programmed Start/Stop - This program shall enable the start/stop of equipment on a scheduled basis using time schedules including special provision for holidays. Changes to start/stop times shall be achievable from a workstation or a portable terminal by personnel with password authority. Provide for automatic override of the programmed start/stop based on outside temperature. This facility shall be operator initiated for each system individually to the automatic override mode and shall be based on the outside temperature reaching or exceeding an adjustable value, unique for each system.
 - 2.5.18.2. Optimal Start/Stop Program - Provide temperature compensated start/stop time program to automatically add, delete, shorten or extend a start/stop time program(s) based on outdoor and indoor temperatures. During the warm-up or cool down cycle, the fan system shall operate with the outside dampers fully closed. The outside dampers shall open to their minimum position within an operator adjustable time period prior to occupancy. Both warm-up and cool down calculations shall use an adaptive modeling or self learning algorithm such that it automatically adjusts the start/stop time. The adjustments shall be made based on the monitored rate-of-change of building temperature for various inside and outside temperature conditions.
 - 2.5.18.3. Temperature Based Load Control -Provide temperature setback or setup according to programmed occupancy schedules. Provide the capability to assign separate schedules to each control zone. Provide for control of setback or setup through setpoint adjustment, cycling of systems or chilled water system temperature adjustment.

- 2.5.18.4. Enthalpy Economizer - Provide a program which will control outside, and relief air dampers during the cooling season based on inside and outside enthalpy comparisons. Based on these inputs, the outside/return air dampers shall be controlled as follows:
- 2.5.18.4.1. If outside temperature is less than the supply air temperature set point the dampers shall be modulated to mix outside and return air for free cooling.
- 2.5.18.4.2. Whenever outside temperature is above the supply set point, compare the outside enthalpy and return enthalpy and use either outdoor or return air to affect the smallest enthalpy change across the cooling coil.
- 2.5.18.5. Runtime Totalization - Provision shall be made to monitor and totalize the runtimes for digital status inputs and outputs of equipment such as motors, fans and pumps. Where an input variable, such as flow rate, is monitored by the EMCS as the positive indication of operation then this input shall be used as the basis for the runtime hours to be totalized. The facility shall exist for providing two high runtime alarm limits for each point on runtime totalization, the attainment of which shall generate suitable hard copy report message.
- 2.5.18.6. Duty Cycling - Provide a software package that cycles parallel equipment on/off in order to equalize or minimize equipment runtime. Provision shall exist to enable the online definition of the minimum time between the switching of a cycled equipment set. The minimum switching period shall be individually assignable for each included equipment set.
- 2.5.18.7. Supply Air Temperature Reset - This program shall establish the supply air temperature set point for air handling systems. This program shall determine the individual optimum supply air temperature setpoints which will minimize the need for reheat in terminal reheat and cooling in all HVAC systems. Provide a program which automatically adjusts fan discharge set point temperature as high as possible (cooling discharge) or as low as possible (heating discharge) to just satisfy the building zones requiring the greatest heating or cooling. Zone heating/cooling requirements shall be determined by monitoring space temperature. An operator adjustable comfort range shall be assigned to each measured input. Discharge temperatures shall be adjusted up or down (as appropriate) until at least one of the measured inputs is at its comfort limit, indicating additional reset would cause zone discomfort. Return air humidity shall be used to override cooling discharge reset. Cooling coil discharge shall be increased as described above unless the return humidity exceeds an operator adjustable limit, indicating insufficient dehumidification is being provided. Cooling discharge temperature shall then be adjusted downward until return air humidity is again below the limit. The supply air temperature setpoint shall not exceed the high and low limits established online by the Operator.
- 2.5.18.8. Electrical Energy Metering and Reporting - Provide an online software package for the metering and reporting of the electrical consumption and demand for the utility metered and building submetered electric services. Hardware for metering electrical consumption is installed under Division 26 00 00. Review Division 26 00 00 requirements to ensure required interfacing between mechanical and electrical loads. Record and store metered information on permanent storage media on a 15 minute, hourly, daily and monthly basis. Retain 15 minute data for 3 months. Retain hourly, shift and daily information for a minimum, 3 years. Retain monthly information for a minimum, 5 years. Reports shall be available on demand and on an automatic scheduled programmed basis. At the end of each month, a report shall be issued for the meter. The report shall indicate electrical usage and demand data in sufficient detail that the total electrical charges, based on the local applicable electrical rate structure, can be computed for that electric service. For flexibility to accommodate changing rate structures, data shall be accumulated on a time-of-day basis. In the event of a temporary loss of monitoring of the electric meters, provide means for the operator to amend, online, any electrical usage. Totalize the daily

consumption totals to provide monthly electrical consumption. Determine electrical demand in accordance with local utility procedures. Totalize the monthly and daily electrical demand and consumption totals to provide the annual electrical demand and consumption. Where any of the instantaneous values are not available, for such reasons as equipment malfunction, then the missing data shall be estimated by operator and manually typed in.

- 2.5.18.9. Domestic Water Metering and Reporting - Similarly to the above electrical requirement, provide software for domestic water metering and reporting of consumption. Provide similar data retrieval, storage and reporting capability.
- 2.5.18.10. Chilled Water Energy Metering and Reporting - Similarly to the above electrical requirement, provide software for metering and reporting of chilled water energy consumption and demand. Provide algorithms for calculation of transferred energy using input from measured flow and temperature differential data and for integration of energy transfer rate into consumption data.
- 2.5.18.11. Power Demand Control - Provide an online electrical prediction and demand control package to control demand while building is on normal power. Predict the probable power demand such that action can be taken to prevent an increase in demand limit. When demand prediction exceeds demand limit, action shall be taken to reduce loads in a predetermined manner. If further demand predictions indicate that the demand limit will not be exceeded, action shall be taken to restore loads in a predetermined manner. The frequency of calculations, the time intervals for calculations and other relevant variables shall be based on the means by which the local electric utility computes demand charges. This program shall be such as to ensure that electrical demand charges are minimized. Online changes shall be possible as follows:
 - 2.5.18.11.1. addition and deletion of loads controlled by this program
 - 2.5.18.11.2. changes in demand intervals
 - 2.5.18.11.3. changes in individual equipment power requirements
 - 2.5.18.11.4. changes in demand limit for the meter(s)
 - 2.5.18.11.5. changes in maximum equipment shutoff time and minimum equipment shutoff time
 - 2.5.18.11.6. changes in the predetermined manner of load shedding and load restoring
 - 2.5.18.11.7. lockout equipment from control by this program
 - 2.5.18.11.8. Loads shall be cycled during normal occupancy hours. Cycling shall be suspended during warm-up, cool down, purge and occupied hours
- 2.5.18.12. Maintenance Scheduling - The maintenance management program shall be capable of planning preventive maintenance type tasks. The following three methods for scheduling preventive maintenance shall be provided:
 - 2.5.18.12.1. Preventive maintenance tasks shall be scheduled on a daily, weekly, monthly, bi-yearly, or some other period based on calendar date.
 - 2.5.18.12.2. Preventive maintenance tasks shall be scheduled whenever the equipment runtime limit of any specified binary point exceeds an operator entered limit.
 - 2.5.18.12.3. Preventive maintenance tasks shall be scheduled whenever a point changes state to an alarm or off normal condition such as when a space temperature exceeds the operator entered limit or when a filter status switch indicates a dirty filter condition.

- 2.5.18.13. Command Alarm Function - The EMCS shall have a commanded alarm function program to test the response of a simulated alarm. The commanded alarm function shall trigger the interlock sequence in the DDC system controller specified under the HVAC system control strategies.
- 2.5.19. To ensure standalone functionality, each NCU shall store 32 independent time schedules, comprising normal weekly timetables and prioritized alternative (incl. holiday) timetables. Alternative timetables shall be able to be programmed for scheduling times different to the normal schedules. It shall be possible to utilize so called wild cards for repeated timetables e.g. every year or monthly. Alternative timetables schedules shall override the normal time schedules. Each timetable shall define one set of start and stop times (accuracy 1 minute) and for which days they are valid. Furthermore, each NCU shall store 16 independent logical time variables. Every time variable shall be controlled from one or several timetables. The 16 independent variables may be assigned to any of the following:
- 2.5.19.1. Command digital outputs to a specific state
- 2.5.19.2. Command analog outputs to a specific value
- 2.5.19.3. In addition to the above, outputs must be capable of being commanded due to the occurrence of single or multiple events.
- 2.5.20. There shall be facility to create programs for the NCU to control logic which is not covered by standard functions. Such programs shall be of high level type, and it shall be possible to make alterations without involvement from the Tenderer. In the programs' comments may be written in text free of format. Programs shall include, but not be limited to:
- 2.5.20.1. ratio control
- 2.5.20.2. output, input and set point bias control
- 2.5.20.3. cascade control
- 2.5.20.4. setpoint and output ramping
- 2.5.20.5. setpoint scheduling by time of day
- 2.5.20.6. interlocking event and input limits/alarms
- 2.5.20.7. time of day scheduling
- 2.5.20.8. lead/lag compensated run time scheduling
- 2.5.20.9. calculated values
- 2.5.20.10. other conditions as applicable

2.6. LOCAL CONTROL UNITS (LCU)

- 2.6.1. Each AHU, packaged cooling unit, VAV terminal, fan powered VAV terminal, fan coil unit or other similar device shall have a unique DDC controller as a Local Control Unit.
- 2.6.2. Each LCU shall be compliant with ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified BACnet Advanced Application Controller (B-AAC). BACnet Application Specific Controllers (B-ASC) are not acceptable.

- 2.6.3. Provide modular designed LCUs with UL listing and software facilities to:
 - 2.6.3.1. Receive signals from system sensors, meters, transmitters and other pertinent equipment.
 - 2.6.3.2. Accept, process, and execute commands from other input devices.
 - 2.6.3.3. Transmit output signals to control system end devices or other pertinent equipment.
 - 2.6.3.4. Use peer-to-peer communication to transmit to, receive from and check the integrity of data and other information received from other system NCUs and LCUs.
 - 2.6.3.5. Record, evaluate, and report changes of state and/or values.
 - 2.6.3.6. Provide power fail safe, automatic restart facilities.
- 2.6.4. The LCU shall be capable of performing its assigned local loop control and other functions as a standalone unit. The LCU shall be capable of having data loaded from a desktop workstation or a portable terminal workstation. It shall perform all specified control functions without interaction to other field panels or to a workstation. Systems that rely only upon processing control functions in a workstation will not be acceptable.
- 2.6.5. The LCU shall have the capability to communicate with a remote workstation and allow monitoring of every sensing point and controlled point data indicated on the drawings and/or input/output schedules.
- 2.6.6. The LCU software and microprocessor operating system shall reside in non-volatile memory.
- 2.6.7. Failure of an LCU shall not prevent other LCUs on the same network from communicating with each other.
- 2.6.8. Each LCU shall consist of a micro computer-based controller, input/output modules, and termination modules.
- 2.6.9. Provide LCUs as specified above. Provide additional LCUs if required to support the control loops specified, the sequence of operations, number of monitoring points or other criteria to permit the field panel capacity to meet the specified functional requirements of the project.
- 2.6.10. Each LCU shall be capable of operation as a completely independent unit and as a part of a facility wide control system. All LCUs are to be equipped to enable transmission of all input and output information to a workstation
- 2.6.11. Each LCU shall be capable of receiving signals from industrial grade and industry standard sensors and transducers. Each LCU shall have the capability to monitor the types of inputs and outputs as below:
 - 2.6.11.1. Analog Inputs - 0 to 20 mA or 4 to 20 mA, 0 to 10 volts DC and resistance (PT-1000, N1-1000, NTC thermistor and potentiometer). It shall be possible to carry out signal type declarations from the workstation, or locally via a portable terminal. Normalization and linearization routines shall exist for all supported inputs.
 - 2.6.11.2. Binary Inputs - from volt free contacts normally open or normally closed, including pulsed contacts at a rate of 20 pulses per second minimum.
 - 2.6.11.3. Analog Outputs - true analog i.e. 0 to 10 volts DC or 2 to 10 volts DC. Pulse width modulation is acceptable only for VAV box LCUs.

- 2.6.11.4. Binary Outputs - momentary or maintained direct form the LCU using triac outputs or volt free contacts.
- 2.6.12. Each control loop is to be of the PID type, although initially most loops will be of the PI type. Adding the derivative function or modifying loop parameters should not require further programming of algorithms, but only entering the desired changes via the workstation or portable terminal.
- 2.6.13. Printed circuit boards shall be able to be removed without having to disconnect any field wiring.
- 2.6.14. Any analog input becoming short circuited shall not prevent any other analog inputs from working.
- 2.6.15. Digital outputs shall be galvanically isolated from each other as well as from the internal electronics of the LCU.
- 2.6.16. To prevent serious damage to the LCU from surges, RFI, electrically induced spikes, etc., protection in the following form shall be provided, as a minimum:
 - 2.6.16.1. Digital outputs singularly or collectively shall be galvanically isolated from the main LCU processor.
 - 2.6.16.2. Analog outputs shall have noise and surge suppressers fitted to prevent damage or malfunction due to induced voltages in series or common mode.
 - 2.6.16.3. Digital and analog inputs shall have noise and surge suppressers fitted to prevent damage or malfunction due to induced voltages in series or common mode.
- 2.6.17. LCU application programs are usually to be entered by downline loading from a workstation. Limited program changes e.g. control parameters, setpoints, time delays, etc. may be carried out via a portable terminal plugged into the LCU.
- 2.6.18. For each LCU it shall be possible to declare alarms on every input, digital as well as analog. Alarming of points shall be operator definable on a per point basis and shall comprise of at minimum:
 - 2.6.18.1. High/low limits
 - 2.6.18.2. High/low differential from setpoint limits
 - 2.6.18.3. Eng. units and timed deadbands
 - 2.6.18.4. Special and interlocked alarms
- 2.6.19. After a power failure, the LCU is to refer to its various time programs and provide start signals in an orderly and predefined manner.
- 2.6.20. For each VAV or FPVAV, the controller shall include an air velocity sensor pickup, velocity controller, damper actuator, electric heating coil SCR control (where indicated) and temperature sensor.
 - 2.6.20.1. Damper Motor - Provide a damper motor compatible with the velocity controller and suitable for the damper to be controlled. Where indicated, provide fail safe motors, which fail to normally open or normally closed. To allow flexibility e.g. to change actuator to fail safe type, it is preferred the actuator be separate to the velocity controller. Tenderers are to state if their actuator is not separate.

- 2.6.20.2. The controller shall control the damper and heating (if required) (either on/off or SCR as scheduled) in sequence. Setpoint, P-band and I-time shall be separately programmable for cooling and heating.
- 2.6.21. For each fan powered VAV box, in addition to the control components specified above, the controller shall provide for stop/start control of the fan. See the sequence of operation shown on the control diagrams on the drawing.
- 2.6.22. For each fan coil unit, the controller shall include for the sequence of operation as shown in the control diagrams on the drawing.
- 2.6.23. For local control units on VAV boxes and fan powered VAV boxes, provide a global command capability by AHU system to affect all boxes in a system simultaneously to set full open damper, full closed damper or to set all dampers at any single percentage open.
- 2.6.24. The following types of alarms shall be detected by LCUs on VAV boxes and fan powered VAV boxes:
 - 2.6.24.1. High and/or low room temperature
 - 2.6.24.2. Temperature transmitter error
 - 2.6.24.3. Air velocity sensor error
- 2.6.25. Zone Temperature Sensors - The sensing element shall be influenced both by the surrounding air temperature and by the radiant heat in the zone. Each zone temperature sensor shall have a modular jack for connection of a portable terminal (PT). The PT via the jack shall be able to communicate to the controller which the sensor is connected to or any other controller or LCU within the system.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1. Install all equipment, accessories, conduit and interconnecting wiring in a neat and protected manner by skilled and qualified work persons using the latest standard practices of the industry.
- 3.1.2. Unless otherwise specified, meet manufacturers latest printed instructions for materials, planned maintenance and installation methods.
- 3.1.3. Notify Owner in writing of any conflict between these Specifications and manufacturer's instructions. Within 2 weeks of submission of Tender, contract award may be determined by these deviations. No deviations will be considered after this time period.
- 3.1.4. Coordinate with other Division 20 00 00 work and provide the necessary relays, auxiliary contacts and transformers required to interconnect equipment. Retain original equipment suppliers to provide contacts as required.
- 3.1.5. All equipment installed shall be mechanically stable and fixed to wall or floor.
- 3.1.6. Install equipment so as to allow for easy maintenance access and such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- 3.1.7. Install equipment in locations providing acceptable ambient conditions for its specified functioning, allowing for adequate ventilation and with no condensation traps.

- 3.1.8. Meet Division 26 00 00 installation and materials requirements.
- 3.1.9. Shield and ground communication trunk wiring at a single end.
- 3.1.10. Do not splice trunk cables.
- 3.1.11. Provide complete installation, testing, debugging and interfacing of specified software.

3.2. SOFTWARE IMPLEMENTATION

- 3.2.1. The work of this section shall include the full implementation of all software described in these specifications, such that all packages are fully operational systems. Where information is required from the Owner in order to complete any item, the Contractor shall request this information in writing at least 10 weeks prior to the date at which this information is required.

3.3. IDENTIFICATION

- 3.3.1. Provide all pieces of supplied equipment with a minimum {25 mm x 75 mm} [1" x 3"] black and white lamacoid nameplate with, at minimum, {6 mm} [1/4"] high bold lettering and affix to control device or on panel front. Identify in accordance with the shop drawing descriptions. Except where specifically noted otherwise, permanently attach using self tapping screws or bead chain.
- 3.3.2. Within each field panel provide a complete listing of points connected, system schematic diagrams, calculated point codes and other information useful to assist an operator using a PT for diagnostic purposes. Fasten information to inside of front door using adhesive backed paper, or mount information in sealed plastic covers and secure to field cabinet.
- 3.3.3. Identify all field wiring terminations with labels corresponding to Shop Drawing identifications.

3.4. POWER

- 3.4.1. Provide single phase, dedicated ground, nominal 125V AC, 60 Hz power to the field panels from emergency panels in locations identified to Division. Provide suitably sized breaker compatible with existing power panels
- 3.4.2. Provide class II 24VAC transformers where required.
- 3.4.3. Under normal conditions, no single power supply shall be operated at more than 75% of its rated maximum continuous load.

3.5. WIRING

- 3.5.1. Provide all wiring required for Instrumentation. Install in EMT conduit or use fire rated cable, and otherwise comply with Division 26 00 00 requirements. FT-6 rated cable may be used where approved by authority.
- 3.5.2. Provide power wiring from nearest 125 volt emergency powered panel to each field device as required. Provide wiring from breaker to all equipment unless specifically indicated otherwise. Power wiring from emergency source to a control device or panel serving any life safety functions shall be fire rated (2 hour minimum).
- 3.5.3. Provide necessary relays required to interconnect equipment.
- 3.5.4. Install wiring parallel and perpendicular to building planes.

3.6. TRAINING

- 3.6.1. Provide practical training for the owners designated representatives. Direct training towards the requirements of the following user groups:
 - 3.6.1.1.1. Supervisors: Control, Monitoring including Offsite Monitoring, Report Generation, Data Base Management
 - 3.6.1.2. Operators: Control, Monitoring including Offsite Monitoring and Maintenance
 - 3.6.1.3. Electricians: System Hardware, Instrumentation and System Wiring
- 3.6.2. Provide training at the site at locations specified by the client. Allow for four separate groups of training sessions which will be scheduled according to the project schedule and the groups may be held weeks apart. Allow 4 full 8 hour days of training for each group (total 16 days) to cover the three user categories above and allow for these days to be staggered to meet the owner's schedule. Training sessions will be scheduled during normal working days and during normal working hours, excluding holidays.
- 3.6.3. Training shall cover the complete operation of the EMCS. Supervision training shall include for the software procedures to allow for the appropriate operators or supervisors to add, or modify points, programs, reports or graphics.
- 3.6.4. Provide training specifically directed to controller programming with the Program Editor Module provided.
- 3.6.5. Submit to the Construction Manager, check lists for each system or piece of equipment indicating that all components have been checked and are complete prior to instruction period.
- 3.6.6. Provide all equipment and supplies, as required by the Contractor in order to execute the training program.
- 3.6.7. Submit a complete record of instructions given to the owner's user groups. For each instruction period, supply the following data:
 - 3.6.7.1. Date
 - 3.6.7.2. Duration
 - 3.6.7.3. Agenda: System or equipment involved
 - 3.6.7.4. Names of persons giving instructions
 - 3.6.7.5. Names of persons being instructed
 - 3.6.7.6. Other persons present
- 3.6.8. Provide at least four complete sets of approved training manuals including final documentation of systems, instructions for hardware and all software, troubleshooting procedures, etc. Provide these manuals as a draft submission for review by the lead consultant before submission of the four final sets. Make changes or additions as directed based on the draft submission. Submit the final sets in time for the training sessions.
- 3.6.9. Verification of completed training shall be submitted to the Construction Manager prior to final release of holdback.

- 3.6.10. Selected client's representatives shall be sufficiently trained so as to be qualified to perform emergency maintenance during the warranty period, without affecting, in any way, the warranty coverage provided. At the end of such training, provide qualification certificate.

3.7. WARRANTY AND WARRANTY SERVICE

- 3.7.1. Warrant in writing, all provided equipment, accessories, installations, software and firmware against defects in workmanship and materials for a period of one year commencing from the date of issue of the Certificate of Completion. Include emergency 24 hour service.
- 3.7.2. In addition to the above, provide a supplier's on-site warranty for two years minimum to cover all parts, materials and labour for the desktop and portable workstation computers, including monitors.
- 3.7.3. These warranties shall take precedence over any other warranties.
- 3.7.4. Maintain the affected parts operational during repair of defective equipment covered by the warranty.
- 3.7.5. All warranty repairs shall be carried out on site or a replacement component shall be issued to the facility at no charge.
- 3.7.6. During the warranty, all components described above shall be routinely inspected and serviced by trained EMCS technicians with written reports to the owner regarding condition, adjustments or changes made to any equipment following each inspection. Change consumable items such as printer ribbons as required at these inspections.
- 3.7.7. Provide all service at no additional cost during the warranty period, with the specified exception of the supply of consumable items as defined above.
- 3.7.8. Perform a final inspection in conjunction with the client and Consultant, 60 days prior to the termination of the warranty period. Submit a full report, to the client at least 30 days prior to the termination of the warranty period.
- 3.7.9. During the warranty period, replace or repair all supplied equipment, documentation and software, at no additional cost. All defective equipment and software shall be replaced or repaired as soon as is reasonably possible after it is considered to be defective.
- 3.7.10. Maintain an inventory of sufficient normal replacement parts, components, materials, tools, equipment and testing devices such that repair or replacement can commence within 8 hours of notification of an inoperable condition.
- 3.7.11. At the end of the warranty period, update software such that all software will be the most recent product.

3.8. CAN/ULC-S1001 COMMISSIONING ASSISTANCE

- 3.8.1. Assist the third-party commission agent through the Integrated Systems Testing of Fire Protection and Life Safety Systems per CAN-ULC-S1001 and Ontario Building Code Section 3.2.10. Provide support staff that are experienced and technically knowledgeable on the subject matter. Coordinate with the commissioning agent in advance of the testing dates and provide all input they may request. Make appropriate staff available for all testing dates and subsequent review periods.

3.9. AFTER WARRANTY SERVICE MAINTENANCE CONTRACT

- 3.9.1. Submit a Separate Price to provide complete routine and emergency maintenance services on the EMCS for a period of one year following the completion of the warranty period. Base the price upon work being executed during normal working hours. Include separate emergency call out provisions. Prices submitted should be based upon current price lists and labour rates, details of which shall be included within this bid.
- 3.9.2. The maintenance contract may be renewed annually, at the option of the client, for up to a term of 10 years. The price shall be negotiated annually, 3 months in advance of the contract expiry. The price shall be a mutual agreement of both parties, with variations reflecting only changes in material and labour costs that can be substantiated by the Contractor and agreed to by the Owner.
- 3.9.3. It shall be understood that the maintenance contract shall not commence in any event before the termination of the warranty period.
- 3.9.4. The maintenance contract services shall, at minimum include:
 - 3.9.4.1. Checking the performance of all equipment and components provided under this contract on a regular scheduled basis. Performance checking shall involve diagnostic tests, examination, cleaning, lubrication, adjustment and calibration, as appropriate, together with other functions to maintain the EMCS fully operational and in compliance with these Specifications.
 - 3.9.4.2. Provide labour and material for the repair and replacement of worn or defective equipment and components where such items were initially provided as part of this contract or the EMCS preventive maintenance contract. Replacement items shall be of the same quality as the parts that are replaced.
 - 3.9.4.3. Update all applicable software, as required to meet the intent of this Specification, at maximum, annually, if the client so wishes, such that all EMCS software will be the most recent product.
- 3.9.5. Maintain an inventory of sufficient normal replacement parts, components, materials, tools, equipment and testing devices such that repairs or parts replacement can commence within 8 hours of notification that the EMCS is malfunctioning or inoperable. Major replacement components shall be available within 8 hours of component malfunction.
- 3.9.6. Undertake maintenance with qualified EMCS technicians.

END OF SECTION

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1. Comply with Division 01 00 00, General Requirements and all documents referred to therein.
- 1.1.2. All labour, materials, products, equipment and services to supply, install and test the operation of the sprinkler, standpipe and smoke control systems interfaced to the Fire Alarm System is by others. Provide all necessary assistance, reporting and sequence verification to ensure a complete and operational system.
- 1.1.3. Refer to Division 26 00 00 for wiring of all smoke control devices and to ensure that sequences are implemented to meet all applicable codes and requirements of authorities having jurisdiction.
- 1.1.4. The Fire Alarm System (FA) head end is located in the Central Alarm and Control Facility (CACF) room. The EMCS shall be interfaced to the FA to indicate general Fire Alarm and Fire Alarm Trouble Status to the EMCS.
- 1.1.5. Include 200 hours specifically for CAN/ULC-S1001 commissioning interfacing of the fire alarm system with all equipment controlled by the fire alarm system in addition to the time required to complete items 1 to 4.

PART 2 - PRODUCTS

2.1. INTERFACE HARDWARE

- 2.1.1. Provide fan status differential pressure switches for each axial and centrifugal type fan connected to the CACF. Set switches to properly detect and report fan operating status. Provide fan status from motor starter contacts for each propellor type fan connected to the CACF.
- 2.1.2. Provide end switches for smoke dampers and combination fire/smoke dampers to indicate both full closed and full open position to the CACF.

PART 3 - EXECUTION

3.1. INTERFACING REQUIREMENTS

- 3.1.1. The CACF will transmit a designated fire alarm signal to the EMCS for use in alarm suppression.
- 3.1.2. The CACF will stop all fans through interconnection to double voltage relays in the starters.
- 3.1.3. The CACF on the basis of the alarm identification received, shall issue commands to operate selected smoke dampers to full closed or full open position, compatible with the required operation of the smoke control system.
- 3.1.4. The CACF will, on the basis of the alarm identification received, issue commands to start selected fans in accordance with the specified smoke control sequences.
- 3.1.5. The CACF will monitor the operational mode of each smoke evacuation fan and smoke damper by interconnection to fan status differential pressure switches and damper status end switches.
- 3.1.6. Regardless of how automatic fire sequences are implemented, it is mandatory that the CACF incorporate the ability to manually override the automatic control mode such that any fan may be started or stopped and any smoke damper may be opened or closed from the CACF control panel.

- 3.1.7. Position all fans operating in the smoke control and smoke evacuation mode for 100% outdoor air intake or 100% exhaust air discharge. Provide override on safety shutoff devices and ensure that coil pumps operate with full flow through the coils.

3.2. SEQUENCES

- 3.2.1. Refer to the Drawings for a detailed listing of automatic fire mode sequences identifying the location of fire and smoke control system response.

3.3. TESTING

- 3.3.1. Provide all labour and materials required to complete the testing of the CACF automatic and manual operation. Ensure that required smoke control systems and components are functional and ensure that smoke control systems operate properly in conjunction with the CACF.
- 3.3.2. Perform tests in the presence of authorities having jurisdiction.
- 3.3.3. Repeat tests as often as necessary to demonstrate acceptable operation of the systems.

3.4. CAN/ULC-S1001 COMMISSIONING ASSISTANCE

- 3.4.1. Assist the third-party commissioning agent through the Integrated Systems Testing of Fire Protection and Life Safety Systems per CAN/ULC-S1001 and Ontario Building Code Section 3.2.10. Provide support staff that are experienced and technically knowledgeable on the subject matter. Coordinate with the commissioning agent in advance of the testing dates and provide all input they may request. Make staff available for all testing dates and subsequent review periods.
- 3.4.2. Take the lead in coordinating the efforts with the TAB contractor (Section 23 05 93), fire protection sprinkler trade (Section 21 13 00), and controls contractor (Section 25 50 00).

END OF SECTION

PART 1 - GENERAL CONDITIONS

1.1. PROJECT DESCRIPTION:

- 1.1.1 The project encompasses the 2000 Simcoe Street North, Oshawa Facility. In general, the work shall include, without being limited to the following:
 - 1.1.1.1. Provide new 120/208 Volt and 347/600 Volt utility power service.
 - 1.1.1.2. Provide new 120/208 Volt and 347/600 Volt EPS power service.
 - 1.1.1.3. Provide electrical distribution, communications conduit systems, overhead cable tray systems, grounding systems, lighting, lighting control system, fire alarm system, public address system and security and access control and CCTV requirements, etc., as shown on the drawings.
- 1.1.2 The electrical contractor shall provide a comprehensive Methods of Procedures (MOPs) four weeks prior to each and every power shutdown. MOPs must include a detailed sequence of operations to be completed during the respective shutdown as well as a back out plan. MOPs must be approved by client and the electrical engineer prior to any work taking place.

1.2. SUB-CONTRACTORS:

- 1.2.1 The Contractor may not assign or sub-contract any work without the prior written consent of the Construction Manager or his designated representative. A list of sub-contractors must be submitted with the tender response.

1.3. SUBSTANTIAL COMPLETION OF CONTRACT

- 1.3.1 All the equipment and wire must be cleaned and tested before acceptance by the consultant.
- 1.3.2 This Contractor shall guarantee all equipment and work furnished under this Division for a period of two (2) years (including all prepurchased and prequalified equipment) or such longer periods as may be provided in the warranty of the manufacturer of individual components, whichever is longer from the date of final acceptance by the Engineer. This contractor shall correct all defects developing as a whole or in part, due to defective workmanship, materials or defective arrangement of the various parts or materials damaged as a result of these defects or repairs. All defects shall be made good to the satisfaction of the Engineer at this Contractor's expense.
- 1.3.3 Replace, at no cost, all incandescent lamps burned out during a thirty (30) day period, all burned-out fluorescent and HID lamps for a period of ninety (90) days and all burned out LEDs based on a 70% lumen maintenance within a 5 year warranty period after date of issuance of certificate of Substantial Performance for the contract of this building.
- 1.3.4 Additional requirements as detailed in Section 26 05 00, paragraph 1.7, sentence 9.

1.4. This section is not used.

1.5. SITE MEETING

- 1.5.1 The site meeting will be scheduled during the tender period by the construction manager.

1.6. EXAMINATION OF PREMISES AND WORK

- 1.6.1 Visit and examine the site where the work is to be done. Become familiar with all features and characteristics of the site and/or any existing structure before submitting a bid. No allowances will be made by the Owner for any difficulties encountered by this Contractor due to any peculiarities of the site, surrounding public or private property that existed when the Tender was submitted.
- 1.6.2 This Contractor shall examine the structural, mechanical, architectural, electrical and any other drawings issued to satisfy himself that the work can be satisfactorily carried out. Before commencing work or prefabrication, examine the work of other trades and report at once any defect or interference affecting the work of the electrical trade.
- 1.6.3 Where variances occur between the drawings and the specifications, or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract sum. The Engineer will decide on the item and manner in which the work shall be installed.
- 1.6.4 All bidders shall familiarize themselves with and adhere to the design builder's / property manager's building standards and guidelines.

1.7. TERMS AND CONDITIONS

1.7.1 DEFINITIONS

- 1.7.1.1. The term Owner shall be understood to refer to University of Ontario Institute of Technology (Ontario Tech University).
- 1.7.1.2. The term consultant shall be understood to refer to Howard Cohen, P. Eng., RCDD/LAN, MBA.
- 1.7.1.3. The term project manager shall be understood to refer to Ontario Tech University..
- 1.7.1.4. The term electrical contractor shall be understood to refer to the successful bidder to this specification for the electrical systems.
- 1.7.1.5. The term Contract shall be understood to refer to all items and conditions of this specification, Drawings, the complete tender package, the Contractor's tender submission and any other future contractual arrangements. All such items and conditions shall be binding unless agreed otherwise by the Contractor, Consultant and Owner.
- 1.7.1.6. The term Project shall be understood to refer to the complete supply and installation of the Electrical System and components, as defined in this specification and Drawings.
- 1.7.1.7. Wherever the words "equal", "equivalent", "approved", or "approved equal" are used, it shall be understood to mean, "equal", "equivalent", "approved", or "approved equal" in the opinion of the Consultant only.
- 1.7.1.8. Wherever the words "install", "provide", or "supply and install", are used it shall be understood to mean "provide and install, inclusive of all labour, materials, installation, testing, and connections" for the item to which referred.
- 1.7.1.9. "Concealed" is defined as "out of sight" in "normal" viewing conditions, and includes buried in concrete, above acoustic tile or gypsum board ceilings, within masonry or gypsum board constructed walls, within cable trays of below raised access floors.
- 1.7.2 These specifications or the drawings shall not be used alone. Any item or subject omitted from one, but mentioned or reasonably implied in the other, shall be provided. Misinterpretation of any requirements of either the specification or drawings shall not

result in any additional charge after submission of Tender. This Contractor shall, by careful study of the total requirements, include all necessary components to make each system workable. The consultant shall be contacted for written clarification on any point before the submission of Tenders.

- 1.7.3 All terms and conditions of the specifications, tender documents and accompanying Drawings shall be strictly adhered to by the Contractor, unless otherwise noted. Any inability to comply with these requirements must be stated in writing, in detail, with the response submission. Otherwise, it shall be understood that the Contractor is bound to compliance with the stated terms and conditions.
- 1.7.4 The Contractor shall co-operate fully with the Owner, Consultant, landlord and landlord's agent and all contractors, sub-contractors and other persons working on the site.
- 1.7.5 The Contractor shall do the complete installation in accordance with the latest editions of the Ontario Building Code, Electrical Safety Code, CSA, NFPA, or other Codes or governing authorities of competent jurisdiction. In case of discrepancies with this or the manufacturer's specifications, the Contractor shall notify the Consultant immediately.
- 1.7.6 Obtain and pay for permits (note: Building Permit obtained by owner) and inspections required for work performed. Provide Certificate(s) of Acceptance from the Authorities Inspection Department, upon completion of work.
- 1.7.7 Submit required Documents and shop drawings to authorities having jurisdiction in order to obtain approval for the Work. Copies of Contract Drawings and Specifications may be used for this purpose. Prepare any additional information, details and drawings which these authorities may require.
- 1.7.8 The Contractor must comply with all requirements of the Occupational Health & Safety Act.
- 1.7.9 In order to meet the requirements of substantial completion the electrical contractor must complete the following:
 - 1.7.9.1. Installation and successful testing of all electrical system devices as per mutually agreed to tests and commissioning plan.
 - 1.7.9.2. Submission of all coordination and permit documentation for the Consultant's review.
 - 1.7.9.3. Submission of all record and As-built documentation.
 - 1.7.9.4. Correction of any deficiencies in the electrical system.

1.8. SCHEDULE

- 1.8.1 All work including testing and commissioning of the 'Utility', 'EPS' and 'UPS' electrical systems must be completed as per the schedule provided by the project manager. Refer to schedule provided by the project manager for additional details. Include for all necessary overtime required to carry out the project. The successful contractor will not be permitted claims as a consequence of this requirement. The successful contractor to submit a full construction schedule before starting any work.
- 1.8.2 Sufficient manpower, materials, equipment, appliances and services are to be kept on site at all times to maintain the scheduled completion of work.

- 1.8.3 All work required to be done after office hours and weekends (including x-raying, core drilling and power shutdowns), shall be included in the tender price. Note: All x-raying and core drilling shall be provided by the electrical contractor.
- 1.8.4 Work associated with power shutdowns (including switching services from permanent, portable or temporary generator distribution back to utility power) and with testing and commissioning of electrical systems (including load bank testing of UPS and EPS) must be carried out between Sunday @12:01am and 4:00am. All shutdowns must be approved by Owner.

1.9. CONTRACT DRAWINGS

- 1.9.1 The Drawings for the electrical system work are diagrammatic performance Drawings, intended to convey the scope of work and indicate the approximate sizes and locations of equipment and outlets. The Drawings do not intend to show Designer's Architectural, Mechanical or Structural details.
- 1.9.2 Do not scale or measure Drawings, but obtain information regarding accurate dimensions, from the dimensions shown or by site measurements. Follow the Drawings for laying out the work.
- 1.9.3 Make, at no additional cost, any changes or additions to materials and equipment necessary to accommodate Structural conditions (offsets around beams, columns, etc.).
- 1.9.4 Alter at no additional cost, the location of materials and/or equipment as directed, provided that the changes are made before installation, and do not necessitate additional materials.
- 1.9.5 Change location of termination panels and devices at no extra cost providing cable length increase resulting from relocation does not exceed 3m (10') and information is given before installation.
- 1.9.6 Confirm at the site the exact location of equipment.
- 1.9.7 Any miscellaneous materials, hardware, devices, wiring, etc., not specifically described, but required for the installation and operation of the electrical system, shall be provided and included as part of the Bid.

1.10. MATERIALS AND EQUIPMENT

- 1.10.1 All materials and equipment shall be completely new and unused products of only the most recent manufacturer model or version number, CSA or UL certified, and manufactured to the Standards specified.
- 1.10.2 Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the local Inspection Department.
- 1.10.3 No damaged, chipped or marked equipment or materials will be accepted and must not be installed.

1.11. SUBSTITUTES

- 1.11.1 All tenders must be based on specified items. Substitutes will not be permitted.

1.12. OPERATION AND MAINTENANCE MANUALS

- 1.12.1 Provide three (3) soft copy scanned sets of operation and maintenance manuals for equipment and products supplied. Media shall be USB drives.
- 1.12.2 Include the following information in the Operation and Maintenance manuals:
 - 1.12.2.1. Names and address of local suppliers for the items included.
 - 1.12.2.2. Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature is not acceptable.
 - 1.12.2.3. Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.
- 1.12.3 Review information provided in the maintenance instructions and manuals with the Owners' operating personnel to ensure a complete understanding of the electrical equipment and systems and their operation.

1.13. PROGRESS PAYMENTS

- 1.13.1 Submit a complete breakdown of the Contract with each progress billing, indicating percentage of work complete, in a form acceptable to the Owner/Consultant.
- 1.13.2 The amount of monies to be allocated for close out documents must be 3% of contract value. This does not include monies allocated for studies, testing, measurement and verification, commissioning, etc.

1.14. SHOP DRAWINGS

- 1.14.1 Submitted Shop Drawings must indicate details of construction, dimensions, capacities, weights and electrical performance and flame spread characteristics of equipment or materials, as well as specification reference Section number and project name.
- 1.14.2 Shop Drawings shall be provided with sufficient space on the front for all Consultant's and Contractor's "review" stamps.
- 1.14.3 Work affected by submittal shall not proceed until review is complete.
- 1.14.4 Review submittal prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of the work and Contract Documents and bears the Stamp of Communications Contractor.
- 1.14.5 Changes made to the Shop Drawings by the Consultant will not affect the Contract Price.
- 1.14.6 Submit Shop Drawings for all material and equipment referred to in contract document.

1.15. FIELD SUPERVISION

- 1.15.1 Throughout the duration of the Project, a properly qualified Electrical Field Supervisor must be available at all times. The Supervisor who starts the work must not be changed unless requested by the project manager, or written permission from the project manager is obtained.

- 1.15.2 In addition, provide proper office supervision of the work. The person responsible for office supervision must visit the site as often as necessary, to ensure work is properly performed, and attend weekly site meetings when so requested.

1.16. SITE RESPONSIBILITIES

- 1.16.1 Maintain work areas to be free of construction debris and waste. The disposal of all materials shall be the responsibility of the Contractor.
- 1.16.2 Make all necessary arrangements to transport materials and equipment to and within the site. The Contractor shall be responsible for arranging for the use of any hoists, lifts, pulleys, winches, cranes or service elevators.
- 1.16.3 The Contractor is responsible for complete storage, handling, delivery, and installation of all materials used in the performance of the work.
- 1.16.4 Obtain a copy of the Landlord's leasehold design manual and ensure that all requirements are complied with.

1.17. DELIVERIES / ACCESS

- 1.17.1 Coordinate all deliveries to site with the Building Manager. Book loading dock and service elevators 72 hours in advance. Contractor must pre-arrange all site access and authorization for all site personnel and subcontractor personnel with the Building Project Manager or his representative

1.18. TESTING AND COMMISSIONING

- 1.18.1 Provide testing and commissioning as per Testing and Commissioning Plan to be reviewed and approved by the Consultant and Project Manager for all items and their related components.
- 1.18.2 Supply all required equipment maintenance and operations manuals, for owner's staff use.
- 1.18.3 Provide all required software for monitoring, annunciation and control/dispatch applications

1.19. OTHER

- 1.19.1 The tender documents shall remain the property of the Project Manager. Bidders are required to return the tender documents to the Project Manager with their bids.
- 1.19.2 It is the responsibility of the Contractor to perform all cutting, patching and repair related to the electrical system work.
- 1.19.3 Work by the electrical contractor shall be protected during erection against disfigurement, contamination or damage by mechanical abuse or harmful materials. Protective covers shall be installed where exposure to potential damage is likely. The contractor shall ensure that no eating, drinking or smoking is carried out in the finished areas. Damages resulting from a breach of these requirements shall be repaired at the cost of the electrical contractor.
- 1.19.4 Existing and adjacent finishes, work and structures shall be protected from damage resulting from work of this project.

1.20. RECORD AND AS BUILT DRAWINGS

- 1.20.1 The Contractor shall maintain two sets of drawings on site. Clearly mark on these drawings all changes and deviations from the contract drawings and in particular mark the actual location of all feeder conduit locations.
- 1.20.2 All deviations from the contract drawings shall be recorded on the "as built" drawings, including those changes due to Addenda, Site Instructions or Change Orders.
- 1.20.3 After the date of Substantial Performance, obtain from the Consultant, a set of the most recent Electrical System Drawings in AutoCAD Version 2024 format. These Drawings shall be marked up to record clearly, neatly, accurately and promptly all locations of Electrical System deviations as a result of Change Orders, Consultant's or Owner's Instruction, site conditions, etc. Utilize normal recognized CAD procedures that match the original drafting methodology. Submit the revised As-Built AutoCAD files and full-sized drawings (three sets) with changes clearly indicated to the Consultant for review and final presentation to the Owner.
- 1.20.4 For the disk drawing submission described above, the contractor must **include as part of the base bid price \$750.00** to have HCC Engineering supply the AutoCAD Version 2024 floor plans denoted as 'Issued for Review' through file transfer site.

1.21. DRAWINGS

- 1.21.1 For exact details and quantities, refer to the later sections of this document and to drawing No. E-0.0, E-1.1 through E-1.4 inclusive, E-2.4, E-2.5, E-3.4, E-3.5, E-4.1, E-5.4, E-5.5, E-6.4, E-6.5, E-7.1, E-12.1, E-15.4 and E-15.5 denoted as 'Reissued for Tender – April 7, 2026.'

1.22. CONTRACT

- 1.22.1 Conform to the conditions stated in the Contract Form, Document CCDC-2.
- 1.22.2 A confidentiality agreement will form an integral part of the contract and will be provided to the successful contractor.

1.23. CLEANING

- 1.23.1 It is the responsibility of the Contractor to dispose of all waste related to this project.
- 1.23.2 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
- 1.23.3 On a daily basis, remove waste materials, rubbish, tools, equipment, machinery, surplus materials and clean all sight exposed surfaces.
- 1.23.4 All materials must be stacked neatly and safely.
- 1.23.5 Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.
- 1.23.6 Cleaning operations shall include those areas used for temporary site access or used on a temporary basis to facilitate work.
- 1.23.7 The contractor will remove all garbage from site on a daily basis at his own expense.
- 1.23.8 Failure to provide housekeeping and/or maintain a clean work area to the satisfaction of the project manager will result in the project manager providing the necessary

housekeeping and/or maintenance service with all related costs, including mark-up's, being charged to the electrical contractor.

1.24. DEMOLITION

- 1.24.1 Disconnect and remove existing conduit and wiring in partitions to be demolished and existing 'BX' cables, conduit and wire in ceiling where existing outlets, lighting fixtures, devices and mechanical equipment are to be removed.
- 1.24.2 Remove all branch circuit wiring and raceways originating from the existing receptacle panels. Wiring and raceways shall be removed back to the source panel. Circuits utilized to feed existing to remain mechanical equipment and other 120/208 volt sources to remain must be maintained.
- 1.24.3 Remove all existing electrical outlets and light switches as well as the associated wiring and raceways not being reused and/or not required for new layout (note: existing outlets and switches to be removed are not shown on the drawings). Provide blank coverplates at all locations where electrical and/or communications devices were removed in which partitions are not being demolished.

1.25. WORK RELATED TO FIRE ALARM SYSTEM

- 1.25.1 All work required related to the base building fire alarm system shall be included in the Tender Price. Employ and pay for the services of Siemens where fire alarm system connections are required. Provide all conduit, cables, connectors and outputs required Chubb (note: all cables must be enclosed in conduit).
- 1.25.2 Digital Photos
- 1.25.3 Provide digital photos of all progress to date on a weekly basis. Each photo submission must be reviewed and approved by the consultant prior to continuing with the installation.

End of Section

PART 1 - GENERAL

1.1. REFERENCE

- 1.1.1 This section forms part of every section of Division 26.

1.2. ACCESS DOORS

- 1.2.1 Not Required.

1.3. CLEANING

- 1.3.1 Clean devices and other surfaces that have been exposed to construction dust and dirt. Clean the insides and outsides of panels and other electrical equipment and completely remove all debris and tools from the project.

1.4. CODES AND STANDARDS

- 1.4.1 Complete the installation of the work in accordance with latest editions of the Ontario Building Code, Electrical Safety Code, CSA, ULC, NFPA or other codes, as required.
- 1.4.2 Comply with Electrical Bulletins in force at time of Bid submission. While not identified and specified by number in this Division, they are to be considered as forming part of related Standards.
- 1.4.3 Abbreviations for electrical terms are as per CSA Z85.

1.5. FINISHES

- 1.5.1 All shop finished metal equipment and enclosure surfaces, must be prepared by removal of rust and scale from the raw metal, degreasing, cleaning, application of rust resistance primer inside and outside, and at least two coats of finish enamel paint. Use factory standard colours unless otherwise specified. Colour reference numbers are Sico.
- 1.5.2 Paint exterior surfaces of indoor electrical equipment to manufacturer's standard.
- 1.5.3 Clean and touch-up (to Consultant's acceptance) surfaces of shop-finished equipment that is scratched or marred during shipment or installation, so as to match original paint.
- 1.5.4 Leave with the Owner, 0.22 gal. of paint of each colour used, in the form of liquid or spray, to allow for future touch-up of damaged areas.

1.6. INSERTS, HANGERS AND SLEEVES

- 1.6.1 Provide hangers, inserts, sleeves and supports as required.
- 1.6.2 Inserts are to be of lead shield type.
- 1.6.3 Hangers must not be welded to structural steel members and burning of holes in structural steel is prohibited.
- 1.6.4 Sleeves are to be of a type suitable for the application and be sealed and made watertight. Sleeves through concrete shall be sized for free passage of conduit, and installed flush with underside of concrete slab and extend 100mm (4") above finished floor unless otherwise shown.

1.7. INTENT

- 1.7.1 It is the intent of these drawings and specifications that the Contractor provide complete and operational systems as required.
- 1.7.2 Where differences occur, the maximum condition shall govern.
- 1.7.3 Any miscellaneous items, hardware, devices, wiring, etc., not specifically described, but required for the operation of the system, must be provided and included as part of the Bid.

1.8. MOUNTING HEIGHTS

- 1.8.1 Mounting height of equipment is from finished floor to center line of equipment unless specified or indicated otherwise.
- 1.8.2 If mounting height of equipment is not indicated, verify with Consultant before proceeding with installation.

1.9. OWNERS INSTRUCTION AND TRIAL USAGE

- 1.9.1 Instruct the Owner's operating personnel in the startup, operation, care and maintenance of all the equipment. All equipment to be tested, operational and commissioned before instruction. Provide sheets for signatures of Owner's representative and operating personnel present at each instruction period.
- 1.9.2 Arrange and pay for the service of the manufacturer's factory service Engineer/Technician to supervise the start-up of his equipment installation, and to check, adjust, balance and calibrate components.
- 1.9.3 Provide these services for such period, and for as many visits as necessary to ensure that the Owner's operating personnel are conversant with all aspects of its care and operation.
- 1.9.4 When commissioning is included in the contract:
 - 1.9.4.1. Prior to any instruction sessions, commissioning coordinator shall submit check lists of each system or equipment indicating their operation status for acceptance by the Owner.
 - 1.9.4.2. Coordinate all instruction sessions to suit Owner's operation personnel schedule. Submit proposed instruction session schedule c/w training agenda three weeks prior to session start date to Owner for review.
 - 1.9.4.3. The Owner's operating personnel must be permitted to operate the systems under the contractor's supervision for a reasonable period of time prior to Substantial Completion of Contract. This use shall not be misconstrued as acceptance of the equipment.

1.10. PLYWOOD BACKBOARD

- 1.10.1 Supply and install all plywood backboards required for the work of this Division. Plywood to be highest quality fire retardant fir. 1200 mm wide x 2400 mm high (4'-0" wide x 8'-0" high), 19mm (3/4") thick unless otherwise specified. Prime and paint backboards on both sides with fire retardant paint, equal to CGSB spec. #1-GP-151M, of a colour to match the equipment and services mounted thereon as defined in "Finishes" above. **Do not paint over fire rated stamps.**

- 1.10.2 Plywood backboards are to be provided for mounting the following surface wall mounted equipment:
 - 1.10.2.1. Cabinets.
 - 1.10.2.2. Contactors.
 - 1.10.2.3. Control Panels
 - 1.10.2.4. Disconnect Switches.
 - 1.10.2.5. Junction Boxes 600mm (2') square and larger.
 - 1.10.2.6. Pull Boxes.
 - 1.10.2.7. Panel Boards.
 - 1.10.2.8. Splitters
 - 1.10.2.9. Transient Voltage Surge Suppression Units.
 - 1.10.2.10. External Breakers
- 1.10.3 Where practical, group devices on a common backboard.

1.11. PROTECTION

- 1.11.1 Protect exposed live equipment during construction for personnel safety.
- 1.11.2 Shield and mark live parts "LIVE 600 VOLTS", or with appropriate voltage in English.

1.12. SEALING

- 1.12.1 Where cables or conduits pass through non fire-rated floors, walls or roof, provide internal and external sealing thereto.
- 1.12.2 Retain the service of a specialty sealant contractor for the work required.
- 1.12.3 Comply with manufacturer's installation instructions for all sealant applications.
- 1.12.4 For non-fire rated locations, Sealant shall be silicone, that meets requirements of CGSB 19-GP-23, for the size of the joint required, and the types of materials being bonded.
- 1.12.5 For fire rated locations, the fire stop shall meet the requirements of UL with regards to the type of assembly and the fire separation.
- 1.12.6 Provide architecturally approved air barrier seals and vapor barrier seals to electrical items passing through or terminating within walls, roofs and decks, humidity controlled areas and pressurized areas.
- 1.12.7 All materials used for fire stopping of penetrations must be Hilti Limited manufactured product only.

1.13. SPRINKLER PROOFING

- 1.13.1 All areas of this building are protected by a wet sprinkler system. **All electrical equipment** to be configured for installation in such an environment.

1.14. WARNING SIGNS

- 1.14.1 Provide warning signs, as specified to meet requirements of Department of Labor Safety Inspection, Inspection Department, Authorities having jurisdiction and Consultant.
- 1.14.2 Use decal signs, in English minimum as required by Authorities.

1.15. WIRE PULLING LUBRICANT

- 1.15.1 Lubricant to be non-corrosive and NFPA 70 approved for the type of cable used.
- 1.15.2 Lubricants to be soap or wax based, depending upon application. Use soap based for short runs and for semi-conducting insulated wires, and wax based for long runs.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1 Provide all wire and box connectors required for a complete electrical system installation.

PART 2 - PRODUCTS

2.1. MATERIALS

- 2.1.1 Pressure type wire connectors are to be manufactured to CSA C22.2 No.65. Clamps and connectors are to be manufactured to CSA C22.2 No. 18.
- 2.1.2 Building Wire Connectors shall be:
- 2.1.2.1. For wire sizes up to #6 AWG - Ideal "Wing Nut" or Gardner - Bender "Wing Gard".
- 2.1.2.2. For Wire Sizes #4 AWG and larger:
- 2.1.2.2.1. End to end splices - Burndy YS.
- 2.1.2.2.2. Parallel splices - Burndy YC & YH (CU) or YHO & YHD (CU / AL).
- 2.1.2.2.3. At studs and bus bars - Burndy YA (CU) or YA-A (CU / AL).
- 2.1.2.2.4. Two or three conductors in parallel - Burndy KA-U (CU / AL).
- 2.1.2.3. Cable connectors shall be:
- 2.1.2.3.1. For armored TECK cables, watertight type, with open compounded head - T&B series "Spin-on 2" with corrosion resistant boot.
- 2.1.2.3.2. For armored cables steel type with nylon insulated throat - T&B "TITE-Bite".
- 2.1.2.3.3. Clamps or connectors for armored cable, flexible conduit non-metallic sheathed cable shall be as required.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1 Remove insulation carefully from ends of conductors and:
- 3.1.1.1. Install connectors and tighten as recommended by manufacturer.
- 3.1.1.2. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
- 3.1.2 Install bushing stud connectors in accordance with NEMA 1Y-2.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1 Provide building wire as detailed below and as required for a complete electrical installation

PART 2 - PRODUCTS

2.1. MATERIALS

- 2.1.1 Wire in Conduit:
- 2.1.1.1. Conductor material to be annealed commercial grade, copper, 98 percent conductivity, up to #10 AWG solid, with RW90 insulation, #8 and larger, stranded, with RW90 insulation, unless noted otherwise, 300V rating for fire alarm, security and other low voltage circuits, 600V rating for 120 / 208V circuits, 1000V rating for 230 / 400V circuits, 1000V rating for 277 / 480V circuits, 1000V rating for 347 / 600V circuits.
- 2.1.1.2. Colour Coding (must be approved by ESA Field Inspector):
- 2.1.1.2.1. Two conductor, 1 phase: 1 black, 1 white
- 2.1.1.2.2. Three conductor, 1 phase: 1 red, 1 black, 1 white
- 2.1.1.2.3. Three conductor, 3 phase: 1 red, 1 black, 1 blue
- 2.1.1.2.4. Four conductor, 3 phase: 1 red, 1 black, 1 blue, 1 white
- 2.1.2 Ground wires: green.
- 2.1.3 Low voltage Armored Cables Type AC-90:
- 2.1.4 Type to be AC-90, Multi-conductor, with solid, annealed commercial grade 98 percent conductivity tinned copper conductors and cross-linked polyethylene with R90 insulation, 600 volt rating, on #10 and #12 size only.
- 2.1.5 Colour Coding:
- 2.1.5.1. Two conductor, 1 phase: 1 black, 1 white
- 2.1.6 Three conductor, 1 phase: 1 black, 1 red, 1 white
- 2.1.7 Grounding to be uninsulated, solid copper, with impregnated paper separator.
- 2.1.8 Low voltage Armored Cables - TECK:
- 2.1.8.1. Type to be TECK, single conductor with annealed. Class B, stranded copper conductors and cross linked polyethylene, RW90 insulation, 1000 volt rating for #8 AWG and larger.
- 2.1.8.2. The inner and outer jackets to be PVC "Flamenol" suitable for -40°C, with mylar tape separator and aluminum strip, armour helically wound and interlocked.
- 2.1.9 Two Hour Fire Rated Cable - Mineral Insulated
- 2.1.9.1. Mineral Insulated Cables:

- 2.1.9.1.1. Mineral insulated cables shall be manufactured to CSA C22.2 No. 124.
- 2.1.9.1.2. Conductors are to be solid, bare, soft annealed copper, sized as required.
- 2.1.9.1.3. Insulation to be compressed powdered magnesium oxide, to form compact homogeneous mass throughout entire length of cable.
- 2.1.9.1.4. Overall covering to be annealed seamless copper sheath, type LW MI, rated 600 volt, 250°C.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1 General:
 - 3.1.1.1. Wire shall be installed in conduit and sized for the connected load(s) and protection as required, unless otherwise specified.
 - 3.1.1.2. Provide a dedicated #12AWG neutral from panel board to wiring devices ran with each of Phase 'A,' B,' C' conductors (ie: dedicated neutral per phase). Minimum power conductor wire size shall be #12 AWG.
 - 3.1.1.3. Minimum power conductor wire size shall be #12 AWG, unless otherwise stated. Home runs in excess of 30 m (90') for circuits protected by a 15A over current device, shall be #10 AWG.
 - 3.1.1.4. The current carrying capacity of the feeders, subfeeders and branch circuit conductors shall be sized to equal or better than shown on the drawings. If wire or cable sizes with equivalent current carrying capacity other than that specified is used, ensure that the voltage drop shall not be more than 2%.
 - 3.1.1.5. The number of wires indicated for various systems is intended to show the general scheme only. The required number and type of wires shall be installed in accordance with the manufacturer's diagrams and with the requirements of the installation.
- 3.1.2 Wire in Conduit:
 - 3.1.2.1. Provide pigtails at all outlets for wiring devices. All neutrals and branch circuits shall be connected in each outlet box to avoid a break in the neutral or the circuit wire when fixture or wiring device is disconnected.
 - 3.1.2.2. At each junction, pull and outlet box make a 360 degree loop of the stripped uncut ground conductor under the ground screws.
- 3.1.3 Low Voltage Armored Cables - (Feeders):
 - 3.1.3.1. Do not directly bury in or below concrete slabs or walls.
 - 3.1.3.2. Do not encircle single conductor cable with ferrous metal.
 - 3.1.3.3. No splices will be permitted.
 - 3.1.3.4. Single conductors of the three or four wire circuit shall be run with uniform spacing of not less than one cable diameter throughout the feeder length.
 - 3.1.3.5. Use wood throated cable clamps to ensure proper and uniform cable spacing.

- 3.1.3.6. Where cables are installed on walls, provide mechanical protection over them up to 2.4m (8') above finished floor, using a 12 gauge U section aluminum cover.
- 3.1.3.7. Cable connections to all enclosures, boxes and panels shall be by means of a watertight malleable aluminum connector.
- 3.1.4 Mineral Insulated Cable:
 - 3.1.4.1. Run cable exposed as required, securely supported by straps.
 - 3.1.4.2. Make cable terminations by using factory made kits.
 - 3.1.4.3. Use thermoplastic sleeving over bare conductors at cable terminations.
 - 3.1.4.4. Do not splice cable.
 - 3.1.4.5. MI cables must be rigidly supported at maximum spacing of 1m (3'). Do not use aluminum products for support.
 - 3.1.4.6. MI cables shall be used for emergency system feeders and branch circuits requiring a one (1) hour fire rating.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1 Provide all grounding to conform with the Canadian Electrical Code and the latest instructions of the Inspection Authority, with any further requirements as noted herein.

PART 2 - PRODUCTS

2.1. MATERIALS

- 2.1.1 All grounding conductors stranded copper, bare or insulated as indicated on Drawings or in Specifications.
- 2.1.2 All ground wires are to be FT-4 rated factory green. Green tape, spray paint or any other means to alter the colour of the conductor is not permitted.
- 2.1.3 Use Cadweld or Burndy Thermoweld process for all weld connections. AMP of Canada Ltd. Wrench-Lok grounding connectors are an acceptable equivalent to welded connections.
- 2.1.4 All ground connectors to be designed and approved for grounding purposes.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1 Ground all conduit, and all non-current carrying metal parts, equipment cases, frames, bases, brackets, etc.
- 3.1.2 Grounding of all trays, AFCRs, racks, cabinets, etc. provided by the electrical contractor.
- 3.1.3 Ground each piece of fixed equipment back to the panel feeding that equipment, by one of the following methods:
- 3.1.3.1. Conduit shall **not** be utilized for the ground return conductor.
- 3.1.3.2. Where the conduit is flexible, install a separate bare soft drawn copper ground inside the conduit. At the switchboard or distribution panel, provide a grounding bushing, loop the ground conductor through the bushing, and connect to the switchboard ground bus. At the fixed equipment, connect to an internal ground bus, or connect to the inside of the metal enclosure utilizing approved screws and connectors (remove all paint).
- 3.1.3.3. Run a separate (dedicated) insulated ground wire in all conduits to all devices and fixtures.
- 3.1.3.4. Where equipment is fed by a multi-conductor power cable, provide a ground conductor in the cable. At the switchboard or panel, connect to the ground bus. Use a grounding connector on the cable for positive grounding of the metallic sheath. Loop the ground wire to the grounding connector.
- 3.1.3.5. Run a separate ground wire in all flexible conduits. Connect each end to ground bus or lug or connector.

- 3.1.3.6. Where mechanical protection is required for insulated grounding conductors install in rigid conduit.
- 3.1.4 Provide weld connection or wrench type grounding connectors for:
 - 3.1.4.1. All connections between grounding conductors.
 - 3.1.4.2. All connections to building steel.
 - 3.1.4.3. All connections between grounding conductors and cable lugs.
- 3.1.5 Arrange grounding to provide the minimum impedance paths for ground fault currents. Provide any additional grounding required for approval by the inspecting authorities.

3.2. EQUIPMENT GROUNDING

- 3.2.1 Install grounding connections to typical equipment including non-current carrying metal parts of transformers, generators, motors, circuit breakers, cable sheaths, raceways, pipe work, screen guards, switchboards, meter and relay cases, any exposed building metal and building structural steel.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1 Provide Hangers and Supports for Electrical Systems as required for a complete electrical system installation.

PART 2 - PRODUCTS

2.1. SUPPORT CHANNELS

- 2.1.1 U shape pre-galvanized steel, size 41 mm x 41 mm x 22 mm (1-5/8" x 1-5/8" x 7/8"), for surface mounting, suspending, or inserting into poured concrete walls and ceilings as required.
- 2.1.2 All channel fittings to suit channel type.
- 2.1.3 All other fittings to suit equipment weight, location and surface as required.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1 Secure plywood backboards, channels, luminaires, equipment and fittings to wood with wood screws, to solid masonry, tile and plaster surfaces with lead anchors, to poured concrete with self-drilling expandable inserts, and to hollow masonry walls with toggle bolts.
- 3.1.2 All ceiling mounted equipment shall be independently supported from the structure. Do not support equipment from ceiling support system.
- 3.1.3 Support equipment, conduit or cable using clips, spring loaded bolts, or cable clamps designed as accessories to basic channel members.
- 3.1.4 Fasten exposed conduit or cables to building using:
- 3.1.4.1. Two-hole steel straps to secure surface conduits and cables 50 mm (2") and smaller.
- 3.1.4.2. Two-hole steel straps for conduits and cables larger than 50 mm (2").
- 3.1.4.3. Beam clamps to secure conduit to exposed steel work.
- 3.1.5 For suspended support system:
- 3.1.5.1. Support individual cable or conduit runs with 6 mm (1/4") diameter threaded rods and spring clips.
- 3.1.5.2. Support two or more cables or conduits on channels support by 6 mm (1/4") diameter threaded rod hangers where direct fastening to building construction is impractical.
- 3.1.5.3. Support suspended luminaire using two or more lengths of Weldless "Single Jack", bright zinc plated steel chain, American Standard #10 gauge, 13 links per foot.
- 3.1.6 Provide metal brackets, frames, hangers, clamps and related type of support structure where indicated or as required to support conduit and cable runs.

- 3.1.7 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- 3.1.8 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- 3.1.9 Do not use supports or equipment installed for other trades for conduit or cable support except with permission and approval of Consultant.
- 3.1.10 Install Hangers and Supports for Electrical Systems as required for each type of equipment, cable and conduits, and in accordance with manufacturer's installation recommendations.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED:

- 1.1.1 Provide splitters, junction boxes, pull boxes and cabinets as shown on the drawings and as required for a complete electrical installation.

PART 2 - PRODUCTS

2.1. SPLITTER TROUGHS

- 2.1.1 Splitter trough construction is to be based on CSA C22.2 No. 76.
- 2.1.2 They shall have sheet steel enclosure, with welded corners and formed hinged cover suitable for locking in closed position.
- 2.1.3 Connection bars are to match required size and number of incoming and outgoing conductors as indicated.
- 2.1.4 Provide at least three spare terminals on each set of lugs in splitter troughs less than 400A and feed through lugs where required.
- 2.1.5 Provide double lugs for neutrals where required.
- 2.1.6 Enclosures shall be CSA/EEMAC Type 1 modified to sprinkler proof enclosure.

2.2. JUNCTION AND PULL BOXES

- 2.2.1 Junction and pull boxes construction is to be based on CSA C22.2 No. 40.
- 2.2.2 They shall be suitable for surface mounting and be of welded steel construction with screw-on flat covers.
- 2.2.3 For flush-mounted pull and junction boxes, provide covers with 25 mm (1") minimum extension all around.

2.3. GENERAL CABINETS

- 2.3.1 Type D or E to be sheet steel, for surface mounting, complete with screw on cover (D) or hinged door (E), and return flange overlapping sides, handle and catch.

PART 3 - EXECUTION

3.1. SPLITTER INSTALLATION

- 3.1.1 Install splitter troughs where required. Mount plumb, true and square to the building lines.
- 3.1.2 Extend splitters for full length of equipment arrangement except where indicated otherwise.
- 3.1.3 Provide **watertight connections** for all services entering the top of the splitter trough.

3.2. JUNCTION, PULL BOXES AND CABINET INSTALLATION

3.2.1 Install junction, pull boxes and cabinets in inconspicuous but accessible locations.

3.2.2 Only certain junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 m (100') of conduit run between boxes, and after every two (2) 90 degree bends.

3.3. IDENTIFICATION

3.3.1 Install nameplates.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1 Provide outlet and conduit boxes and fittings as required for a complete electrical system installation.

PART 2 - PRODUCTS

2.1. OUTLET AND CONDUIT BOXES - GENERAL

- 2.1.1 The construction of outlet boxes, conduit boxes and fittings is to be based on:
- 2.1.1.1. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- 2.1.1.2. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, [ferrous alloy] [aluminum], Type FD, with gasketed cover.
- 2.1.1.3. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C
- 2.1.2 Boxes shall be suitable for the utilization voltage.
- 2.1.3 Combination boxes shall have barriers where outlets for more than one system are grouped.
- 2.1.4 Recessed 100 mm (4") square or larger outlet boxes shall be complete with single or ganged plaster rings to suit application.

2.2. SHEET STEEL OUTLET BOXES

- 2.2.1 Electro-galvanized steel single and multi-gang device boxes for flush installation, shall be minimum size 75 mm x 50 mm x 37 mm (3" x 2" x 1-1/2") unless otherwise specified or required. 100 mm (4") square outlet boxes shall be used when more than one conduit enters one side, with extension and plaster rings as required.
- 2.2.2 Boxes for door switches and push buttons shall be sized as required.
- 2.2.3 Utility boxes for connection to surface mounted EMT conduit, shall be minimum 100 x 54 x 48 mm (4" x 2-1/8" x 1-7/8") size.
- 2.2.4 Square or octagonal outlet boxes for lighting fixture outlets, shall be minimum 100 mm (4") size.
- 2.2.5 Square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls, shall be minimum 100 mm (4") size.

2.3. MASONRY BOXES

- 2.3.1 Electro-galvanized steel masonry single and multi-gang MBD boxes shall be used for flush mounted devices in exposed block walls.

2.4. CONCRETE BOXES

- 2.4.1 Electro-galvanized sheet steel concrete boxes shall be used for flush mounting in concrete, with matching extension and plaster rings as required.

2.5. CONDUIT BOXES

- 2.5.1 Cast FS or FD ferrous boxes with factory-threaded hubs and mounting feet shall be used for outlets connected to surface mounted rigid conduit.

2.6. PVC BOXES

- 2.6.1 F series and octagon boxes shall be moulded type, with fastening ears and screwed secured covers as required.

2.7. FITTINGS - GENERAL

- 2.7.1 Bushing and connectors shall be with nylon insulated throats.
- 2.7.2 Provide knock-out fillers to prevent entry of foreign materials.
- 2.7.3 Use conduit outlet bodies for conduit up to and including 32 mm (1-1/4") and pull boxes for larger conduits.
- 2.7.4 Provide double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1 Support boxes independently of connecting conduits.
- 3.1.2 Fill boxes with paper, foam sponges or similar approved material to prevent entry of construction material.
- 3.1.3 Size box wiring chambers in accordance with Electrical Safety Code.
- 3.1.4 Gang boxes together where wiring devices are grouped.
- 3.1.5 Provide matching blank cover plates for boxes without wiring devices.
- 3.1.6 Use combination boxes where outlets for more than one system or voltage are grouped.
- 3.1.7 For flush installations, mount outlets flush with finished wall using plaster rings to permit wall finish to come within 5mm (1/4") of opening.
- 3.1.8 Provide correct size of openings in boxes for conduit and armored cable connections. Reducing washers are not allowed.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED:

- 1.1.1 Provide conduits, conduit fastenings and conduit fittings as detailed below and as required for a complete electrical installation.

PART 2 - PRODUCTS

2.1. CONDUITS

- 2.1.1 Rigid and epoxy coated conduit shall be threaded, galvanized steel and shall be manufactured to CSA C22.2 No. 45.
- 2.1.2 Electrical metallic tube (EMT) conduit and couplings shall be manufactured to CSA C22.2 No. 83.
- 2.1.3 Flexible metal conduit and liquid tight - flexible metal conduit shall be manufactured to CSA C22.2 No. 56.

2.2. CONDUIT FASTENINGS

- 2.2.1 Conduit straps shall be steel, double hole for rigid or EMT conduit. **Single hole straps are not acceptable.**

2.3. CONDUIT FITTINGS

- 2.3.1 Fittings for conduits shall be manufactured to CSA C22.2 No.18. Provide coatings as per conduit.
- 2.3.2 Fittings for rigid conduit shall be steel threaded type.
- 2.3.3 Fittings for EMT conduit to be steel set screw type fittings.
- 2.3.4 Fittings for flexible conduit and exposed conduit outdoors to be liquid-tight type, straight or angled threaded for rigid and compression for EMT conduit.
- 2.3.5 Expansion fittings for rigid or EMT conduits shall be of the watertight type, with an integral bonding assembly, suitable for deflection in all directions.

2.4. PULLING CABLES

- 2.4.1 Pulling cables shall be ¼" diameter polypropylene and of a strength suitable for tension to be pulled.

2.5. WATERPROOF MEMBRANE

- 2.5.1 Conduits penetrating waterproof membranes shall be PEM #6372.

PART 3 - PART III - EXECUTION

3.1. INSTALLATION (GENERAL)

- 3.1.1 The conduits for the following circuits and systems shall be run separately:

- 3.1.1.1. 120/208 volt utility power distribution.
- 3.1.1.2. 347/600 volt utility power distribution.
- 3.1.1.3. 120/208 volt emergency power distribution.
- 3.1.1.4. 347/600 volt emergency power distribution.
- 3.1.1.5. 120/208 volt UPS power distribution.
- 3.1.1.6. Normal power to luminaries.
- 3.1.1.7. Emergency power to luminaries and exit signs.
- 3.1.1.8. Fire alarm system multiplex loop devices.
- 3.1.1.9. Fire alarm system signaling devices.
- 3.1.1.10. Access Control and CCTV System devices.
- 3.1.1.11. Telephone and data systems.
- 3.1.1.12. Control wiring.
- 3.1.1.13. Net Status devices.
- 3.1.2 All conduits to be surface mounted (exposed, EMT) in mechanical and electrical service spaces and rooms and concealed elsewhere unless otherwise shown.
- 3.1.3 Wiring in ceiling spaces and in all partitions shall be EMT.
- 3.1.4 Exposed conduits shall be installed to conserve headroom and cause minimum interference in spaces through which they pass.
- 3.1.5 Use rigid conduit up to 2.4 m (8' -0") above finished floor where exposed indoors
- 3.1.6 **Use RGS conduit PVC coated galvanized rigid steel Robroy Permacote in all outdoor locations and in areas that are not environmentally controlled.**
- 3.1.7 Use electrical metallic tubing (EMT) above grade, and above 2.4 m (8'-0") above finished floor where exposed indoors.
- 3.1.8 Use flexible liquid tight metal conduit for connection to motors, and transformers.
- 3.1.9 Bend conduit without heating. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- 3.1.10 Mechanically bend conduit over 20mm (3/4") diameter.
- 3.1.11 Field threads on rigid conduit must be of sufficient length to draw conduits tight.
- 3.1.12 Install pulling cables in all conduits that are to remain "empty".
- 3.1.13 A maximum of two (2), 90 degree bends, or equivalent up to 180 degrees, will be permitted without installation of a pull box. Radius of bends must be no less than ten (10) times the conduit diameter.

3.1.14 Conduits must be dry, before installing wires.

3.1.15 Support all branch conduits from building structure. Do not clip conduits to ceiling hangers, sprinkler pipes, plumbing or BAS wiring hangers.

3.2. SURFACE CONDUITS

3.2.1 Surface conduits shall be run parallel or perpendicular to building lines.

3.2.2 Conduits located near any heat producing equipment shall have 1500 mm (5 ft.) clearance.

3.2.3 Conduits adjacent to structural steel, beams or columns shall be run within the flanged portion, unless otherwise shown.

3.2.4 Group exposed conduits on surface or suspended channels.

3.2.5 Do not pass conduits through structural members except where indicated and approved by landlord.

3.2.6 Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines. Provide a minimum clearance of 25 mm (1") at crossovers.

3.3. CONDUIT SIZE

3.3.1 The minimum conduit size shall be 19 mm (3/4").

3.3.2 All undimensioned conduits in the drawings are 19 mm (3/4").

3.4. EXPANSION FITTINGS

3.4.1 Conduit expansion fittings shall be provided on all conduits crossing expansion joints, and at maximum of 60 m (200') spacing.

3.4.2 Install expansion fittings perpendicular to expansion joint.

3.4.3 Refer to structural drawings for location of expansion joints.

End of Section

PART 1 - GENERAL

- 1.1.1 Provide all wiring devices indicated on drawings and described below.

PART 2 - PRODUCTS

2.1. STANDARDS

- 2.1.1 Construction of manually operated general purpose AC switches is to be based on CSA C22.2 No. 111, snap switches on CSA C22.2 No.55, and receptacles, plugs and similar wiring devices on CSA C22.2 No. 42.
- 2.1.2 Devices shall be Specification Grade and of one manufacturer throughout

2.2. SWITCHES

- 2.2.1 Switches shall be suitable for the voltage and load controlled and shall be single pole or three way as indicated.
- 2.2.2 They shall have terminal holes approved for No. 10 AWG wire, silver alloy contacts, and urea or melamine moldings for parts subject to carbon tracking.
- 2.2.3 They shall be suitable for back and side wiring, and rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- 2.2.4 White decorator style switches shall be used for 120V circuits, in all finished areas.
- 2.2.5 White decorator style switches shall be used for 347V circuits in all areas.

2.3. RECEPTACLES

- 2.3.1 Duplex receptacles shall be NEMA Type 5-15R, 125 volt, 15 Amp, U ground and NEMA Type 5-20R (T Slot), 125 volt, 15/20 Amp, U Ground.
- 2.3.2 They shall be decorator style.
- 2.3.3 They shall be suitable for No. 10 AWG, back and side wiring, have break-off links for use as split receptacles and shall have eight (8) back wired entrances, four (4) side wiring crews and double wipe contacts with riveted grounding contacts.

2.4. COVERPLATES

- 2.4.1 Coverplates shall be white in finished areas and stainless steel in unfinished areas.
- 2.4.2 Use die cast aluminum coverplates for wiring devices mounted for surface mounted FS or FD boxes, and pressed steel coverplates for utility surface boxes.
- 2.4.3 Use weatherproof spring-loaded, cast aluminum coverplates complete with gaskets for exterior mounted single receptacles and switches, or where indicated.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1 Switches:

- 3.1.1.1. Install single throw switches with lever in "UP" position when switch closed.
- 3.1.1.2. Install switches in gang type outlet box when more than one switch is required in one location.
- 3.1.2. Receptacles:
 - 3.1.2.1. Install receptacles in gang type outlet box when more than one device is required in one location.
- 3.1.3. Coverplates:
 - 3.1.3.1. Protect coverplate finish until painting and other work is finished or install after painting is complete.
 - 3.1.3.2. Do not use flush type coverplates on surface mounted boxes.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1 Supply and install fuses in disconnect switches, etc. as required to complete this contract.

PART 2 - PRODUCTS

2.1. FUSES - GENERAL

- 2.1.1 Plug and cartridge fuses shall be manufactured to CSA C22.2 No. 59.
- 2.1.2 HRC fuses shall be manufactured to CSA C22.2 No. 106 and to have interrupting capability of 200,000A symmetrical.
- 2.1.3 Fuses shall be the product of one manufacturer.
- 2.1.4 Fuse type reference L1, L2, J1, R1, etc. have been adopted for use in this specification.

2.2. FUSE TYPES

- 2.2.1 HRCI - J fuses.
- 2.2.1.1. Type J1, time delay, capable of carrying 500% of its rated current for 10 seconds minimum.
- 2.2.1.2. Type J2, fast acting.
- 2.2.2 HRC - L.
- 2.2.2.1. Type L1, time delay, capable of carrying 500% of its rated current for 10 seconds minimum.
- 2.2.2.2. Type L2, fast acting.
- 2.2.3 HRC - R fuses (For UL Class RK1 fuses, peak let-through current and I^2t values not to exceed limits of UL 198E table 10.2.)
- 2.2.3.1. Type R1, (UL Class RK1), time delay capable of carrying 500% of its rate current for 10 seconds minimum, to meet UL Class RK1 maximum let-through limits.
- 2.2.3.2. Type R2, time delay, capable of carrying 500% of its rated current for 10 seconds minimum.
- 2.2.3.3. Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- 2.2.3.4. HRCII - C fuses.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1 Install fuses in mounting devices immediately before energizing circuit.

- 3.1.2 Ensure circuit fuses fitted to physically matched mounting devices. Install Class R rejection clips for HRCI-R fuses.
- 3.1.3 Ensure correct fuses fitted to assigned electrical circuit.
- 3.1.4 Fuses protecting motor loads and transformers to be type J1 for up to and including 600A and L1 for ratings above 600A.
- 3.1.5 Fuses protecting feeder circuits to be type J2 for up to and including 600A and type L2 ratings above 600A.
- 3.1.6 Fuses protecting other services or equipment shall be of the type required for that purpose.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1 Provide all disconnect switches shown on the drawings and as required for motors.

PART 2 - PRODUCTS

2.1. EQUIPMENT

- 2.1.1 Fuseholder assemblies to CSA C22.2 No. 39
- 2.1.2 Fusible and non-fusible disconnect switches shall be installed in CSA enclosures.
- 2.1.3 Provide for padlocking in "OFF" switch position by one lock.
- 2.1.4 Provide a mechanically interlocked door to prevent opening when handle in "ON" position.
- 2.1.5 Provide fuses sized as required.
- 2.1.6 Fuseholders in each switch shall be suitable without adapters, for type of fuse as specified.
- 2.1.7 Provide quick make, quick break action.
- 2.1.8 Provide ON-OFF switch position indication on switch enclosure cover.
- 2.1.9 Enclosures shall be CSA/NEMA Type 1 modified to sprinkler proof enclosure.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1 Install disconnect switches with or without fuses as required.
- 3.1.2 Provide **watertight connections** for all services entering the top of the disconnect switches.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1 Provide Lighting fixtures as shown on the drawings and described below.

PART 2 - PRODUCTS

2.1. LAMP STANDARDS

- 2.1.1 Incandescent lamps shall be manufactured to CSA C22.2 No. 84.
- 2.1.2 Fluorescent lamps shall be manufactured to ANSI C78.
- 2.1.3 Incandescent, fluorescent and HID lamps shall be of 1 (one) manufacturer, either in total, or in groups defined by lamp type.
- 2.1.4 Ballast and lamps provided under this contract must be an approved combination by both respective manufacturers.

PART 3 - EXECUTION

3.1. INSTALLATION

- 3.1.1 Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- 3.1.2 Lamp and Driver / Ballast Installation:
- 3.1.2.1. Refer to luminaire schedule and drawings, for lamp and driver / ballast requirements.
- 3.1.2.2. Install lamps only when the luminaires are clean.
- 3.1.2.3. Ensure that lamps are suitable for luminaires before energization and lamp length and colours are that as specified. Report any discrepancies to the consultant.
- 3.1.3 Luminaire Installation:
- 3.1.3.1. Install luminaires accurately and carefully aligned complete with all mounting hardware. Ensure any suspension rods are vertical.
- 3.1.3.2. All luminaires shall be supplied with accessory items such as yokes, plaster rings, frame adjusters, etc., where required for proper installation.
- 3.1.3.3. At the time of date of "Substantial Completion" all luminaires, lenses, louvers and lamps must be clean and the lamps illuminated.
- 3.1.4 Luminaire Support:
- 3.1.4.1. All fixtures in finished ceilings must be chained by 2 points directly to main structure such that they are supported independently of the ceiling system.
- 3.1.4.2. All fixtures in exposed ceiling areas (no T-bar or Drywall) shall be mounted on 1-5/8" unistrut, running the full length of the run of fixtures. The unistrut is to be suspended from the ceiling deck by 3/8" threaded rod from unistrut between the joists. Do not puncture ceiling deck.

3.1.4.3. All lighting feeds for suspended fixtures shall be dropped from the deck or slab straight down into the fixture or raceway. Fixture to fixture conduits will not be permitted. Conduit must go to the deck then to the next fixture.

3.1.5 Cleaning:

3.1.5.1. All luminaires must be cleaned before lamping and installing lenses or louvres.

3.1.5.2. Use dry, clean, soft cloths if luminaires are dusty. Use mild solvents to clean soiled luminaires.

3.2. FIELD QUALITY CONTROL

3.2.1 Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

3.2.2 Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED:

- 1.1.1 Identify electrical equipment as specified herein.

1.2. MANUFACTURER'S NAMEPLATES:

- 1.2.1 Have the manufacturer's nameplates affixed to each item of all equipment showing the size, name of equipment, serial number and all information usually provided, including voltage, cycle, phase, horsepower, etc., and the name of the manufacturer and his address. Ensure that all stamped, etched or engraved lettering on plates is perfectly legible. Ensure that nameplates are not painted over. Where apparatus is to be concealed, attach the nameplate in an approved location on the equipment support or frame.
- 1.2.2 Ensure that panels and other apparatus which have exposed faces in finished areas do not have any visible trademarks or other identifying symbols. Mount nameplates behind doors.

PART 2 - PRODUCTS

2.1. LAMACOID PLATES:

- 2.1.1 Green background with black engraved letters 10 mm (0.4") high or 25 mm (1") high as noted for normal power distribution.
- 2.1.2 Red background with black engraved letters 10 mm (0.4") high or 25 mm (1") high as noted for EPS power distribution.

2.2. CONDUCTOR MARKERS:

- 2.2.1 Cable diameter less than 13 mm (1/2") - Electrovert type Z.
- 2.2.2 Cable diameter 13 mm (1/2") and larger - Electrovert #510 strap-on.
- 2.2.3 Colour - white with black markings except fire alarm and life safety system which shall be white with red markings.

PART 3 - EXECUTION

3.1. CONDUIT SERVICES - POWER:

- 3.1.1 Locate identification:
- 3.1.1.1. Behind each access door.
- 3.1.1.2. At each change of direction and at junction boxes.
- 3.1.1.3. At not more than 10 m (40') apart in straight runs of conduit behind removable enclosures such as lay-in type ceiling, but on both sides of sleeves through walls or floors.
- 3.1.1.4. Above each floor or platform for vertical exposed conduits, preferably 1500 mm (60") above floor or platform.

- 3.1.1.5. Use stencils and stencil paint or lamacoid plates on all conduits.
- 3.1.1.6. Use minimum 25 mm (1") high letters.
- 3.1.1.7. The identification shall describe system voltage and service, i.e., "120 / 208 volt lighting to panel AA".

3.2. CONDUITS AND OUTLET BOXES:

- 3.2.1 Identify conduits and outlet boxes for the various systems by the use of the following distinctive colour paints. Apply a small area of paint to the inside of each outlet box, pull box and panel as it is being installed. Identify junction boxes in suspended ceiling areas with colour on both inside and outside.
 - 3.2.1.1. 120 / 208 volt system. -Black
 - 3.2.1.2. Fire Alarm systems. -Red
 - 3.2.1.3. 347/600 volt system. -Blue
 - 3.2.1.4. Security Alarm system -Orange
- 3.2.2 Use the colour coding as defined in NEC Section 210.
- 3.2.3 Where the existing colour coding differs from these Specifications, notify the Consultant of colours used and maintain existing colour coding.

3.3. EQUIPMENT NAMEPLATES:

- 3.3.1 Identify all equipment listed below with lamacoid plates, letters 10 mm (0.4") high, unless otherwise noted.
 - 3.3.1.1. Lighting and Power Panels - Plates to be on outsides of door. Typical identification: "Lighting Panel C 120/208V, 3PH, 4 W MAINS 225 AMP 18KA RMS. Supplied from Panel BB".
 - 3.3.1.2. Disconnect switches and starters - Plates to be mounted externally on switch cover. Typical identification: "Fan S4, 208V, 3PH".
 - 3.3.1.3. Transformers - Plates to be mounted externally on case. Typical identification: "Transformer TR-UPSA 225 KVA/416/120/208V, 3PH / 4W fed from Panel UPS A".
- 3.3.2 Secure with mechanical fastening devices except on the inside of panel doors where gluing will be acceptable.

3.4. WIRING COLOUR CODE:

- 3.4.1 Power and Lighting Conductors:
 - 3.4.1.1. Phase A - Red
 - 3.4.1.2. Phase B - Black
 - 3.4.1.3. Phase C - Blue
 - 3.4.1.4. Neutral - White

- 3.4.1.5. Ground - Green
- 3.4.2 For sizes available in black only, use coloured tape markers at junction boxes and terminal points to match phase coding described above.
- 3.4.3 Band green isolated ground conductors with yellow tape.
- 3.4.4 Control conductors - Orange
- 3.4.5 Fire Alarm System Conductors.
- 3.4.6 Alarm initiating devices and manual pull stations - red and blue.
- 3.4.6.1. Alarm signaling devices - black and white.

3.5. CONDUCTOR MARKERS:

- 3.5.1 For power feeders, install markers at either end of the conductors where terminated inside of equipment to match wiring diagram conductor identification or panelboard circuit numbers. Typical identification Panel AA circuits - 21; use "AA-21". For a three phase circuit provide identification on phase A conductor only. For a single phase circuit provide identification on the phase conductor.
- 3.5.2 For Branch circuits supplying single phase and three phase devices such as receptacles and connections to equipment identify conductors at panel and in device outlet box. Install marker on phase conductor inside outlet box. Typical identification if device is connected to Panel B - circuit 14, marker identification "B-14".

End of Section

PART 1 - GENERAL

1.1. DESCRIPTION

- 1.1.1 Include in work of this section, the testing and commissioning of all new electrical and component systems.
- 1.1.2 Include any specific testing of equipment required by the Hydro Inspection or Supply Authorities.
- 1.1.3 The complete costs of the site, load bank and factory testing and commissioning witnessing of Electrical Equipment is to be included in the Bid price.
- 1.1.4 Inform manufacturers of all factory and site testing requirements and include all their costs in the Bid price.
- 1.1.5 At their own discretion, testing is to be witnessed by the Owner and the Electrical Consultant.

1.2. SCOPE

- 1.2.1 Include factory testing and approved certification, where required.
- 1.2.2 Coordinate with the equipment manufacturer, notify the Electrical Consultant in writing, 10 (ten) days before any factory testing to confirm Consultant's desired presence, and be present for all site testing.

1.3. COMPLETION OF WORK

- 1.3.1 All electrical systems and equipment shall be totally commissioned and operating before date of "Substantial Completion".
- 1.3.2 Coordinate with other trades and the building operations staff for work which affects the operation of the electrical systems, before submitting request for testing and commissioning. Failing to comply, bear all costs including Consultant's time cost, incurred for re-testing and re-commissioning.

PART 2 - PRODUCTS

2.1. MATERIALS

- 2.1.1 Provide all tools, equipment, labour and materials required to perform electrical testing and commissioning as specified. Provide the test results report (s).

PART 3 - EXECUTION

3.1. GENERAL

- 3.1.1 Perform site testing and commissioning only after all equipment is installed and operational.
- 3.1.2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- 3.1.3 Provide four (4) copies of certificates of all factory and site testing in complete detail bearing in each case, the seal of the engineer responsible for the tests.
- 3.1.4 Submit all test results for Consultant's review.
- 3.1.5 All equipment or system deficiencies identified by factory or site testing procedures, to be corrected by the Contractor prior to obtaining a "Certificate of Substantial Completion".
- 3.1.6 Submit report, at completion of measurements, listing phase and neutral currents on panelboards, dry-type transformers and motor control centres, operating under normal load. Include hour and date on which load was measured, and voltage at time of test.
- 3.1.7 General operations: energize and operate electrical circuit and item. Repair, alter, replace, test and adjust as necessary for a complete and operating electrical system.
- 3.1.8 Test systems and obtain written confirmation from manufacturers that components have been installed correctly and system functioning as intended. Submit certification for power distribution, communications systems and emergency power to Owner's Consultant.
- 3.1.9 Provide labour, instruments, apparatus and pay expenses required for testing. Owner's Consultant reserves right to demand proof of accuracy of instruments used.
- 3.1.10 Perform the following tests on completed power systems:
 - 3.1.10.1. Supply voltage: measure line voltage of each phase at load terminals of main breakers and report results in writing to Owner's Consultant. Perform test with majority of electrical equipment in use.
 - 3.1.10.2. Motor loading: measure line current of each phase of motors with motor operating under load, and report results in writing to Owner's Consultants.
 - 3.1.10.2.1. Upon indications of imbalances or overloads, thoroughly examine electrical connections and rectify defective parts or wiring.
 - 3.1.10.2.2. If electrical connections are correct, report overloads due to defects in driven machines in writing to Owner's Consultant.
 - 3.1.10.3. Insulation resistance tests:
 - 3.1.10.3.1. Megger circuits, feeders and equipment up to 350V with a 500V instrument for at least one (1) minute.
 - 3.1.10.3.2. Megger 350-600V circuits, feeders and equipment with a 1000V instrument for at least one (1) minute.

- 3.1.10.3.3. Check resistance to ground before energizing.
- 3.1.10.3.4. Coordinate and carry out motor testing at same time as driven equipment is being tested. In addition to motor loading tests, provide labour and instruments to read and record motor load readings required to supplement tests on driven equipment through various load sequences, as required by driven equipment tests.
- 3.1.11. Immediately prior to occupancy, test entire electrical system by performing loss and return of utility power test. Demonstrate operation of:
 - 3.1.11.1. Low voltage service equipment and metering
 - 3.1.11.2. Exit and emergency lighting
 - 3.1.11.3. Restabilization of systems after power return. Attach report printouts as evidence of expected operation on systems.
 - 3.1.11.4. User equipment shut-down and auto-restart.

3.2. FIELD TESTS

- 3.2.1. Provide advance notice to Owner's Consultant of proposed testing schedule.
- 3.2.2. Perform tests at time of acceptance of work.
- 3.2.3. Conduct and pay for field tests:
 - 3.2.3.1. Power distribution, including phase voltage, grounding and load balancing.
 - 3.2.3.2. Circuits originating from branch distribution panels.
 - 3.2.3.3. Lighting and lighting control. Motors, heaters and associated control equipment, including sequenced operation.
 - 3.2.3.4. Emergency Power Systems
- 3.2.4. Perform tests in presence of Owner's Representative.
 - 3.2.4.1. Provide instruments, meters, equipment and personnel required to conduct required tests.
 - 3.2.4.2. Test systems to verify operation as specified.
- 3.2.5. Conduct di-electric tests, hi-pot tests, insulation resistance tests and ground continuity tests as required by nature of various systems and equipment

3.3. GENERAL TESTING

- 3.3.1. With the system completely connected, perform the following tests:
 - 3.3.1.1. Control and Switching - all circuits shall be tested for the correct operation of devices, switches and controls.
 - 3.3.1.2. Polarity Tests - all sockets shall be tested for correct polarity.

- 3.3.1.3. Voltage Test - a voltage test shall be made at the last outlet of each circuit. The maximum drop in potential permitted will be 2% on 120 and 208 volt branch circuits and on 208 volt feeder circuits. Any deficiency in this respect shall be corrected.
- 3.3.1.4. Phase Balance - measure the load on each phase at each splitter, and lighting and power panelboard and report the results in writing to the Consultant. Rearrange phase connections as necessary to balance the load on each phase as instructed by the Consultant, with the re-arrangement being restricted to the exchanging of connections at the distribution points mentioned in this paragraph. After making any such changes, make available to the Consultant drawings or marked prints showing the modified connections.
- 3.3.1.5. General Operations - energize and put into operation each and every electrical circuit and item. Necessary repairs, alterations, replacements, tests and adjustments required shall be made for complete and satisfactory operating systems.

3.4. SEALING

- 3.4.1 Ensure and verify that all penetrations of electrical equipment have been properly sealed with appropriate material and to the manufacturer's requirements.

3.5. NOISE AND VIBRATION

- 3.5.1 Ensure and verify that all isolation equipment has been installed where required and to the manufacturers' recommendations. Include the locations of and measurements of static deflection of spring isolators.

3.6. COORDINATION STUDY

- 3.6.1 For the entire electrical distribution system provided as part of this contract and for the existing high voltage base building switchgear and low voltage base building switchgear, supply a report from an independent test agency of the short circuit, protection, co-ordination study of the electrical distribution system. An existing coordination study is not available for contractor's use.
- 3.6.2 Procure (coordinate and pay for) the services of Qualus Services Canada, Rene Seipt Rene.Seipt@QualusCorp.com / QuotesCanada@QualusCorp.com, or Brosz Technical Services Kyle Bunte kbunte@brosz.net to prepare the coordination study and arc flash analysis.
- 3.6.3 Co-ordination of Protective Devices:
- 3.6.3.1. Ensure circuit protective devices such as overcurrent trips, relays, circuit breakers and fuses are installed to values and settings so as to provide protection by means of opening the closest device to the fault.
- 3.6.3.2. Submit a short circuit, protection and co-ordination study as follows:
- 3.6.3.2.1. Obtain and organize all electrical protection data for all the equipment. This will consist of obtaining the relay types and settings, transformer impedances, cable sizes, fuse sizes and types, motor data, etc., required to carry out the short circuit.
- 3.6.3.2.2. Perform a short circuit analysis to determine short circuit current levels at all critical points in the distribution system, having obtained the available short circuit current available from the Hydro Supply Authority.

- 3.6.3.2.3. Generate appropriate settings for all relays and protective devices from the level of the Hydro Supply Authority feeder protective devices to the largest downstream device on all the feeder secondary distribution levels.
- 3.6.3.3. Provide a complete, comprehensive report at the conclusion of the short circuit, protection and co-ordination study consisting of the following:
 - 3.6.3.3.1. A set of time current curve characteristics of all protective devices in the system plotted on log/log graph paper with corresponding short circuit current levels.
 - 3.6.3.3.2. Time current damage curves for all transformers, large motors and cables are also to be plotted.
 - 3.6.3.3.3. Provide a complete schedule of all main protective relays, fuses and other protective device listing device locations, function number, manufacturer, model number, size, range, setting, etc.
 - 3.6.3.3.4. The complete study will illustrate and ensure that the settings and sizes of all protective devices for each voltage level have been chosen to ensure maximum or optional protection and co-ordination during electrical fault or overload conditions.
 - 3.6.3.3.5. These generated settings will then be applied by "in-field" testing methods to the respective devices.

3.7. GROUND FAULT PROTECTION SYSTEM

- 3.7.1 Inspect relays visually for condition and clean where necessary.
- 3.7.2 Check all connections for tightness.
- 3.7.3 Apply settings to each relay as specified in the short circuit, protection and co-ordination study and test operation by means of a relay test set.
- 3.7.4 Verify each protective system by means of a primary current injection through the zero phase sequence transformer. This will provide correct operation of both the transformer and relay as well as proper functioning of the circuitry through to the breaker tripping elements.

3.8. ARC FLASH ANALYSES

- 3.8.1 For the entire electrical distribution system provided as part of this contract and the existing electrical distribution system shown on the drawings, conduct an electrical arc flash hazard analysis as prescribed under NFPA 70E (CSA Z462-18) and provide a written report summarizing the findings and recommended control measures to be taken. The arc flashing analysis results must be deemed acceptable prior to the equipment purchase.
- 3.8.2 The power systems software utilized to perform the study must be SKM Powertools.
- 3.8.3 Provide appropriate labels for all equipment (including all prepurchased equipment and equipment supplied by owner). The labels shall warn a qualified worker who intends to open the equipment for analysis or work that a serious hazard exists and that the workers should follow appropriate work practices and wear appropriate personal protection equipment (PPE) for the specific hazard.
- 3.8.4 An existing coordination study is not available for the electrical contractor's use.

- 3.8.5 Procure (coordinate and pay for) the services of Qualus Services Canada, Rene Seipt Rene.Seipt@QualusCorp.com / QuotesCanada@QualusCorp.com, or Brosz Technical Services Kyle Bunte kbunte@brosz.net to prepare the coordination study and arc flash analysis.

3.8.1 EMERGENCY LIGHT LEVEL MEASUREMENTS

- 3.8.2 As part of this scope of work procure the services of a third party professional engineer to measure and record emergency lighting levels in foot candles throughout the scope of work areas with a calibrated light meter. Readings shall be taken based on a minimum of one reading for every 20' center in open office areas, equipment rooms and corridors / hallways and one reading in each closed office, meeting room, boardroom and stairwell.
- 3.8.3 All light level readings are to be taken during non-daylight hours.
- 3.8.4 Provide a letter identifying light level readings and stating that the emergency lighting levels meet the requirements of the Ontario Building Code (OBC). Notify Owner and Consultant at least ten (10) days prior to proposed testing date and schedule testing at time and date acceptable to Owner and Consultant.

3.9. TEST RESULTS

- 3.9.1 Submit test results to Owner's Consultant for review.
- 3.9.2 Testing methods and test results: to CSA, NEC 2017 and authorities having jurisdiction.
- 3.9.3 Remove and replace conductors found damaged with new materials.
- 3.9.4 Provide required labour and tools, if during testing Owner's Representative requests equipment be opened and removed from their housings to examine equipment, terminations and connections.

End of Section

PART 1 - GENERAL

1.1. WORK INCLUDED

- 1.1.1 All power, wiring and conduit work required and /or shown on drawings related to security system (ie: for electric strike hardware, maglocks, door release button, etc.,) shall be included in the tenant electrical contractor's tender price. Provide all conduit, wiring and junction boxes and all necessary accessories and devices to facilitate the complete installation of the security system. Obtain exact requirements for the tie into the security system (including power requirements) from the security contractor. Installation shall be under the direct guidance of, and to the manufacturer's recommendations.

End of Section

PART 1 - GENERAL

1.1. Work Included:

- 1.1.1 All work required and /or shown on drawings related to life safety systems (ie: fire alarm, EVAC speakers, etc) shall be included in the tenant electrical contractor's tender price. Employ and pay for the services of the landlord's contractor to provide all conduit, wiring, devices, final connections, modifications and provision of new interfacing devices in existing system control panels (ie: modules, relays, sub-panel, etc). Ensure new devices to be used are compatible with the existing system. Maintain the integrity of the existing supervised circuits when new devices are to be connected. The system shall be tested and certified for proper operation upon completion of the work. Employ and pay for the services of the landlord's verification contractor.
- 1.1.2 Employ and pay for the services of the landlord's contractor to update the base building active graphic software system with all devices provided, deleted and relocated as part of this scope of work and with fire alarm system zone changes as part of this scope of work.
- 1.1.3 Employ and pay for the services of the landlord's contractor to update the base building passive graphics with all devices provided, deleted and relocated as part of this scope of work and with fire alarm system zone changes as part of this scope of work.
- 1.1.4 Employ and pay for the services of the landlord's contractor to provide additional power boosters, amplifiers and all other controls and accessories as required to ensure that the existing fire alarm system can accommodate all signaling devices shown on the drawings.
- 1.1.5 In **addition** to the field devices indicated on the drawings to be provided under this contract, include in the tender price to supply and install the following quantities of additional devices throughout the scope of contract floors, complete with 75'-0" of conduit and wiring, programming, testing and certification, labeling, verification and 100% repeat verification for each device post City Fire Department inspection. Reverify all existing fire alarm devices.

Quantity of Devices	Device Type
4	Fire Alarm System Speaker
4	Fire Alarm System Strobe Light
1	Fire Alarm System Pull Station
4	Initiating Device Interface Zone Module
2	Fire Alarm System Smoke Detector

- 1.1.6 Test and verification in conformance with CAN/ULC S1001, Integrated Systems Testing Of Fire Protection And Life Safety Systems. Provide a satisfactory Integrated Testing Report. As part of the base bid price, electrical contractor must procure (engage, coordinate and pay for) an Integrated Testing Coordinator, responsible to develop and implement the Integrated Testing Plan. The systems which must be included as part of the integrated systems testing to be determined by the Integrated Testing Coordinator hired by the electrical contractor. All costs related to the integrated systems testing must be included as part of the base bid price. Electrical contractor is responsible to provide all requirements to all required trades through the construction manager / general contractor during the bid period. The integrated systems testing must be completed after hours.

- 1.1.7 Electrical contractor must include the following scopes of work as part of the base bid price specific to the CAN/ULC S1001, Integrated Systems Testing Of Fire Protection And Life Safety Systems:
 - 1.1.7.1. Fire Alarm Technician required for operations and resetting of the fire alarm control panel for the duration.
 - 1.1.7.2. Electrician required for operations and initiating alarms, demonstrating wiring, etc., for the duration.
 - 1.1.7.3. Generator Technician required for approximately 4 hours for the Operation of the Generator and to Confirm Signals.

End of Section

Project: 25350

Panelboard: DP-5BB2

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	RP-5B3	100			2	RP-5B7	100	
3					4			
5			3		6			3
7	RP-5B4	100			8	RP-5B8	150	
9					10			
11			3		12			
13	RP-5B6	100			14			
15					16			
17			3		18			3
19					20			
21					22			
23					24			
25					26			
27					28			
29					30			
31	SPARE	15	1		32	SPARE	20	1
33	SPARE	15	1		34	SPARE	20	1
35	SPARE	15	1		36	SPARE	20	1
37					38	SPARE	100	
39					40			
41					42			3

PL Denotes plug load controlled receptacle

Project: 25350

Panelboard: DP-5BB2

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43					44			
45					46			
47					48			
49					50			
51					52			
53					54			
55					56			
57					58			
59					60			
61					62			
63					64			
65					66			
67					68			
69					70			
71					72			
73					74			
75					76			
77					78			
79	TVSS	100			80			
81					82			
83			3		84			
TVSS								

Project: 25350

Panelboard:LP-4B1

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	TVSS (EX)	30			2			
3					4			
5			3		6			
7	LIGHTING CCT (EX)	20	1		8	LIGHTING CCT (EX)	20	1
9	LIGHTING CCT (EX)	20	1		10	LIGHTING CCT (EX)	20	1
11	LIGHTING CCT (EX)	20	1		12	LIGHTING CCT (EX)	20	1
13	LIGHTING CCT (EX)	20	1		14	LIGHTING CONTROL VOLTAGE SENSING	15	
15					16			
17	LIGHTING NURSING SUITE	20	1		18			3
19	LIGHTING NURSING SUITE	20	1		20			
21					22			
23					24			
25					26			
27					28			
29					30			
31					32			
33					34			
35					36			
37					38			
39					40			
41					42			

(EX) DENOTES EXISTING BREAKER

Project: 25350

Panelboard:LP-4ELA1

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	TVSS (EX)	30			2	BAS PANEL (EX)	15	1
3					4	BAS PANEL (EX)	15	1
5			3		6	BAS PANEL (EX)	15	1
7	FCU-426	20	1		8	EMERGENCY LIGHTING (EX)	20	1
9	EMERGENCY LIGHTING (EX)	20	1		10	BAS PANEL (EX)	15	1
11	EMERGENCY LIGHTING (EX)	20	1		12	EMERGENCY LIGHTING (EX)	20	1
13	EMERGENCY LIGHTING (EX)	20	1		14	BAS (EX)	15	1
15	IT RACK	30	1		16	IT RACK (EX)	30	1
17	EMERGENCY LIGHTING RESEARCH LAB	20	1		18	MAGLOCK POWER SUPPLY (EX)	15	1
19	EMERGENCY LIGHTING NURSES SUITE	20	1		20			
21					22	POE SWITCH (EX)	20	1
23	LIGHTING CONTROL HUB	15	1		24			
25	LIGHTING CONTROL HUB	15	1		26			
27	LIGHTING CONTROL HUB	15	1		28			
29	LIGHTING CONTROL HUB	15	1		30			
31					32			
33					34			
35					36			
37					38			
39					40			
41					42			

(EX) DENOTES EXISTING BREAKER

Project: 25350

Panelboard:LP-5B1

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	TVSS (EX)	30			2			
3					4			
5			3		6			
7	LTG L5 LIGHTING (EX)	20	1		8	LIGHTING 531/524G/524E	20	1
9	LIGHTING 520	20	1		10	LIGHTING 524F/524/OFFICES	20	1
11	LIGHTING 519	20	1		12	LIGHTING 524B/OFFICES	20	1
13	UNLABELLED (EX)	20	1		14	LIGHTING 532/533A/533B/533C/530	20	1
15	LIGHTING 515/EX CORRIDOR/512	20	1		16	LIGHTING 526/518	20	1
17	LIGHTING 517/516/513/514B/514A/514	20	1		18			
19	LIGHTING 519	20	1		20	LIGHTING CONTROL VOLTAGE SENSING	15	
21					22			
23					24			3
25					26			
27					28			
29					30			
31					32			
33					34			
35					36			
37					38			
39					40			
41					42			

(EX) DENOTES EXISTING BREAKER

Project: 25350

Panelboard:LP-5ELA1

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	TVSS (EX)	30			2	BAS PANEL (EX)	20	1
3					4	BAS PANEL (EX)	20	1
5			3		6	BAS PANEL (EX)	20	1
7	CV-502; ELEV. CONTR. 504 (EX)	30	1		8	LTG L5 LIGHTING (EX)	15	1
9	LTG L5 LIGHTING (EX)	20	1		10	LTG L5 EMERGENCY POT. (EX)	15	1
11	BAS (EX)	15	1		12	BAS (EX)	15	1
13	BAS (EX)	15	1		14	BAS (EX)	15	1
15	LIGHTING CONTROL HUB	15	1		16	FF-04; STAIR A S001 (EX)	15	1
17	LIGHTING CONTROL HUB	15	1		18	CAB LIGHTING CAB 2 (EX)	15	1
19	LIGHTING CONTROL HUB	15	1		20	CV-502 (EX)	15	1
21	CAB LIGHTING CAB 1 (EX)	15	1		22	POE SWITCH (EX)	20	1
23	LIGHTING CONTROL HUB	15	1		24			
25	EMERGENCY LTG 520	20	1		26	EMERGENCY LTG 531/524F/524G	20	1
27	EMERGENCY LTG 519	20	1		28	EMERGENCY LTG 524D/524E/524C/524B	20	1
29	EMERGENCY LTG 517/516/514B/514A/514	20	1		30	EMERGENCY LTG 532/533A/533B/533C/530	20	1
31	EMERGENCY LTG 515/EX CORRIDOR/512	20	1		32	EMERGENCY LTG 518/526/528		
33	EMERGENCY LTG 519	20	1		34			
35					36			
37					38			
39					40			
41					42			

(EX) DENOTES EXISTING BREAKER

Project: 25350

Panelboard: PP-4B5

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1					2	FCU-401 (RE)	15	1
3					4	REC (RE)	20	1
5					6	FCU-418 (RE)	20	1
7	FCU-429 (RE)	15	1		8	FCU-404 (RE)	15	1
9	FCU-405 (RE)	15	1		10	FCU-402 (RE)	15	1
11	FCU-431 (RE)	15	1		12	FCU-413 (RE)	15	1
13	FCU-433 (RE)	15	1		14			
15	FCU-406 (RE)	15	1		16	FCU-432 (RE)	15	1
17	FCU-425 (RE)	15	1		18	FCU-410 (RE)	15	1
19	FCU-434 (RE)	15	1		20	FCU-430 (RE)	15	1
21	FCU-438 (RE)	15	1		22	FCU-437 (RE)	15	1
23	FCU-436 (RE)	15	1		24	FCU-411 (RE)	20	1
25	FCU-407 (RE)	15	1		26	FCU-423 (RE)	15	1
27	FCU-420 (RE)	15	1		28	FCU-419 (RE)	15	1
29	FCU-416 (RE)	15	1		30	FCU-415 (RE)	15	1
31	FCU-417 (RE)	15	1		32	FCU-421 (RE)	20	1
33					34	FCU-435 (RE)	15	1
35	FCU-414 (RE)	15	1		36	FCU-412 (RE)	15	1
37	FCU-408 (RE)	30	1		38	HWIE (RE)	90	
39					40			
41					42			3

RE DENOTES CIRCUIT RELOCATED FROM PANEL PP-4B5(EX)

Project: 25350

Panelboard: PP-4B5

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43	HWT	20	1		44	FCUB-446	15	1
45	HWT LEAK SENSOR	15	1		46	FCUB-442	15	1
47					48	FCUB-445B	15	1
49	FCUB-469A	15	1		50	HWT-HW1E	50	
51	FCUB-469A	15	1		52			2
53	FCUB-472	15	1		54	HWT LEAK SENSOR	15	1
55					56			
57					58			
59					60			
61					62			
63					64			
65					66			
67					68			
69					70			
71					72			
73	SPARE	15	1		74	SPARE	20	1
75	SPARE	15	1		76	SPARE	20	1
77	SPARE	15	1		78	SPARE	20	1
79	TVSS	100			80			
81					82			
83			3		84			
TVSS								

RE DENOTES CIRCUIT RELOCATED FROM PANEL PP-4B5(EX)

Panelboard: PP-5B5

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1					2	UNLABELLED (RE)	20	1
3					4	UNLABELLED (RE)	20	1
5					6	UNLABELLED (RE)	15	1
7	UNLABELLED (RE)	20			8	GLYCOL TANK (RE)	20	1
9			2		10	GLYCOL TANK (RE)	20	1
11	UNLABELLED (RE)	20	1		12			
13	ROOFTOP DOWN LTG (RE)	15	1		14			
15	ROOFTOP DOWN LTG (RE)	15	1		16			
17	ROOFTOP DOWN LTG (RE)	15	1		18			
19	DHW CIRC PUMP (RE)	20	1		20	EAST STAIR HEATER (RE)	20	1
21	S. HW HEATER (RE)	20	1		22	N. H.W. HEATER (RE)	15	1
23	N. HUMIDIFIER (RE)	20	1		24	CAMERA (RE)	20	1
25	UNLABELLED (RE)	15	1		26	S. HUMIDIFIER (RE)	20	1
27					28	FCU-531	15	1
29					30	FCU-531	15	1
31	SPARE	15	1		32	SPARE	20	1
33	SPARE	15	1		34	SPARE	20	1
35	SPARE	15	1		36	SPARE	20	1
37	HPB-533B Maintenance Receptacle	20	1		38			
39	Hypoxico Compressor Receptacle	20	1		40	FCU-525	15	1
41	Hypoxico Compressor Receptacle	20	1		42	FCU-524F	15	1

RE DENOTES CIRCUIT RELOCATED FROM PANEL PP-5B5(EX)

Project: 25350

Panelboard: PP-5B5

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43	ENVIRONMENTAL 533B Hypoxico Cont	15	1		44	FCU-524G	15	1
45	RESEARCH 533A FCU-533C	15	1		46	FCU-524E	15	1
47					48	FCU-524C	15	1
49	CHANGE RM FCU-530	15	1		50	FCU-524	15	1
51	FCU-532	15	1		52	FCU-524B	15	1
53	FCU-526	15	1		54	FCU-521	15	1
55					56	FCU-517	15	1
57	FCU-516	15	1		58	FCU-520	15	1
59	FCU-514	15	1		60	FCU-520	15	1
61	FCUA-512	15	1		62	FCUA-519	15	1
63	FCUB-512	15	1		64	FCUA-519	15	1
65	FCUB-513	15	1		66	FCUB-519	15	1
67	FCU-518	15	1		68	FCUB-519	15	1
69					70	FCU-515	15	1
71					72	EF-516	20	1
73					74			
75	HPB 533B	40			76			
77			2		78			
79	TVSS	100			80			
81					82	CONTROL CIRCUIT	15	1
83			3		84	CONTROL CIRCUIT	15	1
TVSS								

RE DENOTES CIRCUIT RELOCATED FROM PANEL PP-5B5(EX)

Project: 25350

Panelboard:RP-4B3

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	UNLABELLED (RE)	20	1		2	REC; ELEC. CLO 408 (RE)	20	1
3					4	DOOR OPERATOR (RE)	20	1
5					6	TRAP SEAL PRIME (RE)	20	1
7	DRINKING FOUNTAIN (RE)	20	1		8	REC; JC 409 (RE)	20	1
9	REC; STORAGE 404 (RE)	20	1		10	REC; IT CLOSET 407 (RE)	20	1
11	HAND DRYER; WASHROOM 304 (RE)	20	1		12	REC; IT CLOSET 407 (RE)	20	1
13	REC; WASHROOM, UNIVERSAL-2 304-2 (RE)	20	1		14	FAUCET AND FLUSH VALVES (RE)	20	1
15	HAND DRYER; WC FEMALE 406 (RE)	20	1		16	IT CLOSET 407 (RE)	15	1
17	IT CLOSET 407 (RE)	20	1		18	REC CORRIDOR 403 (RE)	20	1
19	REC; IT CLOSET 407 (RE)	20	1		20	IT CLOSET 407 (RE)	15	1
21	REC SIMULATION ROOM LAB 472 (RE)	20	1		22	REC SIMULATION ROOM LAB 472 (RE)	20	1
23	REC SIMULATION ROOM LAB 472 (RE)	20	1		24	REC SIMULATION ROOM LAB 472 (RE)	20	1
25	LAB DOOR OPERATORS (RE)	15	1		26	REC; CRC LAB 471 (RE)	20	1
27	REC; CRC LAB 471 (RE)	20	1		28	REC; DRY LAB 469 (RE)	20	1
29	REC; DRY LAB 469 (RE)	20	1		30	REC; OFFICE 459 (RE)	20	1
31	REC; OFFICE 458 (RE)	20	1		32	REC; OFFICE 452 (RE)	20	1
33	REC; OFFICE 446 (RE)	20	1		34	REC; STORAGE 445 (RE)	20	1
35	BAS (RE)	15	1		36	RECEPTION AREA (RE)	20	1
37	FLOOR BOXES;DEAN'S SUITE 464 (RE)	15	1		38	REC; OFFICE 467 (RE)	20	1
39	FLOOR BOXES;MEETING RM 465 (RE)	20	1		40	REC; MEETING RM 465 (RE)	20	1
41	TV DISPLAY; MEETING RM 465 (RE)	20	1		42	50% RECEPTION AREA DEAN'S SUITE (RE)	20	1

RE DENOTES NEW CIRCUIT REFEEDING EXISTING DEVICE CURRENTLY FED FROM PANEL RP-4B3(EX)

Project: 25350

Panelboard:RP-4B3

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43	REC COPY CENTRE & MAIL (RE)	20	1		44	DOOR OPERATOR (RE)	15	1
45	50% RECEPTION AREA (RE)	20	1		46	DOOR OPERATOR (RE)	15	1
47	TV DISPLAY SOCIAL AND WAIT (RE)	20	1		48	REC CORRIDOR 470 (RE)	20	1
49	IT CLOSET 407 (RE)	15	1		50	IT CLOSET 407 (RE)	20	1
51	REC; CRC LAB 471 (RE)	20	1		52	REC; CRC LAB 471 (RE)	20	1
53	REC (RE)	20	1		54	REC; CRC LAB 471 (RE)	20	1
55	REC; CRC LAB 471 (RE)	20	1		56	REC; CRC LAB 471 (RE)	20	1
57	REC; CRC LAB 471 (RE)	20	1		58	REC; CRC LAB 471 (RE)	20	1
59					60	UNLABELLED (RE)	20	1
61	UNLABELLED (RE)	20	1		62	UNLABELLED (RE)	20	1
63	UNLABELLED (RE)	20	1		64	UNLABELLED (RE)	20	1
65	UNLABELLED (RE)	20	1		66	UNLABELLED (RE)	20	1
67	UNLABELLED (RE)	20	1		68	UNLABELLED (RE)	20	1
69	UNLABELLED (RE)	20	1		70	UNLABELLED (RE)	20	1
71	UNLABELLED (RE)	20	1		72	UNLABELLED (RE)	20	1
73	UNLABELLED (RE)	20	1		74	UNLABELLED (RE)	20	1
75	UNLABELLED (RE)	20	1		76	UNLABELLED (RE)	20	1
77					78	SPARE	15	1
79	TVSS	100			80	SPARE	20	1
81					82	CONTROL CIRCUIT	15	1
83			3		84	CONTROL CIRCUIT	15	1
TVSS								

RE DENOTES NEW CIRCUIT REFEEDING EXISTING DEVICE CURRENTLY FED FROM PANEL RP-4B3(EX)

Project: 25350

Panelboard: RP-4B6

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	Simulation Room 472 Housekeeping	20	1		2	Storage Room 469C Medical Gas Alarm	15	1
3	Simulation Room 472 Counter	20	1		4	Storage Room 469C	20	1
5					6	Nursing Lab 469A Housekeeping	20	1
7	Simulation Room 472 Misc	20	1		8	Nursing Lab 469A TV	20	1
9	Simulation Room 472 Misc	20	1		10			
11	Simulation Room 472 Misc	20	1		12			
13	Simulation Room 472 Beds	20	1		14	Nursing Lab 469A Bed	20	1
15	Simulation Room 472 Misc	20	1		16	Nursing Lab 469A Bed	20	1
17	Simulation Room 472 Misc	20	1		18	Nursing Lab 469A Bed	20	1
19	Simulation Room 472 Beds	20	1		20	Nursing Lab 469A Bed	20	1
21	Door Operator	15	1		22	Nursing Lab 469A Bed	20	1
23	Nursing LAB Suite 471 Housekeeping	20	1		24	Nursing Lab 469A Bed	20	1
25	Nurses Office 473	20	1		26	Nursing Lab 469A Bed	20	1
27	Office	20	1		28	Nursing Lab 469A Bed	20	1
29	Nurses Office 473	20	1		30			
31	SPARE	15	1		32	SPARE	20	1
33	SPARE	15	1		34	SPARE	20	1
35	SPARE	15	1		36	SPARE	20	1
37	Corridor TV	20	1		38			
39					40	Nursing Lab 469A TV	20	1
41					42			

PL Denotes plug load controlled receptacle

Project: 25350

Panelboard: RP-4B6

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43	Nursing Lab 469A Island	20	1		44	Nursing Lab 469A Bed	20	1
45	Nursing Lab 469A Island	20	1		46	Nursing Lab 469A Bed	20	1
47	Nursing Lab 469A Island	20	1		48	Nursing Lab 469A Bed	20	1
49	Nursing Lab 469A Island	20	1		50	Nursing Lab 469A Bed	20	1
51					52	Nursing Lab 469A Bed	20	1
53					54	Nursing Lab 469A Bed	20	1
55	Office Faculty 470	20	1		56	Nursing Lab 469A Bed	20	1
57					58	Nursing Lab 469A Bed	20	1
59	Printer	20	1		60	Nursing Lab 469A Bed	20	1
61	Printer PL	20	1		62	Nursing Lab 469A Bed	20	1
63	ALERTUS BEACON	15	1		64			
65					66			
67					68			
69					70			
71					72			
73					74			
75					76			
77					78			
79	TVSS	100			80			
81					82	CONTROL CIRCUIT	15	1
83			3		84	CONTROL CIRCUIT	15	1
TVSS								

PL Denotes plug load controlled receptacle

Project: 25350

Panelboard: RP-4B7

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	Lab 445B Work Bench	20	1		2	Lab 445B Work Bench	20	1
3	Lab 445B Work Bench	20	1		4	Office 445A	20	1
5	Lab 445B Work Bench	20	1		6	Office 444	20	1
7	Lab 445B Work Counter	20	1		8			
9	Office 446 desk	20	1		10			
11					12			
13	Lab 445B Work MISC	20	1		14			
15	Lab 445B Work Counter PL	20	1		16			
17	Lab 445B Work Counter	20	1		18			
19					20			
21					22			
23					24			
25					26			
27					28			
29					30			
31	SPARE	15	1		32	SPARE	20	1
33	SPARE	15	1		34	SPARE	20	1
35	SPARE	15	1		36	SPARE	20	1
37					38	Lab 445B Door Operator	15	1
39					40			
41					42	Lab 445B Housekeeping	20	1

PL Denotes plug load controlled receptacle

Project: 25350

Panelboard: RP-4B7

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43					44			
45					46			
47					48			
49					50			
51					52			
53					54			
55					56			
57					58			
59					60			
61					62			
63					64			
65					66			
67					68			
69					70			
71					72			
73					74			
75					76			
77					78			
79	TVSS	100			80			
81					82	CONTROL CIRCUIT	15	1
83			3		84	CONTROL CIRCUIT	15	1

Project: 25350

Panelboard: RP-5B3

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	RESEARCH 514 DOOR OPERATOR	15	1		2	MEET 517/3D 516 DOOR OPERATOR	15	1
3	RESEARCH 514 HOUSEKEEPING	20	1		4	MEETING RM 517 FLOOR	20	1
5					6	MEETING RM 517 FL PL	20	1
7	OBSERVATION 514A HOUSEKEEPING	20	1		8	MEETING RM 517 WALL PL	20	1
9	OBSERVATION 514A WORKSTATION	20	1		10	MEETING RM 517 WALL	20	1
11					12	MEETING RM 517 TV	20	1
13					14			
15	OBSERVATION 514A WALL	20	1		16			
17	OBSERVATION 514A WALL	20	1		18			
19	SIMULATION ROOM 514B	20	1		20	3D 516 WALL	20	1
21	SIMULATION ROOM 514B	20	1		22	3D 516 WALL	20	1
23	SIMULATION ROOM 514B	20	1		24			
25	SIMULATION ROOM 514B	20	1		26	3D 516 COUNTER	20	1
27					28	3D 516 COUNTER	20	1
29					30	3D 516 COUNTER PL	20	1
31	SPARE	15	1		32	SPARE	20	1
33	SPARE	15	1		34	SPARE	20	1
35	SPARE	15	1		36	SPARE	20	1
37	STUDENT 512 WALL USB	20	1		38	3D 516 COUNTER	20	1
39	STUDENT 512 WALL	20	1		40	3D 516 COUNTER	20	1
41	STUDENT 512 WALL	20	1		42	3D 516 COUNTER PL	20	1

PL Denotes plug load controlled receptacle

Project: 25350

Panelboard: RP-5B3

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43	512 MISC	20	1		44	3D 516 COUNTER	20	1
45					46	3D 516 COUNTER	20	1
47					48	3D 516 COUNTER	20	1
49	STUDENT 512 WALL	20	1		50	3D 516 COUNTER PL	20	1
51	STUDENT 512 WALL USB	20	1		52	3D 516 COUNTER	20	1
53	STUDENT 512 WALL	20	1		54	3D 516 COUNTER	20	1
55	STUDENT 512 WALL USB	20	1		56	3D 516 COUNTER	20	1
57					58	3D 516 COUNTER PL	20	1
59					60	3D 516 COUNTER	20	1
61					62	OFFICE 513	20	1
63					64	Alertus Beacon	15	1
65					66	STUDENT 512 TV	20	1
67					68			
69					70			
71					72			
73					74			
75					76			
77					78			
79	TVSS	100			80			
81					82	CONTROL CIRCUIT	15	1
83			3		84	CONTROL CIRCUIT	15	1
TVSS								

Project: 25350

Panelboard: RP-5B4

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	CLASS 519 DOOR OPERATOR	15	1		2	RESEARCH 520 DOOR OPERATOR	15	1
3	CLASS 519 ALERTUS BEACON	15	1		4	RESEARCH 520 WALL	20	1
5	CLASS 519 SCREEN	15	1		6	RESEARCH 520 FRONT WALL	20	1
7					8	RESEARCH 520 FRONT WALL	20	1
9	CORRIDOR 515 WORKSTATION	20	1		10	RESEARCH 520 SCREEN	15	1
11	CORRIDOR 515 WORKSTATION USB	20	1		12	RESEARCH 520 AV	20	1
13	CORRIDOR 515 WORKSTATION	20	1		14	RESEARCH 520 WINDOW WALL	20	1
15	CORRIDOR 515 WORKSTATION USB	20	1		16	RESEARCH 520 BACK WALL	20	1
17					18			
19	CLASS 519 FRONT WALL	20	1		20	RESEARCH 520 PROJECTOR	20	1
21	CLASS 519 SCREEN	15	1		22	RESEARCH 520 CEILING CORD SET	20	1
23					24			
25	CLASS 519 WINDOW WALL	20	1		26			
27	CLASS 519 BACK WALL	20	1		28			
29	CLASS 519 BACK WALL	20	1		30			
31	SPARE	15	1		32	SPARE	20	1
33	SPARE	15	1		34	SPARE	20	1
35	SPARE	15	1		36	SPARE	20	1
37	CLASS 519 SIDE WALL	20	1		38			
39	CLASS 519 PROJECTOR	20	1		40			
41	CLASS 519 PROJECTOR	20	1		42			

PL Denotes plug load controlled receptacle

Project: 25350

Panelboard: RP-5B4

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43	CLASS 519 FLOOR BOX	20	1		44			
45	CLASS 519 FLOOR BOX	20	1		46			
47	CLASS 519 FLOOR BOX	20	1		48			
49	CLASS 519 FLOOR BOX	20	1		50	CORRIDOR HOUSEKEEPING	20	1
51	CLASS 519 FLOOR BOX	20	1		52			
53	CLASS 519 FLOOR BOX	20	1		54			
55	CLASS 519 FLOOR BOX	20	1		56	OFFICE 521/522	20	1
57	CLASS 519 FLOOR BOX	20	1		58	OFFICE 523	20	1
59	CLASS 519 FLOOR BOX	20	1		60			
61	CLASS 519 FLOOR BOX	20	1		62			
63	CLASS 519 FLOOR BOX	20	1		64			
65	CLASS 519 PRESENTATION FLOOR B	20	1		66			
67					68			
69	HEAR ASSIST	20	1		70			
71					72			
73					74			
75					76			
77					78			
79	TVSS	100			80			
81					82	CONTROL CIRCUIT	15	1
83			3		84	CONTROL CIRCUIT	15	1
TVSS								

Project: 25350

Panelboard: RP-5B6

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	OFFICE 527/528	20	1		2	VOR 524F	20	1
3	OFFICE 525	20	1		4	VOR 524F	20	1
5	LAB ENTRANCE 524 DOOR HOUSEKEEPING	20	1		6	VOR 524F	20	1
7	LAB ENTRANCE 524 DOOR OPERATOR	15	1		8	VOR 524F	20	1
9	CORRIDOR ALERTUS BEACON	15	1		10	EEG 524G	20	1
11	CORRIDOR HOUSEKEEPING	20	1		12	EEG 524G	20	1
13	LAB EQUIP 524A HOUSEKEEPING	20	1		14	EEG 524G	20	1
15					16	EEG 524G	20	1
17					18			
19					20			
21	RESEARCH 524D COUNTER	20	1		22	HDEMG 524E WORKSTATION	20	1
23	RESEARCH 524B MISC	20	1		24	HDEMG 524E WORKSTATION	20	1
25	RESEARCH 524B MISC	20	1		26	HDEMG 524E WORKSTATION	20	1
27	RESEARCH 524B MISC	20	1		28	HDEMG 524E COUNTER	20	1
29	RESEARCH 524B TV	20	1		30	HDEMG 524E COUNTER	20	1
31	SPARE	15	1		32	SPARE	20	1
33	SPARE	15	1		34	SPARE	20	1
35	SPARE	15	1		36	SPARE	20	1
37	RESEARCH 524B TV	20	1		38	GRADUATE 531 DOOR OPERATOR	15	1
39	RESEARCH 524B CAMERA	20	1		40	GRADUATE 531 HOUSEKEEPING	20	1
41	RESEARCH 524B TV	20	1		42			

PL Denotes plug load controlled receptacle

Project: 25350

Panelboard: RP-5B6

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43	RESEARCH 524B CEILING CORD SET	20	1		44			
45					46			
47					48			
49	DATA 524C WINDOW WALL	20	1		50			
51	DATA 524C WORKSTATION	20	1		52			
53	DATA 524C WORKSTATION	20	1		54			
55	DATA 524C WORKSTATION	20	1		56			
57	DATA 524C WORKSTATION	20	1		58			
59					60			
61	GRADUATE 531 WORKBENCH	20	1		62	GRADUATE 531 WORKBENCH	20	1
63	GRADUATE 531 WORKBENCH USB	20	1		64	GRADUATE 531 WORKBENCH	20	1
65	GRADUATE 531 WORKBENCH	20	1		66	GRADUATE 531 WORKBENCH USB	20	1
67	GRADUATE 531 WORKBENCH USB	20	1		68	GRADUATE 531 WORKBENCH	20	1
69	GRADUATE 531 WORKBENCH	20	1		70	GRADUATE 531 WORKBENCH USB	20	1
71	GRADUATE 531 WORKBENCH USB	20	1		72	GRADUATE 531 WORKBENCH	20	1
73	GRADUATE 531 MISC	20	1		74	GRADUATE 531 WORKBENCH USB	20	1
75					76	GRADUATE 531 WORKBENCH	20	1
77					78	GRADUATE 531 WORKBENCH USB	20	1
79	TVSS	100			80			
81					82	CONTROL CIRCUIT	15	1
83			3		84	CONTROL CIRCUIT	15	1
TVSS								

Project: 25350

Panelboard: RP-5B7

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	RESEARCH 526 MISC	20	1		2	RES 526/SUPPORT 530 DOOR OPERA	15	1
3	RESEARCH 526 MISC	20	1		4	RESEARCH 526 COUNTER GFI	20	1
5	RESEARCH 526 MISC	20	1		6	RESEARCH 526 COUNTER FRIDGE	20	1
7	RESEARCH 526 TV	20	1		8			
9	RESEARCH 526 MISC	20	1		10	CHANGE RM MISC	20	1
11	RESEARCH 526 MISC	20	1		12			
13	RESEARCH 526 FL	20	1		14	LAB SUP 530 COUNTER MW	20	1
15	RESEARCH 526 FL PL	20	1		16	LAB SUP 530 FRIDGE	20	1
17					18	LAB SUP 530 COUNTER	20	1
19					20	LAB SUP 530 PRINTER PL	20	1
21	HOUSEKEEPING	20	1		22	LAB SUP 530 PRINTER	20	1
23					24			
25					26			
27					28			
29					30			
31	SPARE	15	1		32	SPARE	20	1
33	SPARE	15	1		34	SPARE	20	1
35	SPARE	15	1		36	SPARE	20	1
37					38			
39					40			
41					42			

PL Denotes plug load controlled receptacle

Panelboard: RP-5B7

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43					44			
45					46			
47					48			
49					50			
51					52			
53					54			
55					56			
57					58			
59					60			
61					62			
63					64			
65					66			
67					68			
69					70			
71					72			
73					74			
75					76			
77					78			
79	TVSS	100			80			
81					82	CONTROL CIRCUIT	15	1
83			3		84	CONTROL CIRCUIT	15	1
TVSS								

Project: 25350

Panelboard: RP-5B8

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
1	ENVIRONMENTAL 533B MISC	20	1		2	EXERCISE 533C COUNTER GFI	20	1
3	ENVIRONMENTAL 533B MISC	20	1		4	EXERCISE 533C FRIDGE	20	1
5	ENVIRONMENTAL 533B MISC	20	1		6	EXERCISE 533C COUNTER GFI	20	1
7	ENVIRONMENTAL 533B MISC	20	1		8	EXERCISE 533C MISC	20	1
9	ENVIRONMENTAL 533B MISC	20	1		10	EXERCISE 533C MISC	20	1
11	ENVIRONMENTAL 533B MISC	20	1		12	EXERCISE 533C MISC	20	1
13	ENVIRONMENTAL 533B MISC	20	1		14	EXERCISE 533C MISC	20	1
15					16	EXERCISE 533C WORKSTATIONS	20	1
17					18			
19					20	RESEARCH 533A DOOR OPERATOR	15	1
21	CORRIDOR 532 HOUSEKEEPING	20	1		22			
23					24	RESEARCH 533A HOUSEKEEPING	20	1
25					26			
27					28			
29					30			
31	SPARE	15	1		32	SPARE	20	1
33	SPARE	15	1		34	SPARE	20	1
35	SPARE	15	1		36	SPARE	20	1
37					38			
39					40			
41					42			

PL Denotes plug load controlled receptacle

Panelboard: RP-5B8

Voltage (V):

Phase/Wire:

Bus and Lugs Rating (A):

CCT NO	Load	Breaker			CCT NO	Load	Breaker	
		Amp	Pole				Amp	Pole
43					44			
45					46			
47					48			
49					50			
51					52			
53					54			
55					56			
57					58			
59					60			
61					62			
63					64			
65					66			
67					68			
69					70			
71					72			
73					74			
75					76			
77					78			
79	TVSS	100			80			
81					82	CONTROL CIRCUIT	15	1
83			3		84	CONTROL CIRCUIT	15	1
TVSS								