



Smith + Andersen

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AUDIOVISUAL SPECIFICATION

PROJECT NAME:

SENECA POLYTECHNIC

K3170 UPGRADES

1750 FINCH AVENUE EAST, NORTH YORK, ON

OUR PROJECT NUMBER:

01105.034.AV.001

DATE:

2024-04-12

ISSUED / REVISION:

FOR TENDER

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END OF SECTION

27 00 00.10 Audiovisual Compliance Statement

Our company has reviewed all specifications identified on the Audiovisual Index 27 00 00.00, all addenda and contract drawings as identified on AV-000 and confirm our bid submission is compliant with the requirements described in these contract documents. We commit to delivering the project in compliance with the contract documents at the price submitted on the tender form.

Signing Officer Signature

Signing Officer Name

Company

END OF SECTION

27 40 05.00 Audiovisual Definitions and Abbreviations

1. General

1.1. DEFINITIONS

1.1.1. Generally, the following definitions are used in this Division:

Addendum	-	Normative document used to provide additional requirements and recommendations to a published document (e.g., standards, contracts). When published, an addendum effectively becomes part of the document that it supports.
AV Contractor	-	The successful bidder to this Specification responsible for the supply and installation of the Audiovisual Systems as detailed in this document & associated drawings.
AV Consultant	-	Smith + Andersen Consulting Engineers
Deficiency Review	-	A meeting between the Owner, AV Contractor and AV Consultant to review the Project to determine whether the work meets the requirements of the Owner as detailed in this document and associated drawings.
Final Acceptance	-	The date which the Owner, AV Contractor and AV Consultant have agreed the Project is complete, functional, free of deficiencies and the AV Contractor has submitted all required documentation for project closeout. Refer to section 27 40 10 "Final Acceptance" for greater detail.
Project	-	Supply and installation of a complete and functional Audiovisual System as described in this document.
Provide	-	Supply, install, terminate, test and commission.
Substantial Completion	-	The period between the deficiency review meeting date and the date of final acceptance. The audiovisual system physical installation, programming and Contractor commissioning is complete and ready for review by Consultant and Owner.

1.2. ABBREVIATIONS

1.2.1. Generally, the following abbreviations are used in this Division:

ADA	-	Americans with Disabilities Act
AES	-	Audio Engineering Society
AFF	-	Above Finished Floor
AGC	-	Automatic Gain Control
AHJ	-	Authority Having Jurisdiction
ALS	-	Assistive Listening System
AV or A/V	-	Audiovisual

AVB	- Audio Video Bridging
AVC	- Advanced Video Coding
AWG	- American Wire Gauge
BACnet	- Building Automation and Control Networking Protocol
BAS	- Building Automation System
BICSI®	- Building Industry Consulting Service International
BOM	- Bill Of Material
BTU	- British Thermal Unit
CAD	- Computer Aided Design
CATV	- Community Antenna Television (Cable Television)
CCIA	- Computer Communications Industry Association
CCTV	- Closed Circuit Television
CSA	- Canadian Standards Institute
CTS	- Certified Technology Specialist
CTS-D	- Certified Technology Specialist Design
CTS-I	- Certified Technology Specialist Installation
DANTE	- Digital Audio Network Through Ethernet
dB	- Decibel
dBa	- A-weighted Decibels
dBm	- Decibel milliwatt
dBmV	- Decibel millivolt
DCI	- Digital Cinema Initiatives
DHCP	- Dynamic Host Configuration Protocol
DM	- DigitalMedia
DNS	- Domain Name System
DSP	- Digital Sound Processing
DVI	- Digital Visual Interface
EBU	- European Broadcasting Union
EDID	- Extended Display Identification
EIA	- Electronics Industry Alliance
EMI	- Electromagnetic Interference
EMI/RFI	- Electromagnetic Interference / Radio Frequency Interference
FCC	- Federal Communications Commission
ft	- Foot / Feet
ft²	- Square Foot / Feet
FTP	- File Transfer Protocol
Gb/s	- Gigabit per Second
GC	- General Contractor
GHz	- Gigahertz
GUI	- Graphical User Interface
HDCP	- High-Bandwidth Digital Content Protection
HDMI	- High-Definition Multimedia Interface
Hz	- Hertz
IEC	- International Electrotechnical Commission
IEEE®	- Institute of Electrical and Electronics Engineers, Inc.®
IG	- Isolated Ground
in	- Inch
in²	- Square Inch
I/O	- Input / Output (Device)
IPv4	- Internet Protocol version 4
IR	- Infrared
ISDN	- Integrated Services Digital Network
ISO	- International Organization for Standardization
IT	- Information Technology
kb	- Kilobit

kB	-	Kilobyte
kg	-	Kilogram
Km	-	Kilometre
KSVs	-	Key Selection Vectors
kV	-	Kilovolt
kVA	-	Kilovoltampere
kW	-	Kilowatt
kWh	-	Kilowatt hour
LAN	-	Local Area Network
laser	-	Light Amplification by Stimulated Emission of Radiation
lb	-	Pound
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
LSZH	-	Low Smoke Zero Halogen
m	-	Metre
m ²	-	Square Metre
mA	-	Milliampere
Mb	-	Megabit
MB	-	Megabyte
Mb/s	-	Megabit per Second
MB/s	-	Megabyte per Second
MHz	-	Megahertz
MIDI	-	Musical Instrument Digital Interface
mm	-	Millimetre
MM	-	Multimode
MMF	-	Multimode Fibre
ms	-	Millisecond
mW	-	Milliwatt
MW	-	Megawatt
NFPA	-	National Fire Protection Association
NIC	-	Network Interface Card
OD	-	Outside Diameter
OEM	-	Original Equipment Manufacturer
OFE	-	Owner-furnished equipment
OLED	-	Organic Light Emitting Diode
OTDR	-	Optical time domain reflectometry
PBX	-	Private Branch Exchange
PDU	-	Power Distribution Unit
PoE	-	Power-Over-Ethernet
POTS	-	Plain Old Telephone Service
PTZ	-	Pan, Tilt, Zoom
PVC	-	Polyvinyl Chloride
QA	-	Quality Assurance
QC	-	Quality Control
QoS	-	Quality of Service
QXGA	-	Quad Extended Graphics Array
RCA	-	Radio Corporation of America
RCDD®	-	Registered Communications Distribution Designer
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
rms	-	Root Mean Square
RU	-	Rack Unit (1.75")
RX	-	Receiver
SDI	-	Serial Digital Interface
SI	-	International System of Units (Le Système International d'Unités)

SIP	- Session Initiation Protocol
SLA	- Service level Agreement
SM	- Singlemode
SNR	- Signal-to-Noise Ratio
S/PDIF	- Sony/Phillips Digital Interface
SPL	- Sound Pressure Level
STP	- Shielded Twisted Pair
STP-A	- Shielded Twisted Pair A
TCP	- Transmission Control Protocol
TDR	- Time Domain Reflectometer
TFT	- Thin Film Transistor
TIA	- Telecommunications Industry Association
TP	- Twisted Pair
TR	- Telecommunications Room
TRS	- Tip, Ring, Sleeve
TS	- Technical Standard
TV	- Television
UHD	- Ultra high definition
ULC	- Underwriters Laboratories of Canada
UPC	- Universal Product Code
UPS	- Uninterruptible Power Supply
USB	- Universal Serial Bus
UTP	- Unshielded Twisted Pair
V	- Volt
VA	- Volt-Ampere
VESA	- Video Electronics Standards Association
VGA	- Video Graphics Array
VLAN	- Virtual Local Area Network
VoIP	- Voice over Internet Protocol
VPN	- Virtual Private Network
W	- Watt
WAN	- Wide Area Network
WAP	- Wireless Application Protocol
WiFi	- Wireless Fidelity
Wi-Fi	- Wireless Fidelity
WLAN	- Wireless Local Area Network
WUXGA	- Widescreen Ultra Extended Graphics Array
WXGA	- Wide Extended Graphics Array
XGA	- Extended Graphics Array
XLR	- External Line Return

2. Products

2.1. NOT USED

3. Execution

3.1. NOT USED

END OF SECTION

27 40 10.00 General Instructions for Audiovisual System Installation

1. General

1.1. GENERAL

1.1.1. Conform to the requirements of Division 0, Division 1 and Division 25 which applies to and forms part of all sections of the work. If these are not included within Tender package, AV Contractor can request a copy from the Owner's representative.

1.1.2. This Specification is for the supply and installation of AV Systems at the 'facility' for the following project:

1750 Finch Avenue East

K-Building (CITE)

3rd Floor

North York, Ontario

1.2. WORK INCLUDED

1.2.1. Read and comply with all sections of this document.

1.2.2. This Specification is to be read in conjunction with the corresponding Tender Drawings, which together, describe the complete scope of work, associated systems and system requirements necessary to achieve the intended performance, installation and functions of the Audiovisual Systems to be provided. Equipment shown on drawings but not written specifications or vice versa does not preclude the AV Contractor from supplying equipment. Take note of the "Division of Responsibility" table on drawing AV-000.

1.2.3. The Specification is divided into Sections which are not intended to identify contractual limits between Sub-Contractors nor between the AV Contractor and any Sub-Contractors. The requirements of any one Section apply to all Sections. Refer to other Divisions and Sections to ensure a complete and operational system.

1.2.4. Provide AV components and accessories which may not be specifically shown on the Drawings or stipulated in the Specifications, but are required to ensure complete and operational systems.

1.2.5. Provide all labour, materials, tools, and equipment required for the complete installation of work called for in all sections of the Contract Documents.

1.3. ERRORS AND OMISSIONS

1.3.1. Errors and/or omissions in the proposal documents shall be reported to the AV Consultant and Owner immediately during the time of response. Items not reported during this time shall not relieve the AV Contractor of the responsibility for providing properly functioning systems as specified or intended in the Contract Documents.

1.3.2. The AV Contractor shall review all reference drawings and site conditions, and report any discrepancies prior to award of contract, including additional electrical infrastructure requirements, to the AV Consultant as part of the review drawing submission.

- 1.3.3. While every attempt has been made to ensure all information is correct at the time of publication, verification for the availability of products specified and correct part numbers shall be the responsibility of the AV Contractor. Some products and components may be discontinued at the time of procurement. It shall be the responsibility of the proponent to provide the most current replacement model for all discontinued products that meet the requirements of these specifications at no additional cost to the Owner. Any errors and/or omissions in this Specification shall be included with their bid submissions.
- 1.4. BID SUBMISSION
- 1.4.1. Bids shall only be obtained by Seneca Approved vendors. These vendors are:
- .1 Branch Audio Visual
 - .1 Boris Drmanic
 - .2 boris@branchav.com
 - .2 AVI-SPL
 - .1 James Ginther
 - .2 oeem@avispl.com
 - .3 Matrix Video Communications
 - .1 Mark Moore
 - .2 mmoore@mvcc.ca
- 1.4.2. Project Schedule
- .1 Provide a project schedule with milestones and completion dates. Milestones should include:
 - .1 Kick-off meeting (with Owner, general Contractor and AV Consultant)
 - .2 Approval drawing submission
 - .3 Coordination meeting with client's IT department (if required)
 - .4 Equipment delivery to site
 - .5 Room-by-room completion dates
 - .6 Substantial Completion date
 - .7 Date for submission of Owner manuals and as-built drawings
 - .8 Training
- 1.4.3. Compliance Statement
- .1 The Bidder is required to review and sign the included compliance statement. The bidder's Compliance Statement must be provided with the bid response.
- 1.4.4. Bill of Materials
- .1 Responses should include a complete and accurate itemized list of all equipment to be supplied including wire and all hardware. The list should indicate the manufacturer, manufacturer's model number and unit of quantity. The list should be divided according to subsections in section 27 41 00.00. Proposed substitutions should be explicitly stated. If the manufacturer has permanently stopped fabrication of a specific item or has replaced an item with an almost identical item but with new model number, this item should be explicitly noted in this list.
 - .2 The AV Contractor shall review and submit a final Bill of Materials to the Owner four weeks prior to ordering product from the manufacturer/distributors.
 - .3 Include in bid all labour, materials, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all

necessary and related items required to provide complete and operational systems shown and described.

.4 Substitutions

- .1 The AV Contractor is encouraged to review the equipment specified herein and suggest alternates that may provide increased functionality and savings to the Owner without degradation to system performance or functional requirements.
- .2 The AV Consultant's decision regarding the acceptance or rejection of the proposed substitution shall be final. Substitutions may be accepted if the delivery of the component or item is such that it shall not jeopardise the construction schedule. Otherwise substitution shall not be allowed.
- .3 The Owner reserves the right to accept or reject any alternate without question.
- .4 Substitutions shall be proposed during the question period of the bid process.

1.4.5. Pricing

- .1 Provide each of the following in this section as separate sections of the bid.
- .2 Base Price
 - .1 The respondent shall state a stipulated price to provide all work shown and described in the System Specification that shall include all premium and/or overtime charges involved to finish the stages of work before the milestones stated under Schedule. This price shall exclude all Add/Delete and Option pricing
- .3 Detailed Pricing
 - .1 Responses are to include a complete and accurate list of all AV equipment to be supplied including wire. Include name of manufacturer, model number, unit quantity and itemized pricing. Provide subtotals according to subsections in Audiovisual System Scope of Work.
- .4 Add/Delete Option Pricing
 - .1 An Add/Delete Option specifies work which may be added to/deleted from the Base Price at the discretion of the Owner. It can be carried separately at the discretion of the Owner. The bidder shall state a separate price for each Add/Delete option which shall increase/decrease to the total purchase price of the work, including all premiums/overtime charges.
- .5 Alternate Pricing
 - .1 Indicate increase/decrease to overall purchase price of work as a result of switching from one specified item to another.
- .6 Unit Labor Rate
 - .1 State hourly rates for all audiovisual specific trades on a separate page as part of the submission.
- .7 Taxes TO BE ADDED
 - .1 Include as a separate line item applicable taxes.

1.5. CODES, STANDARDS AND REGULATIONS COMPLIANCES

- 1.5.1. The AV Contractor must ensure all federal, provincial, and municipal laws, codes, regulations are adhered to.
- 1.5.2. All products installed must meet or exceed all Local, Provincial and Federal Building, Fire, Health, Safety and Electrical Codes.

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- 1.5.3. The AV Contractor is also responsible for any Sub-Contractors that are providing work or services under the same contract. The AV Contractor, where applicable, shall provide proof that final inspections have been adhered to and are completely satisfactory and clear with regards to the authority having jurisdiction, including any work performed by any and all Sub-Contractors. All costs associated with meeting these requirements shall also be carried within the price of the project.
- 1.5.4. Comply with the following industry standards:
- .1 CSA Standard T527 (ANSI/TIA/EIA-607) - Grounding and Bonding for Telecommunication in Commercial Buildings
 - .2 ANSI/AVIXA 10:2013– Audiovisual Systems Performance Verification
 - .3 EIA RS-310-C – Racks and Associated Equipment
 - .4 AVIXA International - AV Installation Handbook, 2nd Ed. – The Best Practices for Quality Audiovisual Systems
 - .5 ANSI/AVIXA 2M-2010 – Standard Guide for Audiovisual Systems Design and Coordination Processes
 - .6 ANSI/AVIXA 1M-2009 – Audio Coverage Uniformity
 - .7 ANSI/AVIXA 3M-2011 – Projected Image Contrast Ratio
 - .8 AVIXA F502.01:2018 – Rack Building for Audiovisual Systems
 - .9 AVIXA F501.01:2015 – Cable Labeling for Audiovisual Systems
 - .10 ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
 - .11 TIA-568.1-D – Commercial Building Telecommunications Cabling Standard
- 1.6. SUMMARY OF WORK AND AV CONTRACTOR PERFORMANCE
- 1.6.1. The A/V systems described herein, shall include providing and integrating a fully functional and seamlessly integrated Audiovisual system complete with high quality professional and commercial grade audiovisual and electronic products, which include for the following equipment and systems but not limited to:
- .1 Media Control Systems
 - .2 Flat Panel Displays
 - .3 Multimedia Projectors
 - .4 Motorized Projection Screens
 - .5 AV Control Systems including Touch Panel and other controllers
 - .6 Audio Conferencing Systems
 - .7 Loudspeakers
 - .8 Audio-Video Source Equipment
 - .9 Audio-Video Reinforcement and Distribution Systems
 - .10 Audio-Video Switching
 - .11 Audio-Video Interface Equipment
 - .12 Audio-Video Cabling and Terminations
 - .13 Ethernet and Control Support
 - .14 Architectural Elements and Mounting Hardware
 - .15 Display or projector lifts
 - .16 Video cameras (fixed or PTZ)
 - .17 Audiovisual production and broadcast consoles

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- 1.6.2. Quantities or lengths indicated in any of the Contract Documents are approximate only and shall not be held to gauge or limit the work. All dimensions and conditions must be verified at the job site prior to installation. The AV Contractor to include for any additional components, slack of cabling etc. as required to complete and neatly finish the installation throughout the interior design.
- 1.6.3. In assessing differences between customer specifications and vendor equipment specifications, the AV Contractor shall ensure customer's maximum specified parameters are met.
- 1.6.4. Some products and components may be discontinued at the time of procurement. It shall be the responsibility of the proponent to provide the most current replacement model for all discontinued product that meets the requirements of these specifications.
- 1.6.5. The AV Contractor shall 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 material, equipment and part of equipment and repair related damages.
- 1.6.6. In addition to providing the services and materials as described, the AV Contractor is required to provide for the following services and perform the following on-site work.
- .1 Coordinate all AV requirements and system components with the project and construction team of all disciplines as required or specifically stated within the package.
 - .2 If required, remove any existing AV equipment not required for reuse and dispose of the equipment using environmentally accepted electronic waste disposal methods. Provide a disposal report to the project team of equipment being disposed of, include make, model and serial number for each item. Removal and disposal of all existing cabling from the ceiling space, walls and within conduit including all accessories (jacks, furniture adapters, decora straps, faceplates, surface mount boxes, patch panels, patch cords, punch down blocks, cross-connect wire etc.)
 - .3 Coordinate and ensure all AV cabling is provided via conduit infrastructure and raceways correctly installed to support the AV systems and related cabling networks. Where conduit infrastructure is not required, supply and install cable slings and J-hooks to supports any free cables. Any discrepancies shall be reported to the AV Consultant immediately.
 - .4 Coordinate and verify the AV infrastructure required for all equipment including, but not limited to, projectors, loudspeakers and associated mounting hardware prior to installation. The AV Contractor to provide for any infrastructure that has not been coordinated (i.e. backboards).
 - .5 Any other structural support, blocking or infrastructure to be provided by others and required to support the AV systems shall be coordinated by the AV Contractor. The AV Contractor to provide for any infrastructure that has not been coordinated.
 - .6 Coordinate and ensure all AV related millwork is correctly implemented and provided to support the AV systems. The AV Contractor shall review all furniture shop drawings and report to the AV Consultant if there are any issues with cutouts, pathways, ventilation, etc.
 - .7 Pre-build and test all systems possible prior to delivery of equipment to project site.
 - .8 Supply all items to be built in ample time for rapid progress of the work. Schedule and proceed with work as required to satisfy the construction schedule.
 - .9 Include for on-going project management, coordination among trades for all AV work and any required site meetings.
 - .10 Label all equipment to correlate with operation and maintenance manuals. Labelling schemes shall be confirmed with the AV Consultant prior to installation.

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- 1.6.7. Supply all AV outlets, terminating hardware and selected connectivity devices as outlined in this Specification. All outlet shall be metal. Plastic decora plates are not acceptable.
- 1.6.8. Supply all hoists and scaffolds necessary to install AV equipment.
- 1.6.9. Visually inspect all equipment for damage or defects prior to installation. Damaged or defective materials shall be reported to the AV Consultant and the Owner.
- 1.6.10. The AV Contractor is responsible for loss or damage of any and all system equipment until it is permanently fastened to the building or signed over to the Owner.
- 1.6.11. All materials and equipment obtained for this contract shall be through manufacturer authorized distribution channels and the warranty shall be supported in the jurisdiction of the Owner. Under NO circumstances shall 'Grey Market' or 'Refurbished' items be acceptable
- 1.7. DRAWINGS, CHANGES AND INSTALLATION
- 1.7.1. The location, arrangement and connection of equipment and material as shown on the drawings represent a close approximation to the intent and requirements of the contract. The right is reserved by the AV Consultant to make reasonable changes required to accommodate conditions arising during the progress of the work, at no extra cost to the Owner.
- 1.7.2. The location and size of existing services shown on the drawings are based on the best available information. The AV Contractor shall verify the actual location of existing services in the field before work is commenced.
- 1.7.3. Changes and modifications necessary to ensure co-ordination and to avoid interference and conflicts with other trades, or to accommodate existing conditions, shall be made at no extra cost to the Owner.
- 1.7.4. Adequate space and provisions shall be left for removal of components and servicing of equipment, with minimum inconvenience to the operation of systems.
- 1.7.5. Where equipment is shown to be 'roughed in only' obtain accurate information from the AV Consultant before proceeding with the work.
- 1.7.6. Location of outlets, luminaires, diffusers, grilles, registers, thermostats, sprinklers and all other equipment shown on drawings (if shown) is diagrammatic. The AV Contractor to coordinate on-site or ask direction from AV Consultant to address any discrepancies on site.
- 1.7.7. The AV Contractor is responsible to mark-out their work and fully co-ordinate with all other trades. The AV Contractor shall review architectural and interior design drawings for exact locations of equipment. Review with AV Consultant prior to rough in.
- 1.8. FINAL ACCEPTANCE
- 1.8.1. Final acceptance is the date which the Owner, AV Contractor and AV Consultant agree the project is complete, functional, free of deficiencies and the AV Contractor has submitted all required documentation for project closeout.
- 1.8.2. A holdback equating to 10% of the value of the base contract shall be released on the date of Final Acceptance. 10% is equated as the value of testing, training, commissioning, deficiency correction and close-out documentation submittal.
- 1.8.3. The step-by-step process to reach Final Acceptance is as follows:
- .1 AV Contractor declares the project is substantially complete and ready for the deficiency walk-through.
 - .2 AV Contractor to complete the Compliance Checklist as supplied by the AV Consultant prior to deficiency walk-through.
 - .3 Deficiency walk-through visit between AV Consultant, AV Contractor and Owner Representative to review all systems to ensure compliance with the design intent.

- .4 Following the deficiency walk-through, a final Job Report shall be issued by the AV Consultant outlining any deficiencies or outstanding items to be completed. The AV Contractor shall be responsible for making all corrections as identified in the report. A second visit may be required depending on the extensiveness of deficiencies.
- .5 Submittal of as-built drawings, control and DSP program source code and manuals as stated in section 3.
- .6 Training sessions supplied as described in this specification. Training sign-off sheets from each training session including a list of participants.
- .7 Warranty letter with the start of service period marked as the date of final acceptance.

1.9. LABOUR

- 1.9.1. The AV Contractor must comply with all job-site requirements for the duration of the project.
- 1.9.2. The AV Contractor shall not assign or sub-contract any work without the prior written consent of the Project Manager. A list of sub-Contractors shall be submitted with the Tender response.
- 1.9.3. The AV Contractor agrees to use only tradesmen who are fully trained, qualified and experienced on the installation, termination and testing of the AV System Solution. The AV Contractor must have their AVIXA Certified Technology Specialist designation.
- 1.9.4. The AV Contractor shall supply unionized workers on construction sites where this is a requirement.

1.10. PROGRESS BILLING EVALUATIONS

- 1.10.1. Monthly progress billings shall be issued by the AV Contractor and payment certificates shall require approval from AV Consultant. The AV Contractor shall bill according to an estimate of the percentage of the completed AV sub-systems. Progress billings shall not be reviewed unless they are submitted in the format outlined in the following example:

BASE CONTRACT	
Total Contract Amount	\$250,000.00
Tender Completed to Date	\$125,000.00
Amount Previously Approved	\$25,000.00
Amount of this Draw	\$100,000.00
Less 10% Holdback	\$10,000.00
Amount of this Draw (less 10% holdback)	\$90,000.00
CHANGES	
Total Contract Changes:	\$5,000.00
Total Changes Completed to Date	\$2,500.00
Amount Previously Approved	\$0.00
Amount of this Draw	\$2,500.00
Less 10% Holdback	\$250.00
Amount of this Draw (less 10% holdback)	\$2,250.00

- 1.10.2. The AV Contractor shall not bill for materials that are not on-site and in the process of installation.
- 1.10.3. The AV Contractor may be asked to revise the amount being billed based on the AV Consultant's assessment of project progress and completed systems.
- 1.10.4. The AV Contractor shall provide current site progress photos with each draw to support the amounts requested.
- 1.10.5. The following milestones shall be deemed as acceptable for monthly draw (holdback not included):

- .1 Deposit and kick off – 25%
- .2 Shops submitted & Reviewed – 35%
- .3 Cables pulled/Site prepared – 45%
- .4 Equipment delivered – 60%
- .5 Equipment installed – 80%
- .6 Substantial Completion – 90%
- .7 Project Complete & Close out Document Received – 100%
- .8 all above do not include holdback

1.11. TRAINING

- 1.11.1. The AV Contractor shall provide a comprehensive review with the Owner to cover all system operation and maintenance.
- 1.11.2. Training shall be provided in multiple sessions, within a minimum total of sixteen (16) hours. Each session shall be a minimum of two (2) hours in length.
- 1.11.3. One (1) training session shall be scheduled immediately following final acceptance by the AV Consultant of the system.
- 1.11.4. Training materials shall be provided to the users prior to scheduled session.
- 1.11.5. The Owner shall have the ability to schedule sessions within the warranty period at mutually acceptable dates and times.
- 1.11.6. Provide a sign-off sheet for each training session. The sign-off sheet shall include:
 - .1 A list of attendees
 - .2 Topics covered within session
 - .3 Date, time and duration of session
 - .4 Signature by an Owner's representative to confirm session was performed and completed to the satisfaction of the Owner.

1.12. WARRANTY

- 1.12.1. Provide a written warranty for all work of the AV system for a period no less than one (1) year from the date of substantial completion as certified by the AV Consultant. Warranty certificate shall be submitted as part of the close out documentation as described in Final Acceptance
- 1.12.2. Warranty shall cover the installation and equipment to be free of all defects resulting from faulty components, workmanship, installation or incorrect calibration. Replacements and repairs shall be made without cost to the Owner.
- 1.12.3. Provide the name of a contact, phone number and 24 hour emergency number and insert into all manuals and update as required. Ensure that all contact information is kept current.
- 1.12.4. All service calls should be answered or returned within four hours between 8:00am and 6:00pm (local time). All onsite responses should be within 24 hours.
- 1.12.5. Perform onsite replacement of failed equipment. All failed equipment must be replaced by identically functional and technically equivalent device. Timelines for equipment replacement have been separated into two types:
 - .1 Critical Equipment
 - .1 Replacement must be provided by next business day of the initial service call.
 - .2 This includes any piece of equipment that renders the system of a room not useable for either conferencing or presentation capabilities.

- .3 Temporary/rental equipment of similar functionality is acceptable upon approval from Owner at no additional cost.
 - .2 Non-critical
 - .1 Replacement must be provided at best effort within a week of the initial service call.
 - .2 This includes any piece of equipment that limits the functionality of a room system.
- 1.12.6. The system warranty shall include parts and labour for the duration of the warranty.
- 1.12.7. Warranties offered by manufacturers that exceed the AV Contractors installation warranty, shall be reported and noted with the Owner and recorded in the manuals. The AV Contractor shall be responsible for managing these extended warranties. Additional costs regarding removal, shipping and re-installation after the installation warranty period has expired, shall be reported to the Owner prior to commencing work.
- 1.12.8. All custom programming shall be warranted against faults and deficiencies for the duration of the installation warranty commencing at certificate of substantial completion. Any and all necessary changes under this warranty are to be at no cost to the Owner and the AV Contractor shall notify the AV Consultant of such changes.
- 1.12.9. When custom programming is used to mimic a manufacturer's graphical user interface to provide a consistent graphical user experience, the AV Contractor shall update the custom programming at no cost during the warranty period in the event that a firmware updated changes the manufacturer's graphical user interface. For example, if a project contains both Cisco and Crestron Touch panels, any changes made by Cisco to their graphical interface shall result in the AV Contractor adjusting the custom programming to reflect that change. Allow for one update to be complete within the last 60-days of the warranty period.
- 1.12.10. The AV Contractor must follow-up with the Owner ninety days after substantial completion to investigate any potential issues or concerns relating to the completed system. Any concerns raised shall be addressed appropriately and with the AV Consultant for clarification.
- 1.12.11. The AV Contractor shall provide one (1) preventative maintenance visit for the extent of the warranty period at no additional cost to the Owner. This system maintenance visit shall not be required until after duration of six (6) months after substantial completion. Subsequent services shall be coordinated and agreed to by Owner.
- 1.13. EXTENDED WARRANTY
 - 1.13.1. Any extended warranty or service plan commencing after the installation warranty, may be offered by the AV Contractor to the Owner. Communications regarding this service must commence at least sixty (60) days prior to warranty expiration, at which time, the AV Contractor is responsible to update any firmware and software available for system components to the latest version and verify that update has not affected the functional requirements and system performance as outlined in within this scope of work.

2. Products

2.1. NOT USED

3. Execution

3.1. WORKMANSHIP AND BEST PRACTICES

3.1.1. The AV Contractor is responsible for the requirements of the practices and testing requirements detailed in this section.

3.1.2. Equipment installed by the AV Contractor shall not present safety hazards to the public, to other trades, or to equipment operators.

3.1.3. All equipment must be sufficiently ventilated when operating under worst-case power and heat dissipation scenarios.

3.1.4. Any equipment or material not directly specified within this document but still required for a fully functioning system shall be of commercial standard and high quality.

3.1.5. Submit proposed equipment and device samples to AV Consultant if requested.

3.1.6. Workmanship is as important a consideration for the overall job as functionality. Fabricate and install all equipment in accordance with the manufacturers' recommendations and the AV Consultant's specifications. Coordinate with other trades and the AV Consultant to provide an installation of the highest quality.

3.1.7. Before the system is deemed complete and ready for final acceptance, all hardware and software issues shall be rectified by AV Contractor and reviewed by AV Consultant.

3.2. APPROVAL DOCUMENTATION

3.2.1. General

- .1 Prior to ordering equipment, commencing work on site or expending labor on programming time provide the information detailed in this section.
- .2 Maintain a copy all documentation and software files for a minimum of three (3) years and provide accessibility to the Owner at any time within that time frame.

3.2.2. Equipment Cutsheets

- .1 Prior to ordering equipment, submit all equipment cutsheets to be included in the project. Identify all colour choices. Ensure cutsheets are submitted through the established construction process. The general Contractor, architect, interior designer and AV Consultant shall review the cutsheets.
- .2 Provide a spreadsheet of all items that are available to be ordered.
- .3 Organize and name the cutsheets according to product specification types identified in 27 41 00 Audiovisual System Scope of Work Part 2 "Products".
- .4 Indicate all colour choices on the spreadsheet.
- .5 Submit the spreadsheet for approval by the Owner or their representatives and the project team prior to ordering of any equipment.
- .6 Cutsheets for different equipment shall have their own dedicated file. The cutsheet file title shall be formatted as follows: "MANUFACTURER – MODEL NUMBER". Identify the file format naming convention in the spreadsheet.

3.2.3. Approval (Shop) Drawings

-
- .1 The AV Contractor must obtain written approval of shop drawings from the AV Consultant and/or Owner prior to procurement of equipment and commencement of work on site unless directed otherwise by the AV Consultant.
 - .2 Approval drawings are defined as drawings required to execute the job to the standards and conformance of the specification and contract drawings.
 - .3 Approval drawings are used to ensure conformance with the project system design. Only compliance with the Contract Documentation shall be reviewed as part of the approval process. Corrections or comments submitted by the AV Consultant do not relieve the AV Contractor of conformance to the specification and contract drawings.
 - .4 The AV Contractor shall provide to the AV Consultant a complete set of electronic approval drawings in PDF format. Bound hard copies of shop drawings / engineering specifications must be made available on request by the AV Consultant and/or Owner.
 - .5 Approval drawings should include:
 - .1 Cable pull schedules which includes wire numbers, source and destination locations, cable type, AV system serviced and conduit the cable is to be run within.
 - .2 AV system functional diagrams that show the interconnection of all equipment. For each wire indicate wire number (numbering scheme should indicate wire type). At each device connection indicate connector and termination type. For each device or device group identity type, model and location. For each multi-pin connection provide pin/conductor/function detail. For 70 V speakers indicate transformers with loudspeaker tap connections.
 - .3 Front and rear equipment rack elevations including rack accessories. Provide all specifications for equipment rack and accessories. Provide AC rack power distribution scheme.
 - .4 Wall plate, bulkhead and floorbox plate layouts. Give each plate a unique identifier. Give each connector a unique identifier.
 - .5 Sightline studies, equipment installation and any other details that clearly communicates the AV Contractor's installation methodology to the AV Consultant.
 - .1 For devices or systems in weight over 22kg (50lbs), shop drawings shall be reviewed for design intent. After no comments by the AV Consultant, the AV Contractor shall obtain a Structural Engineer stamp with appropriate jurisdiction in the region of that installation on the drawing. The shop drawing with the stamp shall be resubmitted for record. Installation of device or system shall not commence without a stamped drawing.
 - .6 Software flow diagrams and any preliminary control system programming code.
 - .6 Include annotations, amendments and or comments as required. These must be corrected where noted and if modifications are needed or if added equipment is needed for the system to function as intended, there shall be no changes to the contract value as the AV Contractor is responsible to provide a proper working system. Corrections shall be made in a timely manner as to not impact Construction schedule or delivery of system.

3.2.4. Graphical User Interfaces

- .1 Provide preliminary graphical user interfaces for touch panels, custom software, button interfaces or any other control surfaces. Format the document in a method that clearly indicates menu navigation hierarchies.
- .2 Submit user interfaces for review prior to the commencement of system programming. See section 27 41 16.15 Control Systems for further details.

- .3 Coordinate an on-site workshop with the Owner's user group to review the proposed interfaces for Owner feedback. This workshop should occur after GUIs are developed, before detailed programming is completed. Allow for one (1) major revision and one (1) minor revision to the interfaces following the workshop.

3.3. AS-BUILT DRAWINGS

3.3.1. As-Built Drawings

- .1 As-Built Drawings shall include:
 - .1 Approval drawings revised to reflect as-built changes.
 - .2 Device locations showing all floor, wall and ceiling equipment locations
 - .3 Elevation drawings of all mounted AV equipment.
 - .4 Riser/cable diagrams indicating system conduit, back boxes, connector, and cable interconnections. Indicate cable quantity and type for each cable run.
 - .5 Functional line diagram of the completed system per specification
 - .6 Metalwork fabrication drawings can be excluded.
 - .7 Include any other drawings indicated in the specification.
 - .8 Any diagrams that is required for a complete description of the system.
 - .9 Supply two (2) soft copies of As-Built Drawings in PDF and AutoCad format. One copy shall be for the Owner, the other for the AV Consultant.

3.4. SYSTEM MANUALS

3.4.1. Approval System Manuals

- .1 Provide two soft copies of the System Manual, one to the AV Consultant and one to the Owner in PDF format by email/FTP for review and approval.
- .2 All operation and maintenance manuals and all testing and commissioning reports shall be provided to Owner and Owner's representative. Any deficiencies found during the testing or commissioning phase of work, shall be reported immediately to the Owner and the Owner's representative.
- .3 Manuals shall contain a minimum of the following:
 - .1 Detailed table of contents
 - .2 Title page which clearly indicated Project Name and Document Title.
 - .3 Contacts and credits page.
 - .4 User operating instructions with detailed views of various systems for the day-to-day user. Include all control panel layouts, screen dumps, DSP control interfaces, and any other GUI.
 - .5 Manufacturer product manual(s) and literature for all components. Include technical system manuals for all systems described in the specification which should include all service procedures.
 - .6 Software instruction manuals.
 - .7 Copies of all approvals, stamps and inspection certificates.
 - .8 Optimally configured settings for all signal processing equipment, zone selections, gain settings and control systems.
 - .9 Performance data of completed system test results.
 - .10 Amplifier connections and corresponding test results at normal operation.
 - .11 Termination records, for strips, switches, floor plug connections.

- .12 Warranty Certificate with statement of completion.
- .13 List of manufacturer's warranties by date of expiration.
- .14 Room configuration procedures.
- .15 Troubleshooting activities
- .16 Service support contact numbers divided by Account Manager and 24/7 support staff.

3.4.2. As-Built System Manuals

- .1 After AV Consultant sign-off of Approval Manuals, Provide two soft-copy sets in PDF format by cloud storage/FTP/email to the project team, AV Consultant and the Owner. At the request of the Owner or AV Consultant, supply one bound hard copy set of manuals.
- .2 The Owner reserves the right to reproduce all documents for internal corporate use.
- .3 The AV Contractor shall ensure an electronic copy of the close-out documentation are available to the Owner for a period of three years following the date of substantial completion.

3.4.3. Quick Reference Guide

- .1 Provide (qty: 1) laminated quick reference guide for each custom user interface described in the Scope of Work. The quick reference sheet is intended to assist with training end-users on the AV systems in order to minimize unnecessary helpdesk calls. Quick reference sheet shall visually depict user interfaces and describe how the user is to interact with the system.

3.5. EQUIPMENT STORAGE

- 3.5.1. The AV Contractor shall coordinate with the General Contractor/Construction Manager for any required on-site storage during construction.
- 3.5.2. The AV Contractor is responsible for loss or damage of any and all system equipment until it is signed over to the Owner on the date of final acceptance.
- 3.5.3. The AV Contractor shall include all storage costs as required to meet the project timelines at time of bid.

3.6. OFF-SITE SYSTEM STAGING

- 3.6.1. All items within this section shall be completed offsite, at the AV Contractor facility.
- 3.6.2. All equipment shall be tested prior to delivery to site to ensure fully functionality.
- 3.6.3. All equipment shall be configured and shall be ready for use upon installation onsite.
- 3.6.4. All equipment shall have it's firmware updated prior to testing.
- 3.6.5. All equipment racks shall be configured and populated with equipment to allow for pre-delivery inter-rack cabling termination and labeling.
- 3.6.6. All digital signal processors shall have the site file loaded to ensure that only calibration is required to occur on site.
- 3.6.7. All control processors shall have the compiled files uploaded and tested.
- 3.6.8. All touch panels shall have the control interface uploaded and fully operational.
- 3.6.9. All AV network switches shall be configured with port assignments and VLANs.
- 3.6.10. All systems shall be connected to simulate the onsite installation as close as possible prior to delivery on site to test interconnectivity so that upon arrive and installation, the systems shall be ready for testing and commissioning to minimize schedule impacts.

3.6.11. All systems shall be left functioning as per the above for a minimum of two (2) days to allow for a burn-in cycle to occur and identify any possible defective equipment.

3.7. CONTROL HARDWARE AND USER INTERFACES

3.7.1. All custom graphical user interfaces for touch panels and other control system user interfaces shall be submitted to the AV Consultant and the Owner for review and approval prior to system commissioning.

3.7.2. All hardware used to control and interface with the computer system shall be tested and fully functional prior to installation on site.

3.7.3. Software programs that control operable machinery must require tally from said devices.

3.7.4. Any control hardware located on walls that may be subject to impacts shall include an impact resistant cover to prevent damage.

3.8. DEVICE SECURITY (PASSWORDS)

3.8.1. All device access and configuration passwords for devices shall be changed from default to a custom password.

3.8.2. All passwords shall be created to the maximum security level of the device.

3.8.3. Passwords shall include the below criteria items based on the level of security of the device:

- .1 Include a combination of upper and lower case letters
- .2 Include a minimum of one number
- .3 Include a minimum of one special character
- .4 Minimum length of 8 characters

3.8.4. All passwords shall be recorded and included in close out documents.

3.9. SOFTWARE STANDARDS (CONTROL SYSTEM, DSP AND COMPUTER-BASED)

3.9.1. Supply two copies of custom developed software (compiled and uncompiled) and documentation along with System Manuals. The documentation shall describe all GUIs, modes of operation, licenses, presets, and programming so service personnel can competently operate and troubleshoot the system.

3.9.2. Upon request of AV Consultant, supply licensed development environment, compiler software, project-specific source code with source commenting, custom executables and libraries, uncompiled script files and any other code required for program evaluation and debugging.

3.9.3. The AV Contractor can expect that the AV Consultant shall expect the manufacturer to review the AV Contractor's programming. The AV Contractor may be requested to modify program according to manufacturer's recommendations.

3.9.4. All custom software shall be created by programmers with the appropriate manufacturer certification or by manufacturer authorized personnel.

3.9.5. Where security passwords are used, ensure that each security level is properly defined and all users have appropriate access as directed by the AV Consultant. The AV Contractor must submit to the AV Consultant for review all security features prior to commissioning.

3.9.6. When utilizing DSP processing for loudspeaker optimization, consult the manufacturer of the loudspeaker system to obtain recommended settings and/or macros. Include any custom loudspeaker setting within the system documentation.

3.9.7. Prior to commissioning, submit all software programming files to AV Consultant for review. All software submissions must be accompanied by documentation indicating the intent of the program, table of presets, flow diagrams, revision date and any omissions to overall functionality.

3.10. COMPUTER SYSTEMS

3.10.1. Computer system shall not be installed on site during construction with the presence of dust and debris.

3.10.2. All computer system components should be of premium quality and sourced from reputable vendors.

3.10.3. All computer-based systems should meet the Owner's specifications.

3.10.4. All computer systems should be 19" rack-mountable.

3.10.5. Backup all hard drives and ensure a duplicate image of the hard disk exists at time of Owner acceptance.

3.10.6. Integrate any security features with Windows Security standard suite where possible.

3.11. WIRING AND CABLE TERMINATION

3.11.1. The AV Contractor should take all measures to prevent electromagnetic and electrostatic interference.

3.11.2. All precautions should be taken to avoid inadvertent grounding of shield. All terminations of shielded twisted pair cables shall have the shield drain wire covered with a Teflon sleeve and a heat shrink or neoprene sleeve covering the point where the cable jacket and shield end. At the termination point, the unshielded leads should be less than 50 mm in length.

3.11.3. All wiring entering equipment racks should have a 2-meter service loop neatly dressed and harnessed within the equipment rack.

3.11.4. All cable bundles within equipment racks should be neatly and logically routed and organized. Bundles of varying signal level should be spaced at least 10 cm apart and secured using lacing bars. AC power cabling should be separated from low voltage cabling.

3.11.5. All runs of shielded twisted pair and coaxial cable shall be continuous.

3.11.6. Only cables and connectors listed in specifications and drawings shall be used.

3.11.7. All cable run free-air in ceiling spaces and in raised-access floors shall be FT-6 rated.

3.11.8. All IP-based audiovisual solutions utilizing category cabling shall terminate to patch panels at the equipment rack.

3.12. INTERCONNECTION BEST PRACTICES

3.12.1. All audio level wires shall be balanced and floating unless otherwise specified.

3.12.2. Where audio cables share conduits with control cables, appropriate precautions should be taken to prevent pops, clicks and noise in the system.

3.12.3. All shielded cables shall have their shields isolated from both the conduit system and any other shielded cables.

3.12.4. All BNC-type video connectors shall be of high quality with crimp style strain relief.

3.12.5. All BNC-type RF connectors shall be of high quality with compression style strain relief.

3.12.6. All XLR connectors should be inserted into panels from the rear. Ensure labelling strips do not interfere with the connector releasing mechanisms.

3.13. LABELLING

3.13.1. Wire Labelling

- .1 All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition the labels shall meet the general exposure requirements in UL 969 for indoor use.
- .2 Cable Labels shall be of self-laminating vinyl construction with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.
- .3 All labels must be mechanically printed using a laser printer. Hand-written labels are not permitted.
- .4 All wires shall be marked as indicated on functional diagrams and cable schedules.

3.13.2. Wall Plate, Floorbox Plate and Patch Panels

- .1 Ensure each wall plate and floorbox plate is identified to indicate the physical location of the outlet, the designation and the circuit number of termination.
- .2 All panels are to be laser engraved or marked with lamacoid label strips.
- .3 Submit samples to AV Consultant for approval prior to manufacturing.

3.13.3. Network Cabling

- .1 Ensure all new network cable naming conventions are consistent with building infrastructure as specified by the Owner.

3.14. FIELD PANELS

- 3.14.1. All plates shall be 0.125" aluminum stock with 0.125" bevelled edges. All panels shall have anodized finishes.
- 3.14.2. Plastic decora style plates are unacceptable for field connections.
- 3.14.3. All panels shall be labelled and laser engraved.

3.15. METALWORK

- 3.15.1. All metalwork shall have a minimum tolerance of 0.63 mm (0.025"). All edges shall be smooth and free of burrs and other defects.
- 3.15.2. Holes on panels should line up on centers with consistent spacings as shown on fabrication drawings.
- 3.15.3. Finished panel surfaces should be free of any surface defects. Coordinate finishes with Owner.
- 3.15.4. Provide fabrication drawings to AV Consultant for approval prior to fabrication.

3.16. POWER

- 3.16.1. Verify all AC power on site serves the needs of the AV systems and report any concerns to the AV Consultant and the Owner prior to final acceptance testing.
- 3.16.2. Equipment racks shall be wired to AC circuits dedicated to AV systems.
- 3.16.3. The AV Contractor is responsible for AC power distribution within the racks. For fixed equipment racks, provide plug strips (free of switches, fuses and circuit breakers) and direct connect to supply provided by electrical Contractor.

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- 3.16.4. All power cords of rack-mounted equipment shall be neatly dressed so the plug is easily associated with the connected equipment. Where this is not possible clearly label the plug and associated piece of equipment.
- 3.16.5. Ensure that low voltage cabling is dressed separately from high voltage cabling.
- 3.17. RIGGING AND OVERHEAD EQUIPMENT
- 3.17.1. All suspended systems shall use load-rated metallic fitting designed for a load safety factor of five or greater. All fasteners should be a minimum grade 8 steel.
- 3.17.2. All suspended systems shall be independently supported from structure using appropriate rigging fixtures approved by the manufacturer.
- 3.17.3. When total suspended mass exceeds 90 kg, a Structural Engineer with appropriate jurisdiction in the province of that installation shall approve all custom-built rigging fixtures.
- 3.18. PORTABLE CABLING
- 3.18.1. All portable cable shall be stranded copper, flexible and durable for heavy use.
- 3.18.2. Portable cable exposed to damp environments shall be tinned copper.
- 3.18.3. All portable cable for AC power distribution shall conform to all National regulations.
- 3.18.4. All portable cables shall be permanently identified with system information and function. All labels should be heavy-duty type and covered with clear shrink-wrap.
- 3.19. SCHEDULE, ACCESS, PROTECTION AND CLEAN-UP
- 3.19.1. Clean all equipment that has been exposed to construction dust and dirt.
- 3.19.2. The AV Contractor to clean all electrical equipment, inside and out, prior to turn over to Owner. Equipment is subject to inspection by AV Consultant and/or Owner.
- 3.19.3. The AV Contractor is responsible to remove their own waste from the site. All re-usable materials shall be recycled.
- 3.19.4. There shall be no smoking, and the site shall be kept clean at all times.
- 3.20. PREPARATION
- 3.20.1. Clean surfaces thoroughly prior to installation.
- 3.20.2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- 3.21. EXISTING SERVICES AND EQUIPMENT
- 3.21.1. All changes and connections to existing services shall be made only in a manner and at a time approved by the AV Consultant and/or the Owner so as to avoid any interruption of such services during normal working hours. If necessary, changes and connections to existing services shall be made outside of normal working hours, at no extra cost to the Contract.
- 3.21.2. Where connections are made to existing services, existing fire stopping shall be made good under this Division.
- 3.22. OWNER FURNISHED EQUIPMENT
- 3.22.1. All Owner Furnished Equipment (OFE) specified shall be installed by the AV Contractor.
- 3.22.2. Warranty for Owner Furnished Equipment shall be the equipment's warranty. The AV Contractor shall be responsible for any new programming that is supporting the system.

3.23. ACCESS DOORS

- 3.23.1. Adequate access or an Access Door shall be provided or arranged for with Division responsible for installation, for all audiovisual equipment that is concealed and requires accessibility, maintenance and or adjustment.
- 3.23.2. Exact details showing size, type and location shall be submitted to the AV Consultant for review and inclusion in floor plans and shop drawings.
- 3.23.3. Access Door details shall also be captured on as-built drawings and notations shall be included to indicate frequency of maintenance required for concealed equipment.

3.24. CUTTING, PATCHING AND REPAIRING

- 3.24.1. It is the responsibility of the AV Contractor to coordinate all cutting and patching required for AV Cabling work with the General Contractor.

3.25. PROTECTION

- 3.25.1. Protect installed products until completion of project.
- 3.25.2. Touch-up, repair or replace damaged products before Substantial Completion.

3.26. TESTING

- 3.26.1. Provide a test plan for approval by the Owner. Test plan shall identify all testing activities, include sample test reports and accommodate scheduling and sequencing.
- 3.26.2. Typical test plans/reports shall include full testing of all: Video inputs, Video outputs and switching, all device control. Touch panel/programming testing report. Audio inputs, Audio outputs and switching. DSP settings and test calls. Video conferencing test calls.
- 3.26.3. Supply completed testing reports verifying accurate implementation of all signal connections. Provide a written report to the AV Consultant verifying accuracy prior to software deployment on site.
- 3.26.4. Provide test reports of commissioning process for each area according to approved test plan prior to deficiency walk-through by AV Consultant.
- 3.26.5. Include in report confirmation of system implementation as per specification and whether it is inspection ready. Installation Supervisor shall sign-off.
- 3.26.6. All test results and set-ups must be reproducible by the AV Contractor.
- 3.26.7. AV Consultant may elect to perform additional testing during the deficiency walk-through, with the assistance of the AV Contractor.
- 3.26.8. All wiring shall be tested for continuity and short-circuits between conductors and shields. Confirm isolation of conductors and shields, back boxes and conduit systems. Failure of any equipment, system or functionality as intended, shall be revised or replaced by the AV Contractor in full.
- 3.26.9. The following includes, but is not limited to, a list of sub-systems anticipated that shall require testing:
 - .1 Equipment testing
 - .2 Power, Cable Systems and Isolated Ground
 - .3 Audio Systems
 - .4 Distribution outputs and inputs
 - .5 Computer System Hardware
 - .6 Control and Switching

- .7 Video Systems
- .8 Network Cable Systems
- .9 Digital AV Systems
- .10 RF Systems
- .11 Signal System.
- .12 Control Applications
- .13 Cabling systems

3.27. PROJECT CLOSE OUT DOCUMENTATION

- 3.27.1. Provide the following items in this section upon project completion to form as-built documentation.
- 3.27.2. As-built Drawings
 - .1 Refer to section 3.3.1 in this specification for requirements.
- 3.27.3. Compliance Checklist
 - .1 Refer to section 3.26.5 in this specification for requirements
- 3.27.4. Control System Code
 - .1 Refer to section 3.9.1 and 3.9.2 in this specification for requirements
- 3.27.5. Manuals
 - .1 Refer to section 3.4 in this specification for requirements.
- 3.27.6. Network Information with Systems Passwords
 - .1 For passwords, refer to section 3.8.4 this specification for requirements.
 - .2 For network information, refer to specification 27 51 50 – Audiovisual Networking.
- 3.27.7. Test Reports
 - .1 Refer to section 3.26.3 and 3.26.4 in this specification for requirements.
- 3.27.8. Training
 - .1 Refer to section 1.11.2 in this specification to provide a written sign off by the Owner of completed training sessions.
- 3.27.9. Warranty
 - .1 Refer to section 1.12.1 in this specification to provide a written warranty letter.
- 3.27.10.

END OF SECTION

27 41 00.00 Audiovisual System Scope of Work

1. General

1.1. IMPORTANT NOTES AND RELATED SECTIONS

- 1.1.1. Bidders are required to review the Tender Specifications and Drawings in their entirety in order to understand the complete scope of work described herein.
- 1.1.2. Errors and omissions are to be addressed during the tender period. Refer to subsection 1.3 of 27 40 10.00 – General Instructions for Audiovisual System Installation for further detail.
- 1.1.3. All clarifications and substitution requests must be submitted to the Tender administrator before the end of question period, otherwise a response shall not be provided by the Consultant.
- 1.1.4. Provide all interconnecting cables required to complete a fully functioning system. Refer to section 27 41 23.11 - Audiovisual Cabling for further detail.
- 1.1.5. All graphical user interfaces (GUI) must be simple to operate and developed with input from Owner. GUI's must be consistent between system types. Refer to sections 27 40 10.00 – General Instructions for Audiovisual System Installation and 27 41 16.15 - Control Systems for further detail.
- 1.1.6. Throughout the entirety of the tender Specifications and Drawings, the term 'provide' means 'supply, install, terminate, test and commission'.

1.2. DECOMMISSIONING

- 1.2.1. Decommission the following equipment and relocate to a storage space on campus and coordinate designated storage space with the Owner prior to decommissioning:
 - .1 All HDMI transmitters
 - .1 On wall and in floorboxes as required
 - .2 All HDMI receivers
 - .3 70" display
 - .1 Including mounting bracket
- 1.2.2. Decommission and package the following equipment for future use, and relocate to a storage space on campus and coordinate designated storage space with the Owner prior to decommissioning:
 - .1 All 48" displays
 - .1 Including mounting bracket
 - .2 All wall-mounted button panel control interface
- 1.2.3. Test and document all equipment prior to decommissioning. Provide a decommissioning report inclusive of:
 - .1 Photos
 - .2 Recorded serial numbers and makes/models.
 - .3 Equipment operational state
- 1.2.4. Retrieve equipment from storage as required for reinstallation, as listed below.

1.3. CAPSTONE ROOMS

- 1.3.1. This room type shall feature the following functionality for users:

-
- .1 Presentation
 - .1 Wired
 - .2 In-room PC
 - 1.3.2. Reinstall a wall-mounted button panel control interface in each room. This unit shall be located on the wall beside the display. The control interface shall allow for:
 - .1 System on/off
 - .2 Input source selection
 - .3 Volume control
 - 1.3.3. Provide a wall mounted input to allow users to connect devices. The wall plate shall include presentation cables in 12' length, with connectivity for:
 - .1 HDMI with USB-C dongle
 - 1.3.4. A dedicated in-room PC/monitor shall be provided by the Owner. Provide connectivity to this PC to the display.
 - 1.3.5. Reinstall a wall-mounted 48" flat panel display with wall-mount system for playback of video.
 - 1.3.6. All required interconnecting video, control and audio interface cables shall be provided for a fully functional system.
 - 1.4. MEETING ROOM
 - 1.4.1. This room type shall feature the following functionality for users:
 - .1 Presentation
 - .1 Wired
 - .2 Integrated Web-based Video Conferencing
 - .1 BYOD (Bring Your Own Device)
 - 1.4.2. Provide AV inserts for table monument and presentation cables 6' in length to allow users to connect devices. The table mounted shall be provided by the furniture vendor. This shall have connectivity for:
 - .1 HDMI with USB-C dongle
 - .1 Presentation
 - .2 USB-B
 - .1 For BYOD web-based conferencing
 - 1.4.3. Provide video and USB extension systems as required.
 - 1.4.4. Provide a ceiling-mounted 86" flat panel display with integrated speakers for playback of video. This unit shall also include a wall-mount system for installation as well as a display controller to automatically power on/off the display when a user connects a device to use for presentations.
 - 1.4.5. Provide a USB camera, with digital pan, tilt, zoom and auto-framing features, to capture video of local participants. Mount the USB camera at the display location. The camera shall include a USB extension system.
 - 1.4.6. Provide a ceiling-mounted linear digital microphone to allow users in the room be heard on the far-end of web-based conference calls.
 - 1.4.7. Provide a USB audio digital signal interface to allow process the audio.
 - 1.4.8. Provide ceiling-mounted speakers to support audio playback in the space.

- 1.4.9. Provide a network switch to connect to all field equipment to allow all the AV equipment to reside on a common local area network. This network switch shall also provide an uplink to the client local area network.
- 1.4.10. All equipment that shall be provided shall be mounted under the meeting room table.
- 1.4.11. All required interconnecting video, control and audio interface cables shall be provided for a fully functional system.
- 1.5. OPEN ENGINEERING SPACE
 - 1.5.1. This room type shall provide user with the following functionality:
 - .1 Presentation
 - .1 Wired
 - .2 In-room PC
 - .2 Integrated Web-based Video Conferencing
 - .1 In-room PC
 - .2 BYOD (Bring-Your-Own-Device)
 - .3 Active Learning
 - 1.5.2. Provide system presets to allow an active learning environment for presentation:
 - .1 Instructor content to all displays.
 - .2 Each student table content to local display.
 - .3 One student table to all displays.
 - .4 Seneca TEC classroom standard available upon request.
 - 1.5.3. Provide a video projection system for video playback. This system shall include a motorized ceiling mounted projection screen, a ceiling mounted high-definition video projector with a mounting solution as required and a video decoder.
 - 1.5.4. Provide the following cameras:
 - .1 One (1) camera, with motorized pan, tilt, zoom and auto-tracking features. This camera shall be mounted at the column to capture the instructor at the front of the room.
 - .2 One (1) camera, with motorized pan, tilt and zoom features. This camera shall be mounted on the front wall to capture the students.
 - 1.5.5. Provide ceiling-mounted square digital microphones as shown on provided drawings to allow users in the room be heard on the far-end of web-based conference calls.
 - 1.5.6. Provide ceiling-mounted speakers as shown on provided drawings to support audio playback in the space.
 - 1.5.7. Provide a ceiling-mounted occupancy sensor. The sensor shall detect when the room has no users and shall automatically power down the system.
 - 1.5.8. A furniture podium shall be provided by others. The podium shall be used by the instructor to address the students. Provide the following to support the podium:
 - .1 An equipment rack to house the local AV equipment.
 - .2 A 10" table-top graphical control interface. The control interface shall allow for:
 - .1 System on/off
 - .2 Input source selection
 - .3 Volume control
 - .4 Camera controls

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- .5 Lighting controls
 - .6 Room controls
 - .7 Room presets
 - .3 A table mounted input plate to allow users to connect devices. The wall plate shall have connectivity for:
 - .1 Dual AC Power
 - .2 Dual USB-B
 - .1 Connected to in-room PC
 - .3 Microphone input
 - .4 An AV input with cables from a grommet in the podium to allow users to connect devices. The wall plate shall have connectivity for:
 - .1 HDMI with USB-C dongle
 - .1 Presentation
 - .2 USB-B
 - .1 For BYOD web-based conferencing
 - .5 A dedicated in-room PC/monitor shall be supplied by the owner and installed by the AV Contractor. This shall include as well a second monitor, keyboard and mouse. Both monitors shall be mounted by the AV Contractor to the Owner supplied arms with the podium.
 - .6 Video transceivers to allow for the routing of video & audio signals within the space. The system shall be programmed to allow different video sources to be displayed.
 - .7 A HD-SDI switcher for switching the camera feeds.
 - .8 A USB audio interface to send an audio feed from the ceiling microphones to the in-room PC.
 - .9 A USB auto switcher to automatically switch the USB devices between the in-room PC and laptop input.
 - .10 A gooseneck microphone. This shall be used for public address as well as sending the instructor's voice to the far end of web-based conference calls.
 - .11 An audio amplifier to drive the local speakers.
 - .12 A control processor to be used as a central control point for the space.
 - .13 A network switch with power-over-ethernet. This unit shall be provided to connect to all field equipment to allow all the AV equipment to reside on a common local area network. This network switch shall also provide an uplink to the client local area network.
 - .14 All cabling shall be fed from a floor-feed under the podium.
 - .15 A wireless assistive listening system to support users with hearing challenges or disabilities.
- 1.5.9. Provide the following at each of the five (5) student desk locations:
- .1 A table-mounted input shall be provided by the furniture vendor to allow users to connect devices. Provide inserts for this with presentation cables 6' in length. This shall have connectivity for:
 - .1 HDMI with USB-C dongle
 - .2 An AV transceiver to encode the table-mounted input.
 - .3 A wall-mounted 55" flat panel display with integrated speakers shall be provided for playback of video. This unit shall also include a wall-mount system for installation.

- 1.5.10. Provide the following at each of the three (3) student desk locations:
- .1 A table-mounted input shall be provided by the furniture vendor to allow users to connect devices. Provide inserts for this with presentation cables 6' in length. This shall have connectivity for:
 - .1 HDMI with USB-C dongle
 - .2 A dedicated in-room PC/monitor shall be supplied by the Owner and installed by the AV Contractor.
 - .3 An AV transceiver to switch and encode the table-mounted input and dedicated PC.
 - .4 A wall-mounted 55" flat panel display with integrated speakers shall be provided for playback of video. This unit shall also include a wall-mount system for installation.
 - .1 One (1) location shall be have a flat display mounted to a mobile cart rather than be wall-mounted. The cart shall include connectivity cables 15' in length and a cable management system.
- 1.5.11. Provide all required interconnecting video, control and audio interface cables for a full functional system.
- 1.6. SYSTEM PROGRAMMING
- 1.6.1. All systems included in scope shall be integrated with the Owner's asset management system, Crestron Fusion.
- 1.6.2. All custom software shall be programmed using standard Crestron control modules for proper integration into the Fusion system.
- 1.6.3. All control, audio and video systems programming/configuration shall be provided by the Owner's preferred contractor, ClearAlan Inc. AV Contractor shall carry ClearAlan as a sub-contractor. AV Contractor and ClearAlan to establish division of responsibilities based on project requirements.

1.7. ITEMS IN THE SCOPE OF OTHERS

- 1.7.1. Owner shall supply dedicated in-room PCs with wireless keyboards and mice as required.
- 1.7.2. Furniture manufacturer to provide required millwork modifications in coordination with AV Contractor.
- 1.7.3. Refer to the following table for the division of responsibility for IT department regarding AV systems:

IT Systems Information		
Unified Communications System:	Various (Microsoft Teams, Zoom, etc...)	
AV Monitoring System:	Crestron Fusion (on-prem)	
AV / IT Division of Responsibility Matrix		
System Type	AV Contractor	IT
Network Configuration	<ul style="list-style-type: none">- Spreadsheet List of devices to be attached to network with device information- Document Data Jack AV network switch shall connect to- Configuration of Devices for Multicast and static IP addressing- Update of Spreadsheet with IP addresses once assigned.	<ul style="list-style-type: none">- Network Security Rules- Wall jack patching in Telecom Room- Provide IP addresses or IP subnet ranges for devices that shall reside on the Owner's network.
Video/Audio Conferencing	<ul style="list-style-type: none">- Hardware Supply, Installation and Calibration (Microphones, speakers, signal processors)- Hardware Configuration	
AV System Monitoring	<ul style="list-style-type: none">- In-room systems hardware configuration	<ul style="list-style-type: none">- Network Configuration

	<ul style="list-style-type: none">- Configuration of System Monitoring hardware.- Addition of all devices for operation as described in this document.- All Fusion programming on server, control processors and devices. Manufacturer modules must be used.	<ul style="list-style-type: none">- Allocation of Network Drop and Activation- Installation and Configuration of System Monitoring Software- Provide access to AV Contractor to server.
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2. Products
- 2.1. PROJECTOR – 8000 WUXGA
- 2.1.1. Projector shall have a resolution of 1920 x 1200 with aspect ratio of 16:10.
- 2.1.2. Projector shall have a minimum brightness of 8000 ANSI lumens.
- 2.1.3. Projector shall have motorized lens shift capabilities.
- 2.1.4. Projector shall have be of solid state, laser phosphor, with a minimum light output expectancy of 20,000 hours.
- .1 Projectors shall be configured to operate with a constant brightness strategy
- 2.1.5. Projector shall have a minimum of the following inputs:
- .1 HDMI, qty:2
- .2 HDBaseT, qty:1
- 2.1.6. Projector shall have an analog audio output
- 2.1.7. Provide appropriate lens (standard or custom) to meet the throw distance shown on the drawings.
- 2.1.8. Typical device shall be NEC NP-PA803U-41ZL series or approved equivalent.
- 2.2. CEILING PROJECTION SCREEN 133" 16:9
- 2.2.1. Projector Screen shall have an image area diagonal of 133" at 16:9 aspect ratio.
- 2.2.2. Projector Screen shall be a motorized ceiling-recessed, tab-tensioned front projection screen.
- 2.2.3. Projector Screen shall have a bezel trim kit to conceal rough cuts in ceiling opening.
- 2.2.4. Projection screen shall be black-backed.
- 2.2.5. Allow for an additional 24" of black-drop during pricing and confirm required black drop during shop drawing reviews prior to ordering product.
- 2.2.6. Projection screen surface shall have a minimum gain of 1.1 and half angle of 85-degrees with ambient light rejection features.
- 2.2.7. Provide low voltage switch. Install switch in equipment rack for backup operation.
- 2.2.8. Typical device shall be Da-lite Advantage Electrol Tensioned series or approved equivalent.
- 2.3. FLAT PANEL DISPLAY - 55" 4K COMMERCIAL (TYPE – FPD2, FPD3)
- 2.3.1. Flat panel display shall have a minimum diagonal of 55" and resolution of 4K UHD (3840 x 2160) with an aspect ratio of 16:9.
- 2.3.2. Flat panel display shall have either LED edge lit or full LED array backlight system.
- 2.3.3. Flat panel display shall have a minimum brightness of 500 cd/m2 (nits).
- 2.3.4. Flat panel display shall have built-in audio speakers.
- 2.3.5. Flat panel display shall be commercial grade and have an operational rating of 24-hours per day, for 7-days a week for a minimum period of three years.
- 2.3.6. Flat panel display shall have the following inputs and not limited to:
- .1 HDMI (Qty: 2)
- .2 RS232C
- .3 RJ45 for IP-based control

- 2.3.7. Flat panel display screen shall have a haze value between 25%-50%.
- 2.3.8. Provide a mounting solution.
- 2.3.9. Provide trim kit for the display to provide an aesthetic as well as tamper-resistant coverage for the sides of the display.
- 2.3.10. Typical device shall be LG UH-series or approved equivalent.
- 2.4. FLAT PANEL DISPLAY - 86" 4K COMMERCIAL (TYPE – PMD)
 - 2.4.1. Flat panel display shall have a minimum diagonal of 86" and resolution of 4K UHD (3840 x 2160) with an aspect ratio of 16:9.
 - 2.4.2. Flat panel display shall have either LED edge lit or full LED array backlight system.
 - 2.4.3. Flat panel display shall have a minimum brightness of 500 cd/m2 (nits).
 - 2.4.4. Flat panel display shall have built-in audio speakers.
 - 2.4.5. Flat panel display shall be commercial grade and have an operational rating of 24-hours per day, for 7-days a week for a minimum period of three years.
 - 2.4.6. Flat panel display shall have the following inputs and not limited to:
 - .1 HDMI (Qty: 2)
 - .2 RS232C
 - .3 RJ45 for IP-based control
 - 2.4.7. Flat panel display screen shall have a haze value between 25%-50%.
 - 2.4.8. Provide a mounting solution.
 - 2.4.9. Provide trim kit for the display to provide an aesthetic as well as tamper-resistant coverage for the sides of the display.
 - 2.4.10. Typical device shall be LG UH-series or approved equivalent.
- 2.5. WALL DISPLAY MOUNT
 - 2.5.1. Display Mount shall have a leveling control for post-installation for fine tuning of height and leveling to provide post-installation height adjustment and lateral shift for faster and easier installation.
 - 2.5.2. Display Mount shall be an ultra-low-profile display mounting solution.
 - 2.5.3. Display Mount shall have a minimum tilt range of -12 to 2-degree.
 - 2.5.4. Display Mount shall be rated for the appropriate required display being mounted.
 - 2.5.5. Provide a CPU mounting accessory and extenders for a low-profile installation (FCA series) as required if mentioned above.
 - 2.5.6. Typical device shall be Chief Fusion Series or approved equivalent.
- 2.6. CEILING SINGLE DISPLAY MOUNT – TILT
 - 2.6.1. Ceiling Single Display Mount shall include all support systems to structure.
 - 2.6.2. Ceiling Single Display Mount shall include an adjustable extension pole appropriate for site conditions.
 - 2.6.3. Ceiling Single Display Mount shall allow for tilting of display up to +5 and -20 degrees.
 - 2.6.4. Provide an offset ceiling plate accessory.
 - 2.6.5. Typical device shall be Chief MCM1U Series or approved equivalent.

2.7. DISPLAY MOBILE CART

- 2.7.1. Display cart shall feature an integrated display mount that accommodates 50"-90" displays.
- 2.7.2. Display cart shall feature an integrated 14U equipment rack.
- 2.7.3. Display cart shall allow for adequate passive cooling using ventilation slots or similar.
- 2.7.4. Typical device shall be Heckler AV Cart or approved equivalent.

2.8. PROJECTOR MOUNT

- 2.8.1. Projector Mount shall have micro adjustment for precise adjustment.
- 2.8.2. Projector Mount shall have a quick release to provide a quick connect and disconnect of the projector for service.
- 2.8.3. Provide an offset ceiling plate.
- 2.8.4. Provide a 3' to 5' adjustable pipe accessory.
- 2.8.5. Where necessary, provide an above title suspended ceiling kit with 3" fixed pipe.
- 2.8.6. Typical device shall be Chief RPA series with CMA accessories or approved equivalent.

2.9. AV TRANCEIVER – TYPE 1

- 2.9.1. AV Transceiver shall support streaming video and a HDMI video input. Transceiver shall provide 2x1 video auto-switching capabilities.
- 2.9.2. AV Transceiver shall support streaming and HDMI video outputs.
- 2.9.3. AV Transceiver shall at minimum support the following video resolutions: UHD, 4K60 DCI, WUXGA, 1080p and WXGA.
- 2.9.4. AV Transceiver shall support 4:4:4 chroma sampling.
- 2.9.5. AV Transceiver shall have a build-in 4K scaler and audio extractor.
- 2.9.6. AV Transceiver shall have stereo analog an input and output.
- 2.9.7. AV Transceiver shall support transmitting and receiving AES67 digital audio protocol.
- 2.9.8. AV Transceiver shall support USB 2.0 extension and routing, as well as KVM signal extension.
- 2.9.9. AV Transceiver shall provide bidirectional infrared control and RS-232 control.
- 2.9.10. AV Transceiver shall support management of EDID (Extended Display Identification Data).
- 2.9.11. AV Transceiver shall provide video-wall processing of up to 8 displays wide and high.
- 2.9.12. AV Transceiver shall have an onboard video scaler.
- 2.9.13. AV Transceiver shall support network 802.1x protocol.
- 2.9.14. AV Transceiver shall support copper and fiber Ethernet connectivity.
- 2.9.15. Provide a local power supply. Confirm with AV Consultant prior to installation if device shall be powered by PoE or via the local power supply.
- 2.9.16. All systems with three (3) or more transceivers located within an equipment rack shall provide card based units with the appropriate chassis to accommodate cards as required.
- 2.9.17. Typical device shall be Crestron DM-NVX-360 or approved equivalent.
- 2.9.18. Typical card-based device shall be Crestron DM-NVX-360-C with DMF-CI-8.

2.10. AV TRANCEIVER – TYPE 2

- 2.10.1. AV Transceiver shall support streaming video and dual HDMI video inputs. Transceiver shall provide 3x1 video auto-switching capabilities.
- 2.10.2. AV Transceiver shall support streaming and HDMI video outputs.
- 2.10.3. AV Transceiver shall at minimum support the following video resolutions: UHD, 4K60 DCI, WUXGA, 1080p and WXGA.
- 2.10.4. AV Transceiver shall support 4:4:4 chroma sampling.
- 2.10.5. AV Transceiver shall have a build-in 4K scaler and audio extractor.
- 2.10.6. AV Transceiver shall have stereo analog an input and output.
- 2.10.7. AV Transceiver shall support transmitting and receiving AES67 digital audio protocol.
- 2.10.8. AV Transceiver shall support USB 2.0 extension and routing, as well as KVM signal extension.
- 2.10.9. AV Transceiver shall provide bidirectional infrared control and RS-232 control.
- 2.10.10. AV Transceiver shall support management of EDID (Extended Display Identification Data).
- 2.10.11. AV Transceiver shall provide video-wall processing of up to 8 displays wide and high.
- 2.10.12. AV Transceiver shall have an onboard video scaler.
- 2.10.13. AV Transceiver shall support network 802.1x protocol.
- 2.10.14. AV Transceiver shall support copper and fiber Ethernet connectivity.
- 2.10.15. Provide a local power supply. Confirm with AV Consultant prior to installation if device shall be powered by PoE or via the local power supply.
- 2.10.16. All systems with three (3) or more transceivers located within an equipment rack shall provide card based units with the appropriate chassis to accommodate cards as required.
- 2.10.17. Typical device shall be Crestron DM-NVX-351 or approved equivalent.

2.11. AV DECODER

- 2.11.1. AV Decoder shall output a network video stream and allow the source to be accessible via a local HDMI output.
- 2.11.2. AV Decoder shall have stereo analog audio output.
- 2.11.3. AV Decoder shall at minimum support the following video resolutions: UHD, 4K60 DCI, WUXGA, 1080p and WXGA.
- 2.11.4. AV Decoder shall support management of EDID (Extended Display Identification Data).
- 2.11.5. AV Decoder shall support 4:4:4 chroma sampling.
- 2.11.6. AV Decoder shall support at minimum (high dynamic range) HDR10.
- 2.11.7. AV Decoder shall have a build-in 4K scaler.
- 2.11.8. AV Decoder shall provide bidirectional infrared control and RS-232 control.
- 2.11.9. Provide a local power supply. Confirm with AV Consultant prior to installation if device shall be powered by PoE or via the local power supply.
- 2.11.10. All systems with three (3) or more transceivers located within an equipment rack shall provide card based units with the appropriate chassis to accommodate cards as required.
- 2.11.11. Typical device shall be Crestron DM-NVX-D30 or approved equivalent.
- 2.11.12. Typical card-based device shall be Crestron DM-NVX-D30-C with DMF-CI-8.

2.12. HDMI TRANSMITTER

- 2.12.1. HDMI Transmitter shall support HDCP.
- 2.12.2. HDMI Transmitter shall link to the receiver via a single CAT twisted pair cable.
- 2.12.3. HDMI Transmitter shall support a HDMI input. AV Transmitter shall at minimum support the following video resolutions: UHD, 4K DCI, WUXGA, 1080p and WXGA.
- 2.12.4. HDMI Transmitter shall support management of EDID (Extended Display Identification Data).
- 2.12.5. Conform to requirements in section 27 41 16.16 – Audio Video Over Structured Cabling.
- 2.12.6. Typical device shall be Crestron HD-TX-101-C-E or approved equivalent.

2.13. HDMI RECEIVER

- 2.13.1. HDMI Receiver shall support HDCP.
- 2.13.2. HDMI Receiver shall link to the transmitter via a single CAT twisted pair cable
- 2.13.3. HDMI Receiver shall at minimum support the following video resolutions: UHD, 4K DCI, WUXGA, 1080p and WXGA.
- 2.13.4. HDMI Receiver shall support management of EDID (Extended Display Identification Data).
- 2.13.5. Conform to requirements in section 27 41 16.16 – Audio Video Over Structured Cabling.
- 2.13.6. Typical device shall be Crestron HD-RX-101-C-E or approved equivalent.

2.14. HDMI INPUT, 1-GANG DECORA

- 2.14.1. Typical device shall be Crestron MP-WP152 or approved equivalent.

2.15. HDMI INPUT, 1-GANG DECORA 2 INPUT USB SWITCHER

- 2.15.1. USB switcher shall allow for switching between host devices and peripherals.
- 2.15.2. USB switcher shall have a minimum of two (2) USB host ports and a minimum of three (3) USB device ports.
- 2.15.3. USB switcher shall support up to USB 3.0 protocol with transfer rates up to 10 Gbps.
- 2.15.4. USB switcher shall support selectable Host and Peripheral emulation.
- 2.15.5. USB switcher shall support control via RS-232 and contact closure.
- 2.15.6. Typical device shall be Inogeni Toggle or approved equal.

2.16. SDI SWITCHER

- 2.16.1. Typical device shall be Marshall VSW-2000 or approved equivalent.

2.17. USB SDI CAPTURE CARD

- 2.17.1. Typical device shall be AJA U-TAP SDI or approved equivalent.

2.18. CEILING SQUARE MICROPHONE ARRAY

- 2.18.1. Ceiling Microphone shall have a 360 degree directional pick-up pattern with eight (8) steerable lobes.
- 2.18.2. Ceiling Microphone shall have onboard audio digital signal processing.
- 2.18.3. Ceiling Microphone shall have utilize DANTE digital audio network transport protocol.
- 2.18.4. Ceiling Microphone shall be sized to fit within standard ceiling tile size opening.

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- 2.18.5. Typical device shall be Shure Microflex MXA920.
- 2.19. CEILING LINEAR MICROPHONE ARRAY
- 2.19.1. Ceiling Microphone shall have a 360 degree directional pick-up pattern with up to eight (8) lobes.
- 2.19.2. Ceiling Microphone shall have onboard audio digital signal processing.
- 2.19.3. Ceiling Microphone shall have utilize DANTE digital audio network transport protocol.
- 2.19.4. Typical device shall be Shure Microflex MXA710-4FT.
- 2.20. USB AUDIO INTERFACE
- 2.20.1. AV Audio Interface shall support capture and stream audio directly to USB (PC).
- 2.20.2. AV Audio Interface shall utilize DANTE digital audio network transport protocol.
- 2.20.3. Audio Interface support four (4) DANTE inputs and two (2) DANTE outputs.
- 2.20.4. AV Audio Interface shave two (2) analog inputs and two (2) analog outputs.
- 2.20.5. AV Audio Interface shave at minimum support USB 2.0 protocols.
- 2.20.6. AV Audio Interface support one (1) input and one (1) output via USB.
- 2.20.7. AV Audio Interface shall utilize UVC and UAC device drivers.
- 2.20.8. AV Audio Interface shall have network connectivity for external controls.
- 2.20.9. AV Audio Interface shall include a rackmount solution.
- 2.20.10. Typical device shall be Shure P300.
- 2.21. USB AUDIO INTERFACE
- 2.21.1. AV Audio Interface shall support capture and stream audio directly to USB (PC).
- 2.21.2. AV Audio Interface shall utilize DANTE digital audio network transport protocol.
- 2.21.3. Audio Interface support four (4) DANTE inputs and two (2) DANTE outputs.
- 2.21.4. AV Audio Interface shall have one (1) analog inputs and one 1) analog outputs.
- 2.21.5. AV Audio Interface shave at minimum support USB 2.0 protocols.
- 2.21.6. AV Audio Interface support one (1) input and one (1) output via USB.
- 2.21.7. AV Audio Interface shall have network connectivity for external controls.
- 2.21.8. AV Audio Interface shall include a rackmount solution.
- 2.21.9. Typical device shall be Shure ANIUSB-MATRIX.
- 2.22. PTZ CAMERA
- 2.22.1. PTZ Camera shall have include a wall mount bracket.
- 2.22.2. Typical device shall be AVer PTZ330.
- 2.23. PTZ AUTO-TRACKING CAMERA
- 2.23.1. PTZ Camera shall have include a wall mount bracket.
- 2.23.2. Typical device shall be AVer TR530+.

2.24. USB WEB CAMERA

- 2.24.1. USB Camera shall support HD 1080p, 30fps
- 2.24.2. USB Camera shall have a maximum of 4X digital zoom in Full HD
- 2.24.3. USB Camera shall have a privacy shutter.
- 2.24.4. USB Camera shall feature an integrated microphone.
- 2.24.5. USB Camera shall feature a minimum 150 degree field of view.
- 2.24.6. USB Camera shall include wall-mounting hardware.
- 2.24.7. USB Camera shall be powered over USB.
- 2.24.8. Typical device shall be Huddly S1 or approved equivalent.

2.25. GOOSENECK MICROPHONE

- 2.25.1. Gooseneck Microphone shall have a frequency response of 50 to 17,000 Hz.
- 2.25.2. Gooseneck Microphone shall include base.
- 2.25.3. Typical device shall be Shure Microflex Gooseneck Microphone w/Base or approved equivalent.

2.26. ASSISTIVE LISTENING SYSTEM - RF

- 2.26.1. Assistive Listening Transmitter shall operate on multiple frequency bands (72 MHz or 216MHz) as appropriate for the location the system shall be installed into.
- 2.26.2. Assistive Listening Transmitter shall have a minimum frequency bandwidth response of 50 Hz to 15 kHz.
- 2.26.3. Assistive Listening Transmitter shall have 57 selectable transmitting channels.
- 2.26.4. Assistive Listening Transmitter shall have 60 dB SNR (mono) or greater, end-to-end.
- 2.26.5. Assistive Listening Transmitter shall have XLR and ¼ inch outputs.
- 2.26.6. Assistive Listening Transmitter have detachable antennas.
- 2.26.7. Provide antennas as required.
- 2.26.8. Assistive Listening Transmitter shall include a rack mounting kit.
- 2.26.9. Receivers shall incorporate a stereo headset jack that allows the user to plug in either a mono or stereo headset and listen to audio normally.
- 2.26.10. Assistive Listening System shall come complete with:
 - .1 Listening receivers
 - .1 Provide quantities in accordance with local ADA requirements.
 - .2 Rechargeable batteries
 - .3 Ear speaker
 - .4 Charging and carrying case for receivers.
- 2.26.11. Typical device shall be Listen LS-54-072 with LA-401 units as required.

2.27. AUDIO AMPLIFIER 4CH 75W

- 2.27.1. Amplifier shall have four channels and provide 75 watts of power per channel at 70 volts output.
- 2.27.2. Conform to requirements of 27 41 16.10 – Sound System General Requirements.

- 2.27.3. Amplifier shall support stereo low impedance, or mono 70V, loudspeaker systems.
- 2.27.4. Typical device shall be Crestron AMP-X300.
- 2.28. CEILING RECESSED SPEAKER POE (S1)
 - 2.28.1. Ceiling Speaker shall have a two-way coaxially mounted 4 inch, full range driver
 - 2.28.2. Ceiling Speaker shall be a passive speaker with built-in DSP.
 - 2.28.3. Ceiling Speaker shall have a minimum (-3 dB) frequency response of 60 Hz to 20 kHz measured on axis at a distance of 1 metre.
 - 2.28.4. Ceiling Speaker shall have a minimum 90db sensitivity measured at 1 watt and 1 meter from the speaker on the central axis.
 - 2.28.5. Speaker shall have a minimum 120° conical coverage.
 - 2.28.6. Speaker shall support PoE (Type 1 Class 4) or PoE+ (Type 2 Class 4) Typical device shall be Community QSC NL-C4-WH or approved equivalent.
- 2.29. PENDANT SPEAKER (TYPE – S2)
 - 2.29.1. Ceiling Speaker shall have a coaxially mounted 165mm (6.5 inch) woofer and 19mm (0.75”) dome high frequency unit for full range sonic reproduction.
 - 2.29.2. Ceiling Speaker shall have a minimum (-3 dB) frequency response of 55 Hz to 20 kHz measured on axis at a distance of 1 metre.
 - 2.29.3. Ceiling Speaker shall have a minimum 88db sensitivity measured at 1 watt and 1 meter from the speaker on the central axis.
 - 2.29.4. Speaker shall have a minimum 135° conical coverage.
 - 2.29.5. Speaker shall be rated for minimum program wattage of 60W.
 - 2.29.6. Speaker shall have a line transformer for 70V operation. Minimum transformer taps shall be 30W, 15W and 7.5 W.
 - 2.29.7. Typical device shall be QSC AD-P6T or approved equivalent.
- 2.30. CONTROL SYSTEM PROCESSOR
 - 2.30.1. Control Processor shall have real-time, pre-emptive multi-threaded/multitasking kernel; Transaction-Safe Extended FAT file system; supports up to 10 simultaneously running programs.
 - 2.30.2. Conform to requirements of 27 41 16.15 – CONTROL SYSTEMS.
 - 2.30.3. Control System shall have the following minimum specifications – 2 GB of SDRAM, 8 GB of Flash and supports DS/SDHC cards up to 32 GB and USB mass storage devices up to 1 TB.
 - 2.30.4. Control System shall support Ethernet connectivity with the following features:
 - .1 10/100 Mbps
 - .2 Auto-switching
 - .3 Auto-negotiating
 - .4 Auto-discovery
 - .5 Full/half duplex
 - .6 TCP/IP stack
 - .7 BACnet/IP

- 2.30.5. Control Processor shall support 2-way device control and monitoring, all ports support RS-232 up to 115.2k baud with software handshaking, one port also supports RS-422 or RS-485 and hardware handshaking.
- 2.30.6. Control Processor shall have IR/Serial shall support 1-way device control via infrared up to 1.2 MHz or serial TTL/RS-232 (0-5 Volts) up to 115.2k baud.
- 2.30.7. Control Processor shall have a minimum quantity of the following ports:
- .1 COM – Qty:3
 - .2 IR/Serial Out – Qty:8
 - .3 Relay – Qty:8
 - .4 Digital In/Out – Qty:8
 - .5 Ethernet – Qty:2
 - .6 USB – Qty:2
- 2.30.8. USB Configuration/Storage – Qty:1 Control Processor shall support USB HID and USB mass storage class devices via rear panel USB 2.0 host ports, supports computer console via front panel USB 2.0 device port.
- 2.30.9. Provide an Ethernet switch to create an audiovisual control network as shown on drawings.
- 2.30.10. Provide all required power supplies for connected equipment as required.
- 2.30.11. Typical device shall be Crestron CP4 or approved equivalent.
- 2.31. DISPLAY CONTROLLER
- 2.31.1. Display Controller shall provide a variety of options for controlling displays without a control processor.
- 2.31.2. Display Controller shall be configurable to automatically power displays on and off based on schedule, room occupancy, or video sync detect.
- 2.31.3. Display Controller shall support CEC control.
- 2.31.4. Display Controller shall be HDCP compliant.
- 2.31.5. Display Controller shall support HDR10 and HDR10+.
- 2.31.6. Display Controller shall at minimum support the following video resolutions: 8K, 4:4:4 chroma sampling.
- 2.31.7. Display Controller shall have at minimum HDMI input and (Qty:1) HDMI output.
- 2.31.8. Display Controller shall have at minimum the following connectivity:
- .1 HDMI (Qty: 2 for input and output)
 - .2 Digital Control Input
 - .3 RS232C
 - .4 Infrared
 - .5 Ethernet (Qty:2)
 - .6 Relay (Qty:2)
- 2.31.9. Typical device shall be Crestron HD-CTL-101 or approved equivalent.
- 2.32. TABLETOP TOUCH PANEL - 10"
- 2.32.1. 10" Touch Panel shall have a 10" TFT active matrix colour LCD display with aspect ratio of 16:9 pixels and resolution of 1920x1080 pixels.

- 2.32.2. 10" Touch Panel shall provide 400 nits brightness.
- 2.32.3. 10" Touch Panel shall utilize capacitive touch technology.
- 2.32.4. 10" Touch Panel shall support H.264 streaming.
- 2.32.5. 10" Touch Panel shall utilize PoE protocol.
- 2.32.6. Provide a swivel mount base.
- 2.32.7. Typical device shall be TS-1070 series.
- 2.32.8. Typical swivel mount kit shall be Crestron TS-770/1070-SMK series.

- 2.33. OCCUPANCY SENSOR - POE
 - 2.33.1. Provide an occupancy sensor for detecting if the room is in use.
 - 2.33.2. Occupancy sensor shall support an ethernet connection.
 - 2.33.3. Occupancy sensor shall be powered by ethernet.
 - 2.33.4. Sensor shall be a low-profile, ceiling-mounted occupancy sensor designed for large areas up to 2,000 square feet.
 - 2.33.5. Typical device shall be Crestron CEN-ODT-C-POE

- 2.34. NETWORK SWITCH
 - 2.34.1. Network Switch shall support Layer-3 Gigabit Ethernet switching.
 - 2.34.2. Network Switch shall provide Power Over Ethernet (PoE) on all ports.
 - 2.34.3. Network Switch shall be managed.
 - 2.34.4. Network Switch shall support 10Base-T/100Base-TX/1000Base-T Ethernet with network standards of IEEE 802.3, 802.3u, 802.3ab, 802.3x, & 802.3af.
 - 2.34.5. Network Switch shall have sufficient ports to accommodate all system AV devices, with an additional 4-ports for expansion or uplink.
 - 2.34.6. Network Switch shall be compatible with digital audio and video multicast protocols required as part of this project.
 - 2.34.7. Network Switch shall be network stackable.
 - 2.34.8. Network Switch shall be allow for proper bandwidth traffic to traverse across switches as required.
 - 2.34.9. Network Switch shall be rackmountable.
 - 2.34.10. Typical device shall be Araknis Networks AN-210-SW-R-16-PoE or approved equivalent.

- 2.35. TEACHING DESK RACK - 12RU
 - 2.35.1. Credenza Rack shall have a removable enclosure allows in-shop integration and on-site installation of equipment
 - 2.35.2. Credenza Rack shall have proper thermal management include active fans where required for equipment protection. Refer to 27 40 10.00 section 3 – VENTILATION and EQUIPMENT RACKS IN MILLWORK
 - 2.35.3. Credenza Rack shall have a rear cable support for effective cable management.
 - 2.35.4. Credenza Rack shall have 12 useable rackspaces with maximum weight capacity of 250 lb.
 - 2.35.5. Credenza Rack shall have a rack-mounted power strip including surge and spike protection.
 - 2.35.6. Provide appropriate sized runner kit for Credenza Rack.

2.35.7. Typical device shall be Middle Atlantic CFR Series or approved equivalent.

2.36. UNINTERRUPTABLE POWER SUPPLY - MEDIUM

2.36.1. Uninterruptable power supply shall be a series mode UPS.

2.36.2. Uninterruptable power supply shall provide 1000VA capacity.

2.36.3. Uninterruptable power supply shall be rack mountable.

2.36.4. Uninterruptable power supply shall have a maximum transfer time of 4 milliseconds.

2.36.5. Uninterruptable power supply shall have automatic voltage regulation.

2.36.6. Uninterruptable power supply shall have a minimum of eight (8) NEMA5-20R outlets that are able to be remotely controlled in two (2) banks.

2.36.7. Uninterruptable power supply shall provide the ability to connect an expansion battery.

2.36.8. Uninterruptable power supply shall have ethernet connectivity.

2.36.9. Typical device shall be Middle Atlantic UPX-RLNK-1000R-2 or approved equivalent.

2.37. RACK ACCESSORIES

2.37.1. Provide a series mode UPS for all equipment racks that house microprocessor devices such as control systems and DSP. UPS shall be Surgex, Middle Atlantic or approved equal.

2.37.2. Supply cable tie bars for all horizontal cable transitions and vertical lacing bars.

2.37.3. Supply vent panels at the top and bottom of all 44RU equipment racks.

2.37.4. Supply blank panels to fill all empty rack spaces. Panels can be 1, 2 or 3 RU.

2.37.5. Provide one 3 RU steel pull out drawer in each rack unless specified otherwise above in section 1.

2.37.6. Provide a multi-duplex AC outlet plug strip in each rack, one outlet for each 3 RU.

2.37.7. Where isolated ground systems are specified provide copper ground buss bar with tapped holes. Provide copper cable clamps ("Burndy") for connection to equipment. Provide 12 AWG stranded copper strap between buss bar and each rack mount component.

2.37.8. Provide adjustable front and rear mounted rails tapped with #10-32 mounting holes.

2.37.9. Provide all mounting hardware and rack screws with nylon washers.

2.38. AV FIELD PANEL

2.38.1. All field panels shall be 0.125" aluminum stock with 1/8" bevelled edges. Alternate metal stock shall be submitted to AV Consultant for approval.

2.38.2. Standard finish shall be anodized with vertical brush

2.38.3. Submit shop drawings of panels for Owner/architect/AV Consultant approval before fabrication. Indicate on drawings locations for each type of panel and finish.

2.38.4. Panels to be engraved and paint filled.

2.38.5. XLR connectors shall be inserted into panels from rear. Ensure labelling strips do not interfere with the operation of the connector release mechanisms. Holes shall be sized to suit male or female shell interchangeably.

2.39. WIRE

2.39.1. Refer to section 27 41 23.11 Cables and Pathway for Audiovisual Systems for all cabling requirements.

2.40. CONNECTORS

- 2.40.1. All input and output connectors for field plates and equipment rack patch panels shall be Neutrik D-series.

3. Execution

3.1. GENERAL REQUIREMENTS

- 3.1.1. All equipment supplied as part of this project shall conform to the requirements described in the following sections:

- .1 SECTION 27 40 10.00 – GENERAL INSTRUCTIONS FOR AUDIOVISUAL SYSTEM INSTALLATION

END OF SECTION

27 41 16.10 Sound System General Requirements

1. General

1.1. PROGRAM SOUND SYSTEM REQUIREMENTS

- 1.1.1. These are the minimum specifications unless otherwise stated in specific subsections. All equipment selected must meet or exceed these expectations.
- 1.1.2. All AC powered equipment shall be CSA or ULC approved devices.
- 1.1.3. Input and output power levels are expressed in dBm.
- 1.1.4. It is not the intention of the AV Consultant to direct the AV Contractor to verify all manufacturer performance specifications on an individual component level unless it is a necessary process to identify and resolve a fault in the system.

1.2. LOUDSPEAKER PERFORMANCE CRITERIA DEFINITIONS

1.2.1. Equipment

Performance Criteria	Definition
Measured Sound Pressure Level (SPL)	This is the long term SPL capability as measured with a sound level meter using A-weighting and slow response using pink noise. It is measured on axis of the loudspeaker at ear height at the intended listening position. It is measured in free field (direct plus reverberant) with an omnidirectional microphone. It is measured after the system is equalized to installed frequency response.
Predicted Sound Pressure Level (SPL)	This is the maximum long term SPL capability as calculated from manufacturer's data and location design data using inverse square law or approved computer design package, A weighted, slow response (average). It is calculated on axis of loudspeaker at ear height at the intended listening position.
Coverage area	This area is defined as the area where the off-axis attenuation of the direct SPL of the loudspeaker is less than 6 dB at 2 kHz.
Coverage variance	This is the variation in A-weighted SPL due to listener location within the coverage area of the loudspeaker as measured in the room free field. It is measured at ear height at the intended listening position.
Passband (bandwidth)	This is the nominal operating range of unequalized loudspeakers. It is determined by the 3 dB down points of the raw frequency response.
Installed frequency response	This is measured on-site after optimization of aiming and equalization. It is flat (maximum deviation of +1/-3 dB on tone-third octave intervals) within pass band at maximum SPL.
Loudspeaker Headroom	This is the nominal long term power handling capability above that needed to achieve maximum desired SPL. It is expressed in dB.

Amplifier headroom	The difference between the EIA power rating of power amplifier and the power required to achieve maximum SPL, expressed in dB
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1.3. ELECTRONIC SIGNAL CHAIN PERFORMANCE REQUIREMENTS

1.3.1. The following minimum end-to-end specifications must be met by the electronic signal chain:

Performance Criteria	Value
Distortion	Less than 0.01% at full output
Nominal signal level	+4 dBm
Maximum output level	+22 dBm
Frequency response	20 Hz to 20 kHz, +/- 0.5 dB
Signal to noise	Greater than 90 dB
Balanced input common mode rejection	Minimum 70 dB at 15 kHz
Nominal line input impedance	10 K
Balanced line output impedance	600 Ω or less
Crosstalk (for multi-channel units)	More than 70 dB down

1.4. PROGRAM AUDIO SYSTEM PERFORMANCE REQUIREMENTS

1.4.1. Provide an audio system to meet the requirements defined in the Audiovisual System Scope of Work.

1.4.2. The following minimum must be met by the audio system:

Performance Criteria	Value
Measured sound pressure level capability	85 dBA (minimum)
Minimum bandwidth (-3 dB points)	125 Hz to 8 kHz
Distortion and noise (electronic)	Less than 3%
Coverage variance	+/- 3 dB SPL
Acoustic noise (as measured with SPL meter at any and all normal seated positions)	Greater than 25 dBA SPL
Switching noise (due to relays and electronics)	70 dB below nominal signal level

1.4.3. Program Loudspeakers Performance Requirements:

Performance Criteria	Value
Frequency response (minimum)	80 Hz to 12.5 kHz, +/- 3dB
Distortion	Less than 3% at 6 dB down from full output throughout stated frequency response
Drivers	Minimum 2-way

1.4.4. 70V Loudspeaker minimum performance requirements:

Performance Criteria	Value
Frequency response (minimum)	100 Hz to 12kHz, +/- 4dB
Minimum sensitivity	90dBm 1 watt @ 1m
Dispersion	90 degrees at 5 kHz
Distortion	Less than 3% at 6 dB down from full output throughout stated frequency response

1.4.5. For alternates to the proposed system design in the Audiovisual System Scope of Work aimed at providing value to the Owner while reducing cost, provide computer modelled speaker design data using industry standard speaker modelling software with the predicted SPL to meet the performance criteria described above.

1.5. AUDIO TRANSFORMER PERFORMANCE REQUIREMENTS

- 1.5.1. The following criteria must be met by any audio transformer except loudspeakers which are specified elsewhere:

Performance Criteria	Value
Frequency Response	30 Hz to 30 kHz +/- 1 dB
Insertion loss	Less than 1 dB
Primary nominal impedance	10k/40k
Secondary nominal impedance	10k/40k
Shield	Electrostatic shield between primary and secondary windings
Winding	Balanced winding

1.6. DIGITAL SIGNAL PROCESSOR (DSP) REQUIREMENTS

- 1.6.1. Digital signal processors provide audio signal mixing, routing and processing for sound system applications.
- 1.6.2. Provide a rack-mount digital signal processor. Include all rack-mounting and cabling accessories as required.
- 1.6.3. DSP platform shall allow the creation/connection of system components within each hardware unit. Available system components shall include (but not be limited to) mixers, equalizers, filters, crossovers, dynamics/gain controls, routers, delays, remote controls, meters, generators, and diagnostics.
- 1.6.4. Inputs/outputs of the DSP shall be sized accordingly to support the mic/line functionality illustrated as per AV concept functional drawings. Provide a minimum of two additional input and output channels to support user design changes.
- 1.6.5. Ethernet communications shall be utilized for software control and configuration. Provide all PC-based software and files to the Owner to allow programming access through the AV IP network or Owner network when specified.
- 1.6.6. DSP platform shall be RS-232 controllable for interface to third party control systems.
- 1.6.7. DSP platform shall have selectable Phantom Power per channel. Phantom Power, Signal Present and Clip information per channel is preferred without the requirement for a PC.
- 1.6.8. Performance requirements:

Performance Criteria	Value
Distortion	Less than 0.01% at full output
Nominal signal level	+4 dBm
Maximum input level	+18 dBm
Maximum output level	+22 dBm
Frequency response	20 Hz to 20 kHz, +/- 0.5 dB
Signal to noise	Greater than 90 dB
Balanced input common mode rejection	Minimum 70 dB at 15 kHz
Balanced nominal line input impedance	10 kΩ
Balanced line output impedance	600 Ω or less
Crosstalk (for multi-channel units)	Greater than 70 dB down
Minimum sampling frequency	48 kHz
Minimum converter resolution	20 bit
Processing resolution	24 bit minimum

1.7. AUDIO CONFERENCING DSP REQUIREMENTS

- 1.7.1. Provide a digital signal processor with wide-band AEC mic/line inputs, standard mic/line inputs, mic/line outputs, and a telephone interface.
- 1.7.2. Where the Owner phone system is analog, provide an RJ-11 port to enable the DSP to interface with a standard POTS (aka PSTN or Analog PBX) telephone network.
- 1.7.3. Where the Owner phone system is VOIP, provide an RJ45 VOIP port or else external VOIP adapter to enable the DSP to interface to Owner's network.
- 1.7.4. Provide dedicated acoustic echo cancellation (AEC) processing on all audio channels used for audio and video conferencing. The AEC algorithm can be applied to signals coming from the local analog inputs or from the digital audio bus. All microphone inputs shall be fed into an AEC channel.
- 1.7.5. Automatic Gain Control (AGC) and Noise Cancellation (NC) should also be provided per AEC algorithm. AGC ensures that microphone levels remain at an optimum level, and NC removes steady state noise (such as from a projector fan or air conditioning device) from the signal path.

1.8. AMPLIFIERS

- 1.8.1. Program amplifiers must be capable of providing 200% of the power required by the loudspeaker.

1.8.2. Low Impedance Amplifier Performance Requirements:

Performance Criteria	Value
Frequency response	20 Hz to 20 kHz, +/- 0.5 dB
Distortion	Less than 0.1% THD at rated output
Signal to noise ratio 20 Hz to 20 kHz	> -106 dB
Amplifier headroom in watts	200% above load requirement
Mechanical noise	At ambient or below
Dampening Factor	>500

1.8.3. 70V Amplifier Performance Requirements:

Performance Criteria	Value
Output Voltage	70.7 V
Distortion	Less than 0.05% THD at rated output
Frequency Response	60 Hz to 20 kHz, +/- 0.5 dB
Signal to noise ratio	Greater than 90 dB
Amplifier headroom in watts	50% above load requirement
Mechanical noise	At ambient or below

2. Products

2.1. DSP

- 2.1.1. Acceptable DSP brands are: QSC and BIAMP. Any other brand/model must be approved by AV Consultant.

2.2. AMPLIFIERS

- 2.2.1. Acceptable amplifier brands are: QSC, Crown, and LabGruppen. Any other brand/model must be approved by AV Consultant.

2.3. LOUDSPEAKERS

- 2.3.1. Acceptable loudspeaker brands are: QSC, Community, JBL and Electrovoice/Bosch. Submit all other speaker proposals for AV Consultant approval.

3. Execution

3.1. AUDIO SYSTEM TESTING AND CALIBRATION

- 3.1.1. Optimize the digital signal processors, amplifiers, loudspeakers, speaker power taps, phasing, and speaker aiming as required to achieve the system's optimal performance with reference to the intent of the design and the performance criteria defined in the specifications.
- 3.1.2. The system is intended to provide (without clipping) an average program level of at least 85 dBa at 1.5m above the floor.
- .1 Using pink noise (with range of 250 Hz to 8 kHz), measure the sound pressure level at one randomly chosen position in each zone.
 - .2 Adjust signal so the variation in sound pressure level within in each area shall approach +/- 3dB or better, measured in 1/3 octave bandwidth across a frequency range of 250 Hz to 8 kHz)
- 3.1.3. The AV Contractor shall have as a minimum the following test equipment available on site during testing and performance acceptance:
- .1 Sound-level meter (peak and average reading) c/w calibrated microphone
 - .2 Phase checker generator/receiver set
 - .3 Include all necessary cables and specialty adapters
- 3.1.4. All testing of loudspeakers to be installed overhead should be tested thoroughly prior to installation. It is important that all rigging systems are inspected for structural integrity and all fasteners are secured. Once installed, the speakers shall need to be tested for proper polarity.
- 3.1.5. The system shall be free of hum, clicks, RF pickup, thumps or other audible distortions in all configurations and phases of operation. Correct all deficiencies.
- ### 3.2. DIGITAL SIGNAL PROCESSORS
- 3.2.1. Where the DSP is used in conjunction with table microphones and audio/video conferencing, the DSP shall be configured for mix-minus operation to ensure maximum gain before feedback. Ensure room speakers are individually home run back to equipment rack. Provide enough DSP outputs and amplifier channels to support mix-minus operation.
- 3.2.2. DSP shall be programmed and commissioned by programmers and technicians certified on specified platform. Provide all certifications at time of bid.
- 3.2.3. Upon completion of the project, AV Contractor shall provide all custom programmed code to Owner on USB media or Owner identified preferred media format.
- 3.2.4. Provide all programming and end to end calibration to align the DSP with interconnected devices.
- 3.2.5. Provide all GUI's and interface control programming as required. Provide user manuals for custom GUIs.
- 3.2.6. Provide all software applications and tools to configure and maintain the DSP systems.
- 3.2.7. Provide system presets to capture and store signal routing and processing paths for table configurations.

- 3.2.8. Configure the software to allow full processing of all signal paths.
- 3.2.9. Where interfaced with a third party control system, control system shall hang up any open calls on system shutdown routines.
- 3.2.10. Microphone signal paths to include:
 - .1 High pass filter
 - .2 Compression
 - .3 3 band parametric EQ
 - .4 Gain control on each input Level metering on each input
- 3.2.11. Line signal paths to include:
 - .1 High pass filter
 - .2 Levelling
 - .3 3 band parametric EQ , Gain control on each input & Level metering on each input
- 3.2.12. Microphone mixing includes:
 - .1 Automatic gain sharing mixing (organised into groups)
 - .2 Individual and group master levels which can be controlled in real time.
 - .3 Full metering of microphone input
- 3.2.13. Mixing and routing to include:
 - .1 Matrix router to assign any combination of inputs to outs (some signals may be combined to reduce matrix size depending on facility operation)
 - .2 Microphones to be grouped and processed by gain sharing auto mixers
- 3.2.14. Loudspeaker signal paths to include:
 - .1 High pass filter
 - .2 6 band parametric EQ
 - .3 Limiting and compression with side chain
 - .4 Up to 100ms Delay
 - .5 Low pass filter
 - .6 Level control on each output & Metering on each output
- 3.3. DISTRIBUTED AUDIO SYSTEMS
 - 3.3.1. Remove distributed audio line from the output of the distribution amplifiers.
 - 3.3.2. Connect an impedance meter to the distributed loudspeaker line.
 - 3.3.3. Use the meter to verify the total load on the distributed line. The line load shall not exceed the intended design limits.
 - 3.3.4. System Contractor shall include test results in the system manual.
- 3.4. DIGITAL AUDIO SIGNAL SYSTEMS
 - 3.4.1. Test digital audio signals for proper operation between devices. Ensure no additional noise is introduced into the analogue audio and digital signal paths when all devices are interconnected for normal operation.
 - 3.4.2. Ensure all signals throughout the digital audio path are functioning at designed levels.

3.5. HEARING ASSISTANCE SYSTEMS

- 3.5.1. Verify Hearing Assistance systems are free of drop out and interference in the intended areas of operation. Change frequencies and/or relocate transmitters/antennas if necessary to correct such problems. Verify operation of all headsets and receivers.

END OF SECTION

27 41 16.10 Performance Sound System General Requirements

1. General

1.1. PROGRAM SOUND SYSTEM REQUIREMENTS

- 1.1.1. These are the minimum specifications unless otherwise stated in specific subsections. All equipment selected must meet or exceed these expectations.
- 1.1.2. All AC powered equipment shall be CSA or ULC approved devices.
- 1.1.3. Input and output power levels are expressed in dBm.
- 1.1.4. It is not the intention of the AV Consultant to direct the AV Contractor to verify all manufacturer performance specifications on an individual component level unless it is a necessary process to identify and resolve a fault in the system.

1.2. LOUDSPEAKER PERFORMANCE CRITERIA DEFINITIONS

1.2.1. Equipment

Performance Criteria	Definition
Measured Sound Pressure Level (SPL)	This is the long term SPL capability as measured with a sound level meter using A-weighting and slow response using pink noise. It is measured on axis of the loudspeaker at ear height at the intended listening position. It is measured in free field (direct plus reverberant) with an omnidirectional microphone. It is measured after the system is equalized to installed frequency response.
Predicted Sound Pressure Level (SPL)	This is the maximum long term SPL capability as calculated from manufacturer's data and location design data using inverse square law or approved computer design package, A weighted, slow response (average). It is calculated on axis of loudspeaker at ear height at the intended listening position.
Coverage area	This area is defined as the area where the off-axis attenuation of the direct SPL of the loudspeaker is less than 6 dB at 2 kHz.
Coverage variance	This is the variation in A-weighted SPL due to listener location within the coverage area of the loudspeaker as measured in the room free field. It is measured at ear height at the intended listening position.
Passband (bandwidth)	This is the nominal operating range of unequalized loudspeakers. It is determined by the 3 dB down points of the raw frequency response.
Installed frequency response	This is measured on-site after optimization of aiming and equalization. It is flat (maximum deviation of +1/-3 dB on tone-third octave intervals) within pass band at maximum SPL.
Loudspeaker Headroom	This is the nominal long term power handling capability above that needed to achieve maximum desired SPL. It is expressed in dB.

Amplifier headroom	The difference between the EIA power rating of power amplifier and the power required to achieve maximum SPL, expressed in dB
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1.3. ELECTRONIC SIGNAL CHAIN PERFORMANCE REQUIREMENTS

1.3.1. The following minimum end-to-end specifications must be met by the electronic signal chain:

Performance Criteria	Value
Distortion	Less than 0.01% at full output
Nominal signal level	+4 dBm
Maximum output level	+22 dBm
Frequency response	20 Hz to 20 kHz, +/- 0.5 dB
Signal to noise	Greater than 90 dB
Balanced input common mode rejection	Minimum 70 dB at 15 kHz
Nominal line input impedance	10 K
Balanced line output impedance	600 Ω or less
Crosstalk (for multi-channel units)	More than 70 dB down

1.4. PROGRAM AUDIO SYSTEM PERFORMANCE REQUIREMENTS

1.4.1. Provide an audio system to meet the requirements defined in the Scope of Work narrative.

1.4.2. The following minimum must be met by the audio system:

Performance Criteria	Value
Measured sound pressure level capability	85 dBA (minimum)
Minimum bandwidth (-3 dB points)	125 Hz to 8 kHz
Distortion and noise (electronic)	Less than 3%
Coverage variance	+/- 3 dB SPL
Acoustic noise (as measured with SPL meter at any and all normal seated positions)	Greater than 25 dBA SPL
Switching noise (due to relays and electronics)	70 dB below nominal signal level

1.4.3. Program Loudspeakers Performance Requirements:

Performance Criteria	Value
Frequency response (minimum)	80 Hz to 12.5 kHz, +/- 3dB
Distortion	Less than 3% at 6 dB down from full output throughout stated frequency response
Drivers	Minimum 2-way

1.4.4. 70V Loudspeaker minimum performance requirements:

Performance Criteria	Value
Frequency response (minimum)	100 Hz to 12kHz, +/- 4dB
Minimum sensitivity	90dBm 1 watt @ 1m
Dispersion	90 degrees at 5 kHz
Distortion	Less than 3% at 6 dB down from full output throughout stated frequency response

1.4.5. For alternates to the proposed system design in the Scope of Work narrative aimed at providing value to the Owner while reducing cost, provide computer modelled speaker design data using industry standard speaker modelling software with the predicted SPL to meet the performance criteria described above.

1.5. AUDIO TRANSFORMER PERFORMANCE REQUIREMENTS

- 1.5.1. The following criteria must be met by any audio transformer except loudspeakers which are specified elsewhere:

Performance Criteria	Value
Frequency Response	30 Hz to 30 kHz +/- 1 dB
Insertion loss	Less than 1 dB
Primary nominal impedance	10k/40k
Secondary nominal impedance	10k/40k
Shield	Electrostatic shield between primary and secondary windings
Winding	Balanced winding

1.6. DIGITAL SIGNAL PROCESSOR (DSP) REQUIREMENTS

- 1.6.1. Digital signal processors provide audio signal mixing, routing, processing for sound system applications.
- 1.6.2. Provide a rack-mount digital signal processor. Include all rack-mounting and cabling accessories as required.
- 1.6.3. DSP platform shall allow the creation/connection of system components within each hardware unit. Available system components shall include (but not be limited to) mixers, equalizers, filters, crossovers, dynamics/gain controls, routers, delays, remote controls, meters, generators, and diagnostics.
- 1.6.4. Inputs/outputs of the DSP shall be sized accordingly to support the mic/line functionality illustrated as per AV concept functional drawings. Provide a minimum of two additional input and output channels to support user design changes.
- 1.6.5. Ethernet communications shall be utilized for software control and configuration. Provide all PC-based software and files to the Owner to allow programming access through the AV IP network or Owner network when specified.
- 1.6.6. DSP platform shall be RS-232 controllable for interface to third party control systems.
- 1.6.7. DSP platform shall have selectable Phantom Power per channel. Phantom Power, Signal Present and Clip information per channel is preferred without the requirement for a PC.
- 1.6.8. Performance requirements:

Performance Criteria	Value
Distortion	Less than 0.01% at full output
Nominal signal level	+4 dBm
Maximum input level	+18 dBm
Maximum output level	+22 dBm
Frequency response	20 Hz to 20 kHz, +/- 0.5 dB
Signal to noise	Greater than 90 dB
Balanced input common mode rejection	Minimum 70 dB at 15 kHz
Balanced nominal line input impedance	10 kΩ
Balanced line output impedance	600 Ω or less
Crosstalk (for multi-channel units)	Greater than 70 dB down
Minimum sampling frequency	48 kHz
Minimum converter resolution	20 bit
Processing resolution	24 bit minimum

1.7. AMPLIFIERS

1.7.1. Program amplifiers must be capable of providing 200% of the power required by the loudspeaker.

1.7.2. Low Impedance Amplifier Performance Requirements:

Performance Criteria	Value
Frequency response	20 Hz to 20 kHz, +/- 0.5 dB
Distortion	Less than 0.1% THD at rated output
Signal to noise ratio 20 Hz to 20 kHz	> -106 dB
Amplifier headroom in watts	200% above load requirement
Mechanical noise	At ambient or below
Dampening Factor	>500

1.7.3. 70V Amplifier Performance Requirements:

Performance Criteria	Value
Output Voltage	70.7 V
Distortion	Less than 0.05% THD at rated output
Frequency Response	60 Hz to 20 kHz, +/- 0.5 dB
Signal to noise ratio	Greater than 90 dB
Amplifier headroom in watts	50% above load requirement
Mechanical noise	At ambient or below

2. Products

2.1. DSP

2.1.1. Acceptable DSP brands are: QSC, Meyer Sound and BIAMP. Any other brand/model must be approved by Consultant.

2.2. AMPLIFIERS

2.2.1. Acceptable amplifier brands are: QSC, Crown, and LabGruppen. Any other brand/model must be approved by Consultant.

2.3. LOUDSPEAKERS

2.3.1. Acceptable loudspeaker brands are: JBL, Renkus Heinz, L'Acoustics, d&b audiotechnik, EAW, Fulcrum Acoustics, and Meyer Sound. Submit all other speaker proposals for AV Consultant approval.

3. Execution

3.1. AUDIO SYSTEM TESTING AND CALIBRATION

3.1.1. The intent of audio system testing is to ensure a fully functional and operation system is delivered to the client which reflects best industry practices. The AV Consultant shall carry out system performance verification as part of the commissioning process using a random check method. All test setups and methods employed by the AV Contractor must be reproducible.

3.1.2. All tests are to be completed by AV Contractor using test equipment supplied by AV Contractor.

3.1.3. Test Equipment

- .1 The AV Contractor shall have as a minimum the following test equipment available on site during testing and performance acceptance:
 - .1 Sound-level meter (peak and average reading) c/w calibrated microphone
 - .2 Low distortion audio signal generator capable of sine wave, square wave, swept sine and pink noise output.
 - .3 Dual trace digital oscilloscope minimum 20 MHz with selection of audio to BNC adapters and proper test probes in good working condition.
 - .4 Multimeter capable of accurate AC measurement to 10 kHz
 - .5 Random noise generator
 - .6 Dual Channel FFT measurement system such as EAW Smaart including interface, measurement microphone (with stand) and computer with software. During system testing, AV Contractor to provide one technician with proficient understanding of equipment used.
 - .7 Phase checker generator/receiver set
 - .8 Include all necessary cables and specialty adapters
- 3.1.4. All testing of loudspeakers to be installed overhead should be tested thoroughly prior to installation. It is important that all rigging systems are inspected for structural integrity and all fasteners are secured. Once installed, the speakers shall need to be tested for proper polarity.
- 3.1.5. The system shall be free of hum, clicks, RF pickup, thumps or other audible distortions in all configurations and phases of operation. Correct all deficiencies.
- 3.1.6. Using an oscilloscope with minimum bandwidth of 20 MHz and loudspeaker monitor, verify the systems' outputs are free of spurious oscillation and RF pick-up.
- 3.1.7. Perform and document polarity testing to ensure that all portions of the audio system including all microphone and tie-lines, loose cables, wiring, loudspeakers, loudspeaker wiring and cables are in-polarity.
- 3.1.8. Using broadband music, drive each audio system to 1/rd of the rated output for 1 hour and ensure that the equipment ventilation is adequate to prevent front panels from becoming too hot to the touch.
- 3.1.9. Using music drive each system to its maximum long-term sound pressure level and eliminate any buzzing, audible distortion, rattles and/or other undesirable noises. Repeat this procedure but substitute a slow sine wave sweep from 20 to 8000 Hz at about 15 dB below system rated output.
- 3.1.10. Adjust gain of line level systems components to nominal unity. Assume console output to be +4dB. Using pink noise and dual channel FFT analyzer with calibrated microphone(s) or other approved measurement system, equalize the sound reinforcement system to flat, within the nominal flat frequency band of the loudspeaker system. Optimize the signal processing and amplifier gains for the best system signal-to-noise ratio and consistent amplitude throughout the audience seating areas.
- 3.1.11. To ensure proper gain structures throughout the system, perform an end-to-end system test with amplifiers turned off. Utilize an oscilloscope to measure the max output of the first gain stage(s) and compare those results with the final gain stage at the input of the amplifiers. Ensure that no distortion is introduced into the signal path at maximum levels.
- 3.1.12. Optimize the digital signal processors, amplifiers, loudspeakers, speaker power taps, phasing, and speaker aiming as required to achieve the system's optimal performance with reference to the intent of the design and the performance criteria defined in the specifications.

- 3.1.13. The system is intended to provide (without clipping) an average program level of at least 85 dBa at 1.5m above the floor.
- .1 Using pink noise (with range of 250 Hz to 8 kHz), measure the sound pressure level at one randomly chosen position in each zone..
 - .2 Adjust signal so the variation in sound pressure level within in each area shall approach +/- 3dB or better, measured in 1/3 octave bandwidth across a frequency range of 250 Hz to 8 kHz)
- 3.2. DIGITAL SIGNAL PROCESSORS
- 3.2.1. Where the DSP is used in conjunction with table microphones and audio/video conferencing, the DSP shall be configured for mix-minus operation to ensure maximum gain before feedback. Ensure room speakers are individually home run back to equipment rack. Provide enough DSP outputs and amplifier channels to support mix-minus operation.
- 3.2.2. DSP shall be programmed and commissioned by programmers and technicians certified on specified platform. Provide all certifications at time of bid.
- 3.2.3. Upon completion of the project, AV Contractor shall provide all custom programmed code to Owner on USB media or Owner identified preferred media format.
- 3.2.4. Provide all programming and end to end calibration to align the DSP with interconnected devices.
- 3.2.5. Provide all GUI's and interface control programming as required. Provide user manuals for custom GUIs.
- 3.2.6. Provide all software applications and tools to configure and maintain the DSP systems.
- 3.2.7. Provide system presets to capture and store signal routing and processing paths for table configurations.
- 3.2.8. Configure the software to allow full processing of all signal paths.
- 3.2.9. Where interfaced with a third party control system, control system shall hang up any open calls on system shutdown routines.
- 3.2.10. Microphone signal paths to include:
- .1 High pass filter
 - .2 Compression
 - .3 3 band parametric EQ
 - .4 Gain control on each input Level metering on each input
- 3.2.11. Line signal paths to include:
- .1 High pass filter
 - .2 Levelling
 - .3 3 band parametric EQ , Gain control on each input & Level metering on each input
- 3.2.12. Microphone mixing includes:
- .1 Automatic gain sharing mixing (organised into groups)
 - .2 Individual and group master levels which can be controlled in real time.
 - .3 Full metering of microphone input
- 3.2.13. Mixing and routing to include:
- .1 Matrix router to assign any combination of inputs to outs (some signals may be combined to reduce matrix size depending on facility operation)
 - .2 Microphones to be grouped and processed by gain sharing auto mixers

3.2.14. Loudspeaker signal paths to include:

- .1 High pass filter
- .2 6 band parametric EQ
- .3 Limiting and compression with side chain
- .4 Up to 100ms Delay
- .5 Low pass filter
- .6 Level control on each output & Metering on each output

3.3. DISTRIBUTED AUDIO SYSTEMS

3.3.1. Remove distributed audio line from the output of the distribution amplifiers.

3.3.2. Connect an impedance meter to the distributed loudspeaker line.

3.3.3. Use the meter to verify the total load on the distributed line. The line load shall not exceed the intended design limits.

3.3.4. System Contractor shall include test results in the system manual.

3.4. DIGITAL AUDIO SIGNAL SYSTEMS

3.4.1. Test digital audio signals for proper operation between devices. Ensure no additional noise is introduced into the analogue audio and digital signal paths when all devices are interconnected for normal operation.

3.4.2. Ensure all signals throughout the digital audio path are functioning at designed levels.

3.5. HEARING ASSISTANCE SYSTEMS

3.5.1. Verify Hearing Assistance systems are free of drop out and interference in the intended areas of operation. Change frequencies and/or relocate transmitters/antennas if necessary to correct such problems. Verify operation of all headsets and receivers.

END OF SECTION

27 41 16.11 Displays

1. General

1.1. FLAT PANEL DISPLAYS

- 1.1.1. All sources to flat panel display shall be scaled so display sees its native resolution. Scale input signal as required to ensure correct resolution and aspect ratio.
- 1.1.2. All displays must be bi-directional RS-232 or network controllable.
- 1.1.3. All efforts to provide an Energy Star / Green certified display model to be provided whenever possible.
- 1.1.4. When used in conjunction with audio-video transmission systems, the AV Contractor shall ensure display does not over scan the video signal when full-pixel sources are routed.
- 1.1.5. If consumer grade displays are specified, verify that the manufacturer warranty is not void if used in business applications. Bidders to notify the AV Contractor at time of bid if no such displays can be sourced. A minimum one year warranty for consumer grade displays shall be provided.

1.2. WALL MOUNTS FOR DISPLAYS

- 1.2.1. Displays shall be mounted as shown on architectural drawings.
- 1.2.2. The AV Contractor shall provide wall-mount that allows accessibility to infrastructure located at center of the display.
- 1.2.3. The AV Contractor shall select mounts to match blocking requirements shown on audiovisual and/or architectural drawings.

1.3. DIGITAL SIGNAGE DISPLAYS

- 1.3.1. All displays used for digital signage applications shall be commercial grade and designed to run 24/7 operation.
- 1.3.2. All digital signage displays shall have on-board scheduling systems for system power on and off.
- 1.3.3. Digital signage displays shall have a minimum three-year warranty.
- 1.3.4. Provide all necessary mounting accessories to professionally mount digital signage players behind the display. Velcro or zip ties are not acceptable.

1.4. VIDEOWALL DISPLAYS

- 1.4.1. All displays used for videowall applications shall be commercial grade and designed to run 24/7 operation.
- 1.4.2. All videowall displays shall have on-board scheduling systems for system power on and off.
- 1.4.3. Videowall displays shall have the connectivity to allow a video input to be passed-through natively to a video output.
- 1.4.4. Videowall display screens shall have a haze value between 25%-50%.
- 1.4.5. Videowall displays shall have a minimum three-year warranty.
- 1.4.6. All displays must be bi-directional RS-232 or network controllable.
- 1.4.7. Provide all necessary mounting accessories to properly align all display, as well as prevent the displays from coming out of alignment over time.

2. Products

2.1. FLAT PANEL DISPLAYS

2.1.1. Acceptable brands are: NEC/Sharp, Planar, Sony, Samsung and LG. Any other brand/model must be approved by AV Consultant.

2.2. WALL MOUNTS FOR FLAT PANEL DISPLAYS

2.2.1. Acceptable brands are Chief, Premier Mounts and Peerless. Any other model must be approved by the AV Consultant.

3. Execution

3.1. DISPLAYS

3.1.1. Provide all necessary mounting hardware to mount the displays to structural and route cabling concealed from view.

3.1.2. Displays to be wall mounted or ceiling mounted as per manufacturer's instruction.

3.1.3. Provide all necessary accessories and hardware for a fixed installation of the display system.

3.1.4. Locking display mounts shall contain the same locking mechanisms / keys on all mounts (unless specified otherwise).

3.1.5. The AV Contractor to confirm all required wall blocking, power and conduit required at display locations is adequate and properly installed prior to display installation.

3.2. VIDEOWALL DISPLAYS

3.2.1. Provide all necessary mounting hardware to mount the displays to structural and route cabling concealed from view.

3.2.2. Displays to be wall mounted or ceiling mounted as per manufacturer's instruction.

3.2.3. Provide all necessary accessories and hardware for a fixed installation of the display system.

3.2.4. All displays shall be calibrated to display uniform:

.1 Colour

.1 Including edge-to-edge in corners

.2 Brightness

.3 Contrast

3.2.5. Videowall displays shall be physically aligned on X, Y and Z-axis of all edges and corners to within 2mm tolerance.

3.2.6. The AV Contractor to confirm all required wall blocking, power and conduit required at display locations is adequate and properly installed prior to display installation.

END OF SECTION

27 41 16.12 Projection Systems

1. General

1.1. PROJECTORS

- 1.1.1. Projector must be bi-directional RS-232 or network controllable.
- 1.1.2. All efforts to provide an Energy Star / Green certified model to be provided whenever possible.
- 1.1.3. Provide zoom lens with throw distance appropriate to on-site conditions. The AV Contractor to confirm correct lens prior to purchase and installation of projector.
- 1.1.4. The AV Contractor to confirm projector power requirements on site with supplied electrical trade prior to deployment.
- 1.1.5. Projectors with solid state and/or laser phosphor light sources shall have a minimum lifecycle output expectancy of 20,000 hours.

1.2. MOTORIZED PROJECTION SCREENS

- 1.2.1. Motorized projection screens shall be black-backed.
- 1.2.2. All motorized projection screens shall have a standard 12" black drop unless indicated differently in section 27 41 00.
- 1.2.3. All motorized screens shall be supplied with an external low voltage controller and screen switch.
- 1.2.4. All motorized screens shall have quiet motors installed.
- 1.2.5. All motorized screens shall have a seamless screen surface.

1.3. LIFTS

- 1.3.1. For all products, if installed in a non-plenum space, or if installed in a plenum space with Environmental Airspace Housing and Closure, the entire unit is approved to UL 2442 and CSA C22.2 No. 60065-03 by Underwriters' Laboratories for the U.S. and Canada.
- 1.3.2. Motors for projector lifts shall be certified for use in the United States and Canada by Underwriter's Laboratory (UL) Inc and shall be UL label.

2. Products

2.1. PROJECTOR

- 2.1.1. Acceptable manufacturers are Christie Digital, Epson, NEC and Panasonic. Any other brand/model must be approved by AV Consultant.

2.2. MOTORIZED PROJECTION SCREENS

- 2.2.1. Acceptable manufacturers are Stewart Filmscreen and Da-Lite. Any other brand/model must be approved by AV Consultant.

2.3. LIFTS

- 2.3.1. Acceptable manufacturers are Draper, Da-Lite, SVS Lifts and Chief Manufacturing. Any other brand/model must be approved by AV Consultant.

3. Execution

3.1. PROJECTOR

- 3.1.1. Projector to be ceiling mounted as per manufacturer's instruction.
- 3.1.2. Provide all necessary mounting hardware to mount the projector to structural and route cabling concealed from view.
- 3.1.3. Confirm correct lens prior to purchase and installation of projector.
- 3.1.4. Optimize and align viewing characteristics of projector. Keystoning is not an accepted practice.
- 3.1.5. Provide all necessary accessories and hardware for a fixed installation of the projection system.
- 3.1.6. For non-accessible ceilings, coordinate locations of access hatches with general Contractor.
- 3.1.7. Projectors with solid state and/or laser phosphor light sources shall be configured to operate with a manufacturer recommended constant brightness strategy to allow the light output of the device to be consistent throughout the life of the unit.

3.2. PROJECTION SCREENS

- 3.2.1. Install in accordance with manufacturer's instructions.
- 3.2.2. Install front projection screens with screen cases in position and relationship to adjoining construction, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.
- 3.2.3. Test electrically operated units to verify that screen, controls, limit switches, closure and other operating components are in optimum functioning condition.

3.3. PROJECTOR LIFTS

- 3.3.1. Install in accordance with manufacturer's instructions.
- 3.3.2. Shop drawings: Include dimensions, method of attachments, structural support, bracing and electrical wiring.
- 3.3.3. Provide finish samples.
- 3.3.4. Obtain motorized projector lifts from a single manufacturer as a complete unit including necessary mounting hardware and accessories.
- 3.3.5. Inspect motorized projector lifts for freight damage, upon delivery to project site. Report damage to freight carrier immediately for replacement of unit.

END OF SECTION

27 41 16.15 Control Systems

1. General

1.1. DESCRIPTION

- 1.1.1. The control system provides a central microprocessor for control and automation of project audiovisual systems and equipment, and interfaces for user interaction with all devices.
- 1.1.2. Control processors shall be rackmount based. Provide all rackmount accessories to properly mount and house processor.
- 1.1.3. Provide all networking components required to provide an audiovisual control network. Coordinate with Owner's IT officers to arrange an IP subnet range as required.
- 1.1.4. Supply, install and program all expansion modules to provide functionality and control as outlined in the Specification.
- 1.1.5. Where devices are under the control of the AV system controller, connections and hardware shall support bi-directional communications with the AV systems controller.
- 1.1.6. Coordinate with the Owner and/or appointed representative to provide a user intuitive and functional control methodology for all room uses, configurations and user skill sets.
- 1.1.7. System programming shall meet with all specified requirements for a complete control solution.
- 1.1.8. All control system program files shall be created by the AV Contractor. Reuse of old programming code on existing systems is not acceptable without approval of the Owner and AV Consultant.
- 1.1.9. Upon completion of the project, all control system software files shall be submitted in complied and uncompiled formats. Executable files that mimic the graphical control interfaces shall also be provided to the Owner to be used on designated computers.

2. Products

2.1. CONTROL SYSTEM

- 2.1.1. Acceptable control system products are: Crestron, QSC and AMX. Any other brand/model must be approved by AV Consultant.

3. Execution

3.1. CONTROL SYSTEM PROGRAMMING AND INSTALLATION STANDARDS

- 3.1.1. All control system programmers and field commissioning technicians must possess manufacturer specific programming certifications.
- 3.1.2. Where Touch Panels or button panels are used to control AV systems, the AV Contractor shall work with the AV Consultant and Owner to develop user interfaces that are intuitive for the Owner and system users to operate. This practice should occur in as far advance as possible prior to project deployment.

- 3.1.3. Where Touch Panels or button panels are used to control AV systems, the AV Contractor shall coordinate a minimum of two (2) development workshops, each being a minimum of four (4) hours in length, with the AV Consultant and Owner to develop user interfaces that are intuitive for the Owner and system users to operate. This practice should occur in as far advance as possible prior to project deployment.
- 3.1.4. Prior to commissioning, submit all software programming files to AV Consultant for review. All software submissions must be accompanied by documentation indicating the intent of the program, table of presets, flow diagrams, revision date and any omissions to overall functionality.
- 3.1.5. All hardware used to control and interface with the computer system shall be tested and fully functional prior to installation on site.
- 3.1.6. Control system shall manage all system devices and provide full feature control of the following devices using the protocols indicated in brackets.:
- .1 Audiovisual Matrix Switchers (RS-232 or Ethernet)
 - .2 Flat panel displays (RS-232 or Ethernet)
 - .3 Projector/display lifts (Relay or contact closure)
 - .4 Video conference codec (RS-232 or Ethernet)
 - .5 Audio DSP (RS-232 or Ethernet)
 - .6 Document camera (RS-232 or Ethernet)
 - .7 Lighting (Ethernet or RS-232; Interface at AV rack location by others)
 - .8 Blinds and shades (Ethernet, Relay or RS-232; Interface at AV rack location by others)
 - .9 Projection screen low-voltage controller (Relay)
 - .10 Partition status and activation where applicable
- 3.1.7. In addition to typical device control, the AV Contractor programming is to include the following functionality within the control software and touch panel page design:
- .1 Provide pop window to indicate "System initializing" upon system start when projection systems are utilized.
 - .2 Provide pop-up window to indicate "System shutting down":
 - .1 Include countdown timer, or bar graph indication of time remaining
 - .1 Confirm timer setting during workshop
 - .2 Provide menu to cancel shutdown request.
 - .3 Upon timer expiration, the system shall automatically shutdown without user action.
 - .3 Automatic system shut down with timing to be confirmed with Owner. Provide 15 minute prompt screen pop-up
 - .4 Room program audio and voice reinforcement level and mute controls. Include master fader and mute control as required
 - .5 Password protected start up page (to be confirmed during workshop)
 - .6 Dynamic and speed dial facilities for audio conferencing
 - .7 Dynamic and speed dial facilities for video conferencing.
 - .8 Automated system on/off when a user connects a presentation device to the system such as a laptop/tablet to a input presentation cable.
 - .9 All other programming features deemed appropriate by the Owner and/or appointed representative to provide an intuitive and easy to understand user interface.

- 3.1.8. Where the project contains graphical user interfaces from multiple manufacturers, provide a consistent graphical user experience regardless of manufacturer. For example, if a project contains both Cisco and Crestron Touch panels, ensure the custom Crestron interfaces match the Cisco user interface/user experience as closely as possible. Provide mock-ups of interfaces for Owner/AV Consultant approval prior to the completion of development of custom software and the deployment of custom software to touch panel hardware on site.
- 3.1.9. All control programming with custom graphical user interfaces shall be controllable through the Owner's computers, mobile devices or tablets. Provide executable files of the control system program graphical user interface and deploy on computers as directed by the Owner. Submit executables as part of the as built documentation. Provide a method (eg. QR code) to allow the user to transfer the interface to their own device (mobile or tablet). Confirm with Owner/consulting preferred operating system and network configuration requirements

END OF SECTION

27 41 23.10 Audiovisual Cabinets, Racks, Frames and Enclosures

1. General

1.1. FIXED INSTALLED RACKS

1.1.1. All equipment racks must conform to the following standards:

- .1 EIA RS-310-C, Racks, Panels and Associated Equipment
- .2 AVIXA F502.01:2018 – Rack Building for Audiovisual Systems
- .3 IEC 60297-3-100 – Mechanical Structures for Electronic Equipment

1.1.2. Provide openings top and bottom as required for cabling.

1.1.3. Provide rack elevations as part of shop drawing submissions.

1.1.4. Racks to be Black unless otherwise specified.

1.1.5. All racks to be of a professional quality, all steel welded construction, baked enamel finish, removable side panels, sliding front and rear equipment mounting rails, formed dress panels and a bottom dress panel.

1.1.6. PORTABLE RACKS

1.1.7. Provide portable steel equipment racks with dress panels and removable sides as required for a completed look and finish. Top panel should be solid or vented depending on cooling requirements and rear doors with flush key locks are required. Doors should be perforated unless solid doors are required in cooling scheme.

1.1.8. Top and bottom planes should incorporate a recess on the rear edge to allow for the passage of cables when the cabinet is located against a surface to the rear.

1.1.9. Provide approval drawing of this equipment for review by the AV Consultant prior to construction.

1.2. WALL MOUNT RACK REQUIREMENTS

1.2.1. For wall mounted racks, provide swing-out style steel racks with locking front doors and vented side panels. Ensure the rack has appropriate ventilation requirements.

1.3. RACK ACCESSORIES

1.3.1. Supply cable tie bars for all horizontal cable transitions and vertical lacing bars.

1.3.2. Supply blank panels (blank or vent) to fill all empty rack spaces. Panels can be 1, 2 or 3 RU.

1.3.3. Provide one 3 RU steel pull out drawer in each rack that is greater than 27RU in capacity.

1.3.4. Provide a multi-duplex AC outlet plug strip in each rack, one outlet for each 3 RU.

1.3.5. Provide a permanent work light with switch, mounted at the rear top of the rack to assist with service.

1.3.6. Provide adjustable front and rear mounted rails tapped with #10-32 mounting holes.

1.3.7. Provide all mounting hardware and rack screws with nylon washers.

1.4. UNINTERRUPTIBLE POWER SUPPLY (UPS)

1.4.1. Provide a series mode UPS for all equipment racks that house microprocessor devices such as control systems and DSP.

1.5. WORK INCLUDED

1.5.1. Conform to Section 27 40 10 – GENERAL INSTRUCTIONS FOR AUDIOVISUAL SYSTEM INSTALLATION.

2. Products

2.1. FIXED INSTALLED RACKS AND ACCESSORIES

2.1.1. Acceptable brands are: Middle Atlantic. Any other brand/model must be approved by AV Consultant.

2.2. PORTABLE RACKS

2.2.1. Acceptable brands are: Engineered Case Manufacturer. Any other brand/model must be approved by AV Consultant.

2.3. UNINTERRUPTIBLE POWER SUPPLY (UPS)

2.3.1. Acceptable brands are: Middle Atlantic, Surgex and APC. Any other brand/model must be approved by AV Consultant.

3. Execution

3.1. FIXED INSTALLED RACKS

3.1.1. Amplifiers should be mounted at the bottom rail of the equipment rack to maintain balance and stability. Support the weight of the amplifier with angle brackets attached to the side rails of the equipment rack or with the rear support flanges included with some amplifiers. Attach a label to the faceplate of each amplifier to indicate function.

3.2. EQUIPMENT RACKS IN MILLWORK

3.2.1. Racks in millwork must have a minimum of 2" clear space behind the racks and rear of the cabinet.

3.2.2. Millwork should be cut to allow access to electrical, data and AV wall boxes.

3.2.3. Millwork and credenza must have ventilation slots provided to allow for proper cooling of the audiovisual equipment.

3.3. VENTILATION

3.3.1. Provide vent panels at the top and bottom of all 44RU equipment racks.

3.3.2. Provide blank or perforated metal panels as required to provide adequate cooling. If rack is convection cooled, install a 1RU panel above and below each power amplifier.

3.3.3. Internal equipment rack temperature should not exceed 85°F. Provide passive or active thermal management solutions to maintain an internal temperature lower than stated.

3.3.4. For equipment racks mounted in credenzas, ensure adequate cutouts are provided to dissipate heat. Cutouts should be provided at the bottom and top (or rear) of all millwork for ventilation. Provide active thermal management if required to the millwork. Coordinate with millwork Contractor.

3.3.5. Avoid locating racks directly under supply ductwork. The flow of hot air rising from the top of the rack should have no impediments on its way back to the return air intake duct.

3.4. PORTABLE RACKS

3.4.1. Provide four high-quality locking casters, 4" wheel diameter for cabinets taller than 21". wall mount RACK REQUIREMENTS

3.5. UNINTERRUPTIBLE POWER SUPPLY (UPS)

3.5.1. All connected equipment shall be considered critical use devices.

3.5.2. Ensure all power cords connected are properly labelled with destination device name.

END OF SECTION

27 41 23.11 Audiovisual Cabling

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 27 40 10 – GENERAL INSTRUCTIONS FOR AUDIOVISUAL SYSTEM INSTALLATION.

1.1.2. Supply and install cabling as detailed in Contract Documents. The AV Contractor shall provide all required pathways to distribute the cables throughout the facility where the pathway has not been provided by Division 26. Where cables leave the pathways, the AV Contractor shall supply and install cable slings and/or j-hooks to support cabling up to point of termination. Comply with the following section - *27 05 28.00 Pathways for Communication Systems*.

1.1.3. Supply and install conductors and cables as detailed in Contract Documents and as required and as recommended by the manufacturer to ensure proper operation of all systems. The AV Contractor shall use pathways (by Division 26) to distribute the cables throughout the facility. Where the cables leave the pathways and extend to the termination point the AV Contractor shall ensure cable have appropriate infrastructure to support and secure the cables.

1.1.4. Avoid scraping, denting, or otherwise damaging cables, before, during or after installation. The AV Contractor without any additional compensation shall replace damaged cables.

1.1.5. Ensure that all cable lengths are sufficient to allow for slack, vertical runs, wastage, connectorization and future moves.

1.2. CABLE ROUTING

1.2.1. Make any necessary changes or additions to routing of cables, pathways to accommodate structural, mechanical, electrical and architectural conditions. Where pathways or cables are shown diagrammatically run them parallel to building columns. If it is necessary to run cables otherwise to accommodate acceptable cable lengths, written permission must be obtained from the Audiovisual Engineer's Representative prior to installation.

1.2.2. For all schemes of cable routing, no point in the path shall be subjected to a bend radius of less than eight times the cable diameter or minimum cable bend radius specified by the manufacturer.

1.3. CABLE PROPERTIES

1.3.1. Conductors and cables shall be CMR where installed completely in conduit and/or where installed in non-plenum rated areas. Conductors and cables shall be CMP where not completely installed in conduit and/or installed in plenum rated areas. All cable shall conform to the recommendations of the manufacturers of the audiovisual systems.

1.3.2. Conductors and cables shall be outdoor rated where installed outdoor and /or installed in locations where exposed to weather elements.

1.3.3. Provide and install shielded cables where required and or recommended by the manufacturer of the audiovisual systems.

1.3.4. Wiring shown is for typical systems. All wiring shall be as required and recommended by the manufacture of the audiovisual systems.

1.3.5. All wiring shall be of proper gauge, type and quantity of conductors as required and as recommended by the manufacturer to ensure proper operation of audiovisual systems and peripheral devices.

- 1.3.6. Multi-conductor cables shall have color-coded conductors.
- 1.3.7. All conductors and cables shall be CSA approved and must bare stamping by the manufacturer. .
- 1.3.8. Consult drawings and provide FT-6 rated cable where cables are outside of conduit systems

1.4. CABLE DISTRIBUTION

- 1.4.1. Utilise all indicated and available cable pathways such as conduits, communications cable tray, ducts, surface raceways and furniture system channels except where otherwise noted.
- 1.4.2. Wires and cables shall be segregated according to signal type. In addition, audio cable shall be subdivided into three classes: microphone level circuits, analog line level circuits and speaker level circuits.
- 1.4.3. Microphone level audio circuits shall be kept at least 75mm (3") away from any other type of parallel signal circuits and at least 150mm (6") away from any parallel AC power circuits.
- 1.4.4. Speaker level audio circuits shall be kept a minimum of 75mm (3") from line level audio and AC power circuits. All other signal circuits shall be kept at least 75mm (3") away from any parallel AC power circuits. Where conditions allow, high impedance and low impedance (8 ohm) speaker levels shall be separated by minimum of 75mm (3").
- 1.4.5. Where circuits of different types must cross, they shall do so at right angles and then return to the above required separations in as short a distance as possible.
- 1.4.6. Inside buildings minimise any possibilities of disruption by maintaining the following minimum clearances from electrical and heat sources when routing cables.

Item	Minimum Clearance
Motors	1.20 m (4'-0")
Transformers	1.20 m (4'-0")
Conduit and cables used for electrical distribution less than 1kVA	0.30 m (1'-0")
Conduit and cables used for electrical distribution greater than 1kVA	1.00 m (3'-0")
Fluorescent Luminaries	12 cm (0'-5")
Pipes (gas, oil, water, etc.)	30 cm (1'-0")
HVAC (equipment, ducts, etc.)	15 cm (0'-6")

1.5. FIRE STOPPING

- 1.5.1. General
 - .1 Provide seals in all Fire Rated Separations and Firewalls to form tight barriers to retard the passage of flame and smoke.
 - .2 The installed seals shall provide and maintain the fire resistance rating of the adjacent floor, wall or other fire separation assembly to the Code Requirements.
 - .3 Moisture seals as well as fire and smoke seals shall be required for all floor penetrations in Laboratories and Operating Rooms in Hospitals, Universities and Schools.
 - .4 The Communications Contractor shall establish/re-establish the integrity of all fire-rated structures and assemblies that they have created or disturbed, or that were created by others for use by the Communications Contractor.
 - .5 Supply and install Fire Stop pillows for existing cable tray penetrations through firewalls.
 - .6 For the purposes of this specification, the only acceptable Fire Stop Systems shall be those that have been tested to the CAN/ULC S115 Standard.

- .7 Supply and install non-permanent CSA approved Fire Stop systems that are dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required).
- .8 All fire stopping shall maintain a minimum one hour rating and shall meet applicable Federal, Provincial and Local building codes.
- .9 All Fire Stop Systems shall be listed and tested by an SCC and accredited Third Party Testing Agency in accordance with the Standards.
- .10 Fire resistance ratings of installed Fire Stop Systems shall not be less than the fire resistance rating of the surrounding Fire Separation or Firewall.
- .11 All Smoke Seals selected for use shall comply with Standards.
- .12 Where moisture seals are required for floor penetrations in Operating Rooms, Morgues, and Laboratories in Hospitals, Universities and Schools, the Fire Stop Materials selected shall be compatible with Formalin.
- .13 All Fire Stop Materials and Smoke Seals shall have elastomeric characteristics to allow for building settling and seismic movement. All Fire Stop Materials and Smoke Seals shall be free of asbestos.

1.5.2. Quality Assurance

- .1 Provide fire stopping systems that comply with the following requirements following:
 - .1 Fire stopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for fire stop system acceptable to authorities having jurisdiction.
 - .2 Fire stopping products bear the classification marking of qualified testing and inspection agency.
- .2 Provide the work of this Section using competent installers, experienced in the application of the materials and systems being used, approved and trained by the material or system manufacturer.
- .3 Fire Stop Systems shall conform to the fire (F), hose (H) and temperature (T) ratings of Codes.
- .4 Fire Stop Materials and Smoke Seal materials shall have a flame spread rating of 25 or less, National Fire Protection Association (NFPA Class "A").
- .5 For the purposes of this specification the only acceptable Fire Stop Systems are those that have been tested to the CAN/ULC S115 Standard.

1.5.3. Performance

- .1 Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes shall occur.
- .2 Where non- mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.
- .3 Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.
- .4 Openings for cable trays shall be sealed using re-enterable fire stopping pillows.

1.5.4. Project Conditions

- .1 Do not install fire stopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer

- .2 Do not install fire stopping products when substrates are wet due to rain, frost, condensation, or other causes.
- .3 Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- .4 Do not use materials that contain flammable solvents.
- .5 Coordinate construction of openings and penetrating items to ensure that through-penetration fire stop systems are installed according to specified requirements.
- .6 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems.
- .7 Schedule installation of fire stopping after completion of penetrating item installation but prior to covering or concealing of openings.

2. Products

2.1. MIC/LINE LEVEL ANALOG AUDIO CABLE (TYPE MLA)

- 2.1.1. The mic/line cable is an installation grade cable intended for permanent analog microphone and line level installations.
- 2.1.2. Mic/line level cable shall be minimum 22 AWG stranded twisted pair copper with propylene insulated conductors and PVC outer jacket.
- 2.1.3. Mic/line cable shall have 100% foil shield with 22 AWG drain wire.
- 2.1.4. Mic/line cable shall have a voltage rating of 300 V RMS.
- 2.1.5. Mic/line cable shall be Belden 9451 (FT-4), 9451P (FT-6) or approved equivalent.

2.2. MIC/LINE LEVEL DIGITAL AUDIO CABLE (TYPE MLD)

- 2.2.1. The mic/line level digital audio cable is an installation grade cable intended for digital audio (AES/EBU signals).
- 2.2.2. Mic/Line Level digital audio cable shall be minimum 24 AWG stranded shielded twisted pair copper with propylene or equivalent insulated conductors and PVC outer jacket.
- 2.2.3. Mic/Line Level digital audio cable shall have minimum 95% braided shield and bare copper 26 AWG drain wire.
- 2.2.4. Mic/Line Level digital audio cable shall have a voltage rating of minimum 300 V RMS.
- 2.2.5. Mic/Line Level digital audio cable shall have a nominal impedance of 110 ohms.
- 2.2.6. Mic/Line Level digital audio cable shall be Belden 1800B (FT-4), 1801B (FT-6) or approved equivalent.

2.3. SPEAKER CABLE HIGH IMPEDANCE (TYPE LS16 AND TYPE LS14)

- 2.3.1. The speaker cable –high impedance is an installation grade cable intended for permanent 70-volt speaker system installations.
- 2.3.2. Speaker cable – high impedance shall be unshielded stranded twisted pair copper with propylene insulated conductors and PVC outer jacket.
- 2.3.3. Speaker cable – high impedance shall be minimum 16 AWG for low power (under 200 watt loads) to a maximum of 500ft – 152m.
- 2.3.4. For higher than 200 watt loads or cable runs longer than 200ft, utilize a 14 AWG unless otherwise specified. See “Speaker Cable – Low Impedance”.

- 2.3.5. Speaker cable – high impedance shall have a voltage rating of 300 V RMS.
- 2.3.6. Speaker cable – high impedance shall be Belden 6200UE (16AWG FT-6), 5200UH (16AWG FT-4), 6100UE (14 AWG FT-6), 5100UH (14 AWG FT-4) or approved equivalent.
- 2.4. SPEAKER CABLE LOW IMPEDANCE (TYPE LS14 AND LS12)
- 2.4.1. Speaker cable – low impedance is an installation grade cable intended for permanent performance audio system installations.
- 2.4.2. Speaker cable – low impedance shall be unshielded stranded twisted pair copper with propylene insulated conductors and PVC outer jacket.
- 2.4.3. Speaker cable – low impedance shall be minimum 14 AWG for runs that are not longer than 75ft (23 metres).
- 2.4.4. Speaker cable – low impedance shall be minimum 12 AWG for runs that are longer than 75ft (23 metres) to a maximum of 200ft (63 metres).
- 2.4.5. Cabling for speaker cable runs longer than 200ft (63 metres) to be coordinated with the AV Consultant.
- 2.4.6. Speaker cable – low impedance shall be Belden 6100UE (14 AWG FT-6), 5100UH (14 AWG FT-4), 6000UE (12 AWG FT-6), 5000UH (12 AWG, FT-4) or approved equivalent.
AUDIOVISUAL STRUCTURED CABLING (TYPE D)
- 2.5.1. Audiovisual structured cabling is an installation grade cable used for IP control, video-over-IP solutions or audio-over-ethernet solutions (eg. Dante, AES67).
- 2.5.2. Cabling used for IP-based audiovisual solutions such as AES67 or H.264 shall comply with ANSI/EIA/TIA standards (minimum Category 6) and manufacturer specific networking requirements.
- 2.5.3. Comply with the following specifications:
- .1 27 13 13.00 Communications Copper Backbone Cabling
 - .2 27 13 23.00 Communications Optical Fibre Backbone Cabling
 - .3 27 15 00.19 Data Communications Horizontal Cabling
 - .4 27 15 33.00 Communications Coaxial Horizontal Cabling
- 2.5.4. Refer to division of responsibility between AV Contractor and communications Contractor on AV drawings and scope of work specification (27 41 00.00) for project specific audiovisual structured cabling requirements.
- 2.6. ANTENNA CABLE UHF (TYPE ANT-U)
- 2.6.1. The antenna cable is an installation grade cable intended for permanent wireless microphone system antennas and assistive listening system transmitters (IR radiators and antennas) operating in the UHF frequency bands.
- 2.6.2. Antenna cable shall be RG-8X type with 10AWG solid copper conductor.
- 2.6.3. Antenna cable shall have minimum braided shield and over foil shield.
- 2.6.4. Antenna cable shall have a nominal impedance of 50 ohms.
- 2.6.5. Antenna cable shall be Belden 9913 (FT-4), 89913 (FT-6) or approved equivalent.
- 2.7. ANTENNA CABLE DECT (TYPE ANT-D)
- 2.7.1. The antenna cable is an installation grade cable intended for digital wireless systems operating the DECT frequency bands (above 1GHz).
- 2.7.2. Antenna cable shall have a frequency range of 30MHZ to 8000MHZ.

- 2.7.3. Antenna cable shall have minimum braided shield and over foil shield.
- 2.7.4. Antenna cable shall have a nominal impedance of 50 ohms.
- 2.7.5. Antenna cable shall be Times Microwave LMR-400-LLPX or approved equivalent.

- 2.8. 12 GHZ SERIAL DIGITAL INTERFACE COAXIAL VIDEO CABLE (TYPE SDI)
 - 2.8.1. The 12G-SDI digital video cable is intended for permanent installations requiring transmission of uncompressed UHD and 4K-DCI video signals requiring an approximate 12 Gb/s data rate.
 - 2.8.2. 12G-SDI Digital Video Cable shall be minimum 18 AWG bare silver-plated copper insulated conductor, shielded and PVC outer jacket.
 - 2.8.3. 12G-SDI Digital Video Cable shall have a minimum 95% braided shield and 100% foil shield.
 - 2.8.4. 12G-SDI Digital Video Cable shall have a nominal impedance of 75 ohms.
 - 2.8.5. 12G-SDI Digital Video Cable shall adhere to SMPTE 2082-1 specifications.
 - 2.8.6. 12G-SDI Digital Video Cable shall be Belden 4794R or approved equivalent.

- 2.9. HDBASE-T CABLE (TYPE HDBT)
 - 2.9.1. Refer to 27 41 16.16 Audio Video Transmission Systems for projects with HDBase-T solutions.

- 2.10. FIRE STOP
 - 2.10.1. Products manufactured by Hilti Corporation (or approved equivalent) are acceptable.
 - 2.10.2. Obtain fire stop systems for each type of penetration and construction condition indicated only from a single manufacturer.

- 3. Execution
 - 3.1. CABLE INSTALLATION
 - 3.1.1. Exercise caution when pulling cables in pathways to avoid damage to any existing cables and follow manufacturer's maximum pull-force and minimum bend radii.
 - 3.1.2. All cables and components shall be installed and terminated in accordance with applicable Codes, Standards and Regulations.
 - 3.1.3. Supply and install all wiring as required for the proper operating of each audiovisual system and each peripheral device.
 - 3.1.4. After installation, and before termination, all wiring and cabling shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors or shields.
 - 3.1.5. Visually inspect wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps except during actual termination.
 - 3.1.6. Protect wire and cable from kinks.
 - 3.1.7. Provide grommets and strain relief where required.
 - 3.1.8. Comply with controller and peripheral device manufactures installation and termination recommendation.
 - 3.1.9. Where more than two cables shall terminate at the output of a device a terminal block with identification must be provided near the device to gather the cables together so only one cable actually terminates on the device. Provide terminal blocks, marking and mounting systems.

- 3.1.10. Provide brush plates or scoop wall plates to cover all mudrings and backboxes used for cable passthrough.
- 3.2. CABLE SUPPORT
- 3.2.1. Hangers shall be installed at 4' intervals (maximum). Cables shall be run such that sag between supports does not exceed 4". Secure all cables to J-hooks/supports with Velcro tie-wraps. Cables shall be combed and dressed for all visible portions of the install. The above noted conditions shall be strictly checked and the AV Contractor shall be required to comb and redress any cables that are unsatisfactory at no additional cost.
- 3.2.2. Attaching to T-bar support rods is not acceptable. Anchors for hangers must not be drilled into post tensioned beams under any circumstances. The AV Contractor shall not use Hilti Pneumatic hammers. All anchors must be drilled into slab.
- 3.2.3. The AV Contractor must minimize the disturbance or removal of 'fire spray' insulation during installation of cable supports.
- 3.3. NON-CONTINUOUS CABLE SUPPORT
- 3.3.1. The AV Contractor shall supply and install cable support for the distribution of horizontal and backbone cables where conduit or ladder tray has not been provided.
- 3.3.2. The size of J-hooks/support shall suit quantity of cables in runs used for distribution.
- 3.3.3. Include any other miscellaneous hardware (angled hanger bracket, hammer/screw on clamps) required to support horizontal and backbone cabling.
- 3.4. GROUNDING WIRE
- 3.4.1. Supply and install #6 AWG green grounding wire for all metallic components that shall be grounded and Code Conductor Two Hole Long Barrel with Window Lug to bond the conductor to the ground bus.
- 3.5. VELCRO TIE-WRAPPS
- 3.5.1. Velcro tie-wraps shall be used to neatly dress cables; they shall be placed at a maximum of 4' intervals for horizontal distribution (centre points between cable supports).
- 3.6. CABLE DISTRIBUTION
- 3.6.1. Do not exceed the copper cables maximum tensile rating during installation. Monitor tension of the cable during installation. Use a dynamometer to record installation tension. Use a tension limiting device to prevent the exceeding of maximum pulling tension specifications during installation. The tension limit shall be set at or below the manufacturer's limit. The cable shall be taken up at intermediate pulling points with an intermediate take-up device as approved by the Audiovisual Engineer's Representative, to prevent over tension on the cable.
- 3.6.2. Minimum bend radius shall be as per manufacturer's recommendations.
- 3.6.3. Make cable pulls continuous and steady between pull points. Do not interrupt the pull unless necessitated by excessive tension on the cable.
- 3.6.4. Protect exposed cable ends from moisture ingress.

3.7. DUCT AND CONDUIT

- 3.7.1. Clean out each section of duct or conduit by pulling a steel wire brush and mandrel of the correct size through the duct or conduit before pulling cables. Bush, ream and remove any sharp projections on all conduits prior to installation of cables. When cleaning ducts, if obstructions are encountered which cannot be removed, advise the Audiovisual Engineer's Representative of the problems encountered.
- 3.7.2. Apply manufacturer's recommended lubricant to cables to reduce friction between the cable and the conduit. Cable grip shall be attached to the sheath and its strength members so that no direct force is applied to the conductors/fibres. The cable grip shall have a ball bearing swivel to prevent the cable from twisting during pulling.

3.8. TESTING

3.8.1. Coaxial Cable Testing

- .1 All horizontal CATV Coaxial cables shall be swept tested to industry standards using a Time Domain Reflectometer (TDR).
- .2 All horizontal CATV Coaxial cables shall be sweep tested after installation for opens, shorts, and kinks. Damaged cables shall be replaced by installing a new cable. Indicate on the floor plans the actual length of each cable section as installed.
- .3 The AV Contractor shall provide soft and hard copy of cable test result for each CATV cable. Cable test results shall identify cable numbers and associated test results.

3.8.2. Copper Cabling Test Requirements

- .1 Every cabling link in the installation shall be tested (as required by the Cabling specified) in accordance with the Telecommunications Industry Association (TIA) Standard ANSI/TIA/EIA-568-B.1.
- .2 The installed twisted-pair horizontal links shall be tested from the Telecom Room to the workstation against the "Permanent Link" performance limits Specification as defined in ANSI/TIA/EIA-568-B.1.
- .3 Trained technicians who have successfully attended an appropriate training program and have obtained a certificate, as proof thereof shall execute the tests. Appropriate training programs include installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals) and Vendor supplied certifications for their product.
- .4 The test equipment shall comply with or exceed the accuracy requirements for enhanced level II and/or level III field testers (according to Cabling specified) as defined in TIA-568-B; Annex I: Section I.4. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table I.4 of Annex I of TIA/EIA-568-B.2.
- .5 The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The AV Contractor shall provide proof that the interface has been calibrated within the period recommended by the Vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
- .6 The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.

- .7 A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks. (Reference TIA-568-B; Annex I: Section I.2.2).

3.8.3. Optical Fibre Cabling Test Requirements

- .1 Every optical fibre cabling link in the installation shall be tested in accordance with the field test Specifications defined by the Telecommunications Industry Association (TIA) Standard ANSI/TIA/EIA- 568-C (or by the appropriate network application Standard(s) whichever is more demanding).
- .2 ANSI/TIA/EIA-568-B, defines the passive cabling network, to include cable, connectors, and splices (if present), between two optical fibre patch panels (connecting hardware). A typical horizontal link segment is from the telecommunications outlet/connector to the horizontal cross-connect. This TIA document describes three typical backbone link segments: (1) main cross-connect to intermediate cross-connect, (2) main cross-connect to horizontal cross-connect, or (3) intermediate cross-connect to horizontal cross-connect. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.
- .3 Trained technicians who have successfully attended an appropriate training program and have obtained a certificate, as proof thereof shall execute the tests. These certificates may have been issued by any of the following organisations or an equivalent organisation:
 - .1 The manufacturer of the optical fibre cable and/or the optical fibre connectors
 - .2 The manufacturer of the test equipment used for the field certification
 - .3 Training organisations authorised by BICSI (Building Industry Consulting Services International) or by the ACP (Association of Cabling Professionals™).
 - .4 Vendor supplied certifications for their product.
- .4 Field test instruments for multimode fibre cabling shall meet the requirements of ANSI/TIA/EIA-526-14A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B; Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-B.1) with a Category 1 light source. Field test instruments for singlemode fibre cabling shall meet the requirements of ANSI/EIA/TIA-526-7.
- .5 The optical fibre launch cables and adapters must be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
- .6 The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests as detailed below.
- .7 A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.

3.8.4. Optical Fibre Cabling Performance Test Parameters

- .1 ANSI/TIA/EIA Standard 568-C3 prescribes that the single performance parameter for field testing of optical fibre links is link attenuation when installing components compliant with this Standard.
- .2 The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA 568-B:

.3	Link Attenuation =	.4	Cable_Attn + Connector_Attn + Splice_Attn
.5	Cable_Attn (dB) =	.6	Attenuation_Coefficient (dB/km) * Length (Km)
.7	Connector_Attn (dB) =	.8	Number_of_connector_pairs * connector_loss (dB)
		.9	(Maximum allowable connector_loss = 0.75 dB)
.10	Splice_Attn (dB) =	.11	Number of splices (S) * splice_loss (dB)
		.12	(Maximum allowable splice_loss = 0.3 dB)

- .13 The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fibre	Wavelength (nm)	Attenuation Coefficient (dB/km)
Multimode 62.5/125 µm	850	3.5
	1300	1.5
Multimode 50/125 µm	850	3.5
	1300	1.5
Single-mode (Inside plant)	1310	1.0
	1550	1.0
Single-mode (Outside plant)	1310	0.5
	1550	0.5

- .14 Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
- .15 The above link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1. The user shall follow the procedures established by these Standards or application notes to accurately conduct performance testing.
- .16 The Horizontal Link (multimode): acceptable link attenuation for a multimode horizontal optical fibre Cabling Solution is based on the maximum 90 m (295 ft) distance. The horizontal optical fibre cabling link segments need to be tested at only one (1) wavelength. Because of the short length of cabling [90 m (295 ft) or less], attenuation deltas due to wavelength are insignificant. The horizontal link should be tested at 850 nm or 1300 nm in one direction in accordance with ANSI/EIA/TIA-526-14A, Method B, and One Reference Jumper. The horizontal link may be tested using a fixed upper limit for attenuation of 2.0 dB. This value is based on the loss of two (2) connector pairs, one (1) pair at the telecommunications outlet/connector and one (1) pair at the horizontal cross-connect, plus 90 m (295 ft) of optical fibre cable.
- .17 The Backbone Link (multimode) shall be tested in one direction at both operating wavelengths to account for attenuation deltas associated with wavelength.
- .18 Multimode Backbone Links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A. Because backbone length and the potential number of splices vary depending upon site conditions, the link attenuation equation shall be used to determine limit (acceptance) values.
- .19 Singlemode Backbone Links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, and One Reference Jumper. All singlemode

links shall be certified with test tools using laser light sources at 1310 nm and 1550 nm (See Note below).

.20 Notes:

- .1 Link attenuation has been based upon the use of a light source categorised by a Coupled Power Ratio (CPR) of Category 2, Underfilled, per Annex B of ANSI/EIA/TIA-526-14A. The use of a light source categorised as Category 1, Overfilled, may provide results higher than the 2.0 dB limit. A field test tool based on LED (light emitting diode) light sources is a Category 1 device and typically yields high attenuation results.
- .2 Links destined to be used with network applications that use laser light sources (underfilled launch conditions) shall be tested with test equipment based on laser light sources. This rule should be followed for Cabling Solutions to support Gigabit Ethernet. Gigabit Ethernet only specifies laser light sources.
- .3 For Gigabit Ethernet compliant certification (IEEE STD 802.3z application), use test equipment which uses a VCSEL (Vertical cavity surface emitting laser) at 850 nm (compliant with 1000BASE-SX) and a FP laser at 1310 nm (compliant with 1000BASE-LX).

- .21 Each optical fibre link terminated with an optical adapter system which does not impose a transmission direction because the adapters are not or cannot be ganged should be tested and documented in both direction since the direction of the signal transmission cannot be predicted at the time of installation.

3.8.5. Test each strand of fibre with an Optical Time Domain Reflectometer for length and attenuation. Performance test must be below the total return loss budget for the cable connectors/balun. Provide comprehensive optical time domain reflectometry (OTDR) testing for all fibre runs. Include a hard copy chart recording with the test documentation.

3.9. FIRE STOPPING

- 3.9.1. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of fire stopping in accordance with manufacturer's installation instructions and technical information
- 3.9.2. Examine sizes and conditions of voids to be filled to establish correct thickness and installation of Fire Stop Materials.
- 3.9.3. Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion
- 3.9.4. Prepare surfaces in contact with Fire Stop Systems and Smoke Seals to manufacturer's instructions. Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.
- 3.9.5. The Communications Contractor shall install/replace sound barrier/fire stopping materials as soon as cables have been pulled through the opening.
- 3.9.6. In all Fire Stop Systems that require mineral wool or ceramic fibre backer or filler materials, these materials shall be dry and free of other contaminants before, during and after installation of sealant Fire Stop Materials. Alkaline water contamination of the backer or filler materials may cause corrosion of metallic penetrating items.
- 3.9.7. Apply Fire Stop Systems and Smoke Seals in strict accordance with manufacturer's instructions to prevent the passage of fire and smoke, and where required and / or specifically designated, the passage of fluids.
- 3.9.8. Provide temporary forming and packing as required. Tool or trowel all exposed surfaces to smooth, neat and tidy finish.

- 3.9.9. Fire Stop and smoke seal gaps and holes in all Fire Separation and Firewall construction through which cables pass as a result of work in this document.
- 3.9.10. In Combustible Construction (membrane GWB type) where the framing members are wood or where paper faced insulation is incorporated within the separation, a Fire and Temperature rise "FT" rating is required equal to that of the rating of the Fire Separation. Include openings which have been formed and sleeved.
- 3.9.11. Where the bottom of a Fire Stop System is exposed, seal bottom side of the assembly with a fire rated elastomeric Fire Stop sealant.

END OF SECTION

27 41 23.12 Grounding and Bonding for Audiovisual Systems

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 27 40 10 – GENERAL INSTRUCTIONS FOR AUDIOVISUAL SYSTEM INSTALLATION.

1.2. APPLICABLE CODES & STANDARDS

1.2.1. Provide grounding & bonding in accordance with good industry practices and in accordance with the following codes and standards:

- .1 CSA Standard C22.2 No.41-M1987 – Grounding & Bonding Equipment
- .2 CSA Standard T527 (ANSI/TIA/EIA-607)
- .3 Provincial Hydro Electrical Safety Code
- .4 Provincial Building Code
- .5 Local Codes & Bylaws
- .6 BICSI requirements
- .7 AVIXA/Infocomm AV Installation Handbook, latest edition

1.3. GROUNDING PRACTICES

1.3.1. It is the responsibility of the AV Contractor to follow good engineering practices to minimize crosstalk and maximize signal-to-noise ratios in audiovisual systems.

1.3.2. The AV Contractor shall take care to consider ground references within each device and ground factors on site.

2. Products

2.1. RACK ACCESSORIES

2.1.1. Provide rack isolation kits to maintain galvanic isolation between the equipment rack and semi-conductive flooring.

3. Execution

3.1. GENERAL REQUIREMENTS

3.1.1. Ensure ganged equipment racks are bonded. Scrape paint off adjacent racks and utilize a stranded bonding jumper with a lug to connect racks to the same ground reference. Bolting racks together is an insufficient bonding method.

3.1.2. The AV Contractor shall ensure that there is complete metal-to-metal contact is made when grounding to painted or powder coated metal surfaces.

3.1.3. Grounding & bonding installed by the AV Contractor shall not interfere with the existing grounding practices within the customer premises.

3.1.4. The AV Contractor shall utilize thread-forming screws, bonding screws & any other hardware necessary to complete the ground system.

END OF SECTION

00 00 00.00 Attachment A Audio Visual Tender Form

AUDIOVISUAL TENDER FORM
FOR
**Seneca Polytechnic
K3170 Upgrades
01105.034.AV.001**

SUBMITTED BY: _____ DATE: _____

1. Having carefully examined and understood the site and all the Bid Documents, and having complied with all the conditions of the Instructions to Bidders including those issued prior to this date, we hereby offer to furnish all materials, equipment, plant and labour necessary for the proper completion of the Audiovisual work, and enter into a Lump Sum Contract for the execution of the aforementioned work, in accordance with the Contract Documents, for the stipulated sum of:

_____ Dollars in lawful money of Canada \$ _____

The Stipulated Sum excludes all applicable taxes. H.S.T. shall be identified below.

Harmonized Sales Tax excluded in total Stipulated Sum \$ _____

2. Breakdown of work shall be provided as follows and sum shall equal previously Stipulated Sum, excluding taxes. General Contractor to submit a copy of the A/V bid as part of the submission.

SYSTEM (ROOM TYPE)	LABOUR	EQUIPMENT/MATERIALS	TOTAL
Capstone	\$	\$	\$
Shared Meeting Room	\$	\$	\$
Open Engineering Space	\$	\$	\$
TOTAL \$			\$

3. We shall hold our tender open for acceptance for a period of sixty (60) days from the date of this tender.
4. The Tenderer acknowledges that the Owner shall have the right to reject any and all tenders for any reason or to accept any tender which the Owner in its sole unrestricted discretion deems

most advantageous to itself. The Tenderer acknowledges that the Owner may rely upon criteria which the Owner deems relevant even though such criteria have not been disclosed to the Tenderer. By submitting a tender, the Tenderer acknowledges the Owner's rights under this clause and absolutely waives any right of action against the Owner and its consultants for the Owner's failure to accept the Tenderer's tender whether such right of action arises in contract, negligence, bad faith, or any other cause of action.

5. ALTERNATIVE PRICES

We submit the following Alternative Prices for items as defined:

ALTERNATE	DEDUCT FROM BID PRICE	ADD TO BID PRICE
5.1 _____	_____	_____
5.2 _____	_____	_____
5.3 _____	_____	_____

6. Acceptance to this agreement is to accept confirmation of completion date as noted. Expected equipment delays shall be identified and specifically noted on Tender documentation. Failure to comply to this delivery may be subject to penalty as negotiated prior to Tender Award

7. AUDIOVISUAL TENDER DOCUMENTS

We further confirm that we have received the following documents:

- a. Audiovisual Tender Form
- b. Audiovisual Instructions to Bidders
- c. Audiovisual Specifications as described on Index 27 00 00.00
- d. Audiovisual Drawings consisting of those listed on drawing number AV-000
- e. Audiovisual Addenda listed below:

ADDENDUM NO.	DATE	PAGES

8. ACCEPTANCE

If we are notified of the acceptance of our Tender within the time stipulated as mentioned above, we shall:

- a. Execute a contract on Document CCDC-2 (latest edition) subcontract, Canadian Standard Construction Subcontract stipulated Price or as identified by the General Contractor.
- b. Commence work immediately with approval or letter of intent
- c. Substantially perform the work within the construction schedule agreed upon above and with the project team recognising that time shall be of the essence of the Contract. We understand that regardless of the time period we have indicated for substantial performance of the entire work (the 'Work' of the Contract), certain parts of the work included in the Contract have specified completion dates to enable use, occupancy and access by the Owner, and we accept and shall meet those requirements.

9. BID SUBMITTED BY

(Company)

(Address)

(Date)

SIGNING OFFICER:

(Printed Name)

(Signature)

WITNESS:

(Printed Name)

(Signature)

END OF SECTION