

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

1.2 Description

- .1 Audio-video infrastructure requirements for Sections 27 41 16 to 27 41 52.

2.0 DESIGN REQUIREMENTS

2.1 Consultant Coordination

- .1 Coordination of architectural systems, audio-video power, data and pathways requirements is paramount for a successful implementation of all audio-video systems. It is the responsibility of the Consulting Engineer to ensure that all requirements have been captured in their Construction Documents.
- .2 UBC IT Audio Visual shall be engaged by the project team to provide AV Infrastructure instructions, conceptual drawings or markups to be incorporated into the Consulting Engineer's Construction Documents, or in a case where an external AV system design consultant has been engaged this consultant shall provide same for review and approval by UBC IT Audio Visual. The instructions, conceptual drawings or markups provided by UBC IT Audio Visual shall not be issued to the Contractor performing the work in the Tender, or as a Site Instruction or Change Order. It is the responsibility of the Consulting Engineer to transfer the requirements to their documentation. This will ensure that the proper communication protocol is maintained throughout the project and that the requirements are fully coordinated with other disciplines.
- .3 The Consulting Engineer shall provide UBC IT Audio Visual with Schematic Design, Design Development and Construction Documents for review and sign off at a minimum. Iterative reviews are required to ensure minimal impact prior to Tender. The Consulting Engineer shall provide electronic copies of the Drawings and Specifications for review.
- .4 The Consulting Engineer shall use the UBC IT Audio Visual standard drawing symbols shown in AVSK-01.
- .5 The Consulting Engineer shall provide the Issued for Construction Drawings and Specifications once issued to the Contractor.
- .6 Shop Drawings, Site Instructions and Change Orders that affect audio-video systems shall be submitted to UBC IT Audio Visual for review.
- .7 The Consulting Engineer shall inform UBC IT Audio Visual when audio-video power, data and pathways are ready for rough-in inspection, prior to boarding. UBC IT Audio Visual's site inspection will not remove the responsibility of the Consulting Engineer to ensure that the audio-video power, data and pathways conform to the Issued for Construction Documents requirements.

2.2 Basic Requirements

- .1 Provide electrical power of the voltage, current and phase(s) required, from the main sources of supply to each audio-visual equipment load requiring supply of power. Typically a 120 VAC, 15A, single phase connection is required unless specified otherwise by UBC IT Audio Visual through design consultation.
- .2 Provide an audio-visual raceway system consisting of outlet boxes, conduits, cable trays, pull boxes, sleeves and caps, and pull strings. New conduit for cable runs are preferred for all new buildings. Free-air cabling is permitted for existing buildings where conduit is non-existent and/or inadequate for required AV cabling with permission from UBC IT Audio Visual.
- .3 Provide plywood backing behind finished wall surface for audio-visual equipment such as flat panel displays, projection screens and equipment racks.
- .4 It is not permitted to install audio-visual equipment in an IT communications room, electrical room or mechanical room. Notwithstanding, at the UBC Okanagan campus, audio-visual equipment may be installed in an IT communications room with approval from both UBCO IT Audio Visual and UBCO IT Data & Infrastructure.
- .5 It is not permitted to share conduit pathway with IT communications cabling with the exception of cable/basket tray that has barriers to separate IT and audio-visual cabling to ensure proper cable management for both disciplines. Notwithstanding, at the UBC Okanagan campus, IT and audio-visual cabling may share conduit and basket trays without barrier if they are the same type of cable (i.e. Category 6A) and is approved by both UBCO IT Audio Visual and UBCO IT Data & Infrastructure.

2.3 Performance Criteria

- .1 Basket tray shall be sized for communications and audio-visual cable density plus 25% future expansion capacity:
 - .1 Continuous, rigid, welded steel wire mesh spaced 50mm x 100mm;
 - .2 Continuous T-weld on top rail of tray;
 - .3 And Finish: electroplated zinc coating.
- .2 A zone conduit system shall be used in areas where basket tray is not feasible. Zone pull boxes c/w access hatches shall be spaced maximum 9 meters apart. All outlet box conduits shall homerun to the nearest zone pull box.
- .3 Power connection shall be adjacent to audio-visual outlet box.
- .4 Pathways shall avoid potential sources of electromagnetic interference by maintaining clearances of at least:
 - .1 305mm from fluorescent ballasts;
 - .2 305mm from electrical distribution conduit and cable less than 1kV;
 - .3 1000mm from electrical distribution conduit and cable more than 1kV;
 - .4 1220mm from motors and transformers;
 - .5 And 305mm from HVAC equipment, ducts and pipes.

- .5 Audio-visual outlet boxes shall be masonry back box with minimum depth of 90mm. Outlet box shall be recessed if wall mounted below finished ceiling. All outlet boxes shall have cover plates installed and colour coordinated with other outlets and services.
- .6 Floor boxes with audio-visual requirements shall be able to accept Extron AAP or MAAP plates. Floor box lid shall allow cable egress while in the closed position. Floor box shall be intended for AV cabling and termination use, and allow sufficient room for all required cabling without cable strain at the connectors.
- .7 The bend radius shall be at least six (6) times the internal diameter for conduit that has an internal diameter of 50mm or less. The bend radius shall be at least ten (10) times the internal diameter for conduit that has an internal diameter more than 50mm.
- .8 The maximum number of bends between cable pull boxes in a conduit run shall be two (2) 90 degree bends.
- .9 Conduit runs shall have no continuous sections longer than 30m between pull boxes.
- .10 If a conduit run requires a reverse bend between 100 degree and 180 degree then a pull box shall be inserted into the bend but shall not be used as the bend.
- .11 Pull boxes shall be installed in fully accessible spaces.
- .12 Support and secure all boxes independent of the conduit connected thereto.
- .13 All conduit ends shall be protected by insulating bushings.
- .14 Conduit stub and insulating bushing shall be as short as possible inside the outlet box to ensure that it does not obstruct installation of the audio-visual device. *Refer to AVSK-03 for AV outlet box detail.*
- .15 All conduits shall be left with a nylon pull string installed.
- .16 Plywood backing shall be a minimum of 20mm thick and spanned between a minimum of three (3) studs. The dimensions of the backing shall be sized appropriately for the equipment being installed.
- .17 Each outlet box shall be clearly marked in back of box with an 'AV#' that corresponds to the riser diagram and floor plan.
- .18 Audio-visual conduits and outlet boxes shall be colour coded with paint or similar. The colour shall be different from other systems including communications pathway.

2.4 General Device Power, Data and Pathway Requirements

- .1 This section will aid Consultants and Contractors with general infrastructure requirements for each type of audio-visual device. Final infrastructure requirements shall be verified by UBC IT Audio Visual prior to finishing design or pricing scope of work.
- .2 Ceiling Mount Projector
 - .1 Provide ceiling mount double duplex receptacle, shared with respective electric screen 15A circuit.
 - .2 Provide ceiling mount 2-gang projector outlet box.

- .3 Provide 41mm conduit from projector outlet box to audio-visual rack back box.
- .4 If the room does not have a rack, then conduit shall run to audio-visual input plate outlet box and provide ceiling mount data outlet box adjacent to projector outlet box.
- .3 Wall Mount Flat Panel Display
 - .1 Provide wall mount double duplex receptacle on dedicated 15A circuit.
 - .2 Provide wall mount 2-gang display outlet box.
 - .3 Provide 41mm conduit from display outlet box to audio-visual rack back box.
 - .4 If the room does not have a rack, then conduit shall run to audio-visual input plate outlet box and provide wall mount data outlet box adjacent to display outlet box.
 - .5 Provide plywood backing behind display.
- .4 Wall Mount Digital Signage Flat Panel Display
 - .1 Provide wall mount duplex receptacle.
 - .2 Provide wall mount data outlet box adjacent to duplex receptacle.
 - .3 Provide plywood backing behind display. Refer to AVSK-17 for typical flat panel display mounting detail.
- .5 Recessed Electric Screen
 - .1 Provide ceiling mount power connection c/w local disconnect switch on left-hand side of screen, shared with respective projector 15A circuit.
 - .2 Provide ceiling mount single-gang electric screen outlet box mounted on left-hand side of electric screen.
 - .3 Provide wall mount single-gang manual screen control outlet box mounted adjacent to local light switch.
 - .4 Provide 21mm conduit from each outlet box to audio-visual rack back box.
 - .5 If the room does not have a rack, then conduit shall run to the audio-visual control panel outlet box.
- .6 Wall Mount Electric Screen
 - .1 Provide ceiling mount duplex receptacle on left-hand side of screen, shared with respective projector 15A circuit.
 - .2 Provide ceiling mount single-gang electric screen outlet box mounted on left-hand side of electric screen.
 - .3 Provide wall mount single-gang manual screen control outlet box mounted adjacent to local light switch.
 - .4 Provide 21mm conduit from each outlet box to audio-visual rack back box.
 - .5 If the room does not have a rack, then conduit shall run to the audio-visual control panel outlet box.
 - .6 Provide plywood backing at screen anchor points.
- .7 Ceiling Mount HD Camera
 - .1 Provide ceiling mount duplex receptacle.
 - .2 Provide ceiling mount single-gang camera outlet box adjacent to power receptacle.
 - .3 Provide 35mm conduit from camera outlet box to audio-visual rack back box.
- .8 Wall Mount HD Camera
 - .1 Provide wall mount duplex receptacle.

- .2 Provide wall mount single-gang camera outlet box adjacent to power receptacle.
- .3 Provide 35mm conduit from camera outlet box to audio-visual rack back box.
- .9 Ceiling Mount Microphone
 - .1 Provide ceiling mount single-gang microphone outlet box above finished ceiling.
 - .2 Provide 27mm conduit from microphone outlet box to audio-visual rack back box.
 - .3 Multiple microphone outlet boxes can be daisy chained but conduit size may need to be increased to accommodate the additional cabling.
- .10 Wall/Ceiling Mount Antenna
 - .1 Provide ceiling or wall mount single-gang antenna outlet box.
 - .2 Provide 27mm conduit from antenna outlet box to audio-visual rack back box.
- .11 Wall/Ceiling Mount Room Support IP Camera
 - .1 Provide one (1) wall or ceiling mount duplex receptacle.
 - .2 Provide one (1) wall or ceiling mount data outlet box adjacent to power receptacle.
- .12 Ceiling Mount Speaker
 - .1 Provide ceiling mount single-gang outlet box above finished ceiling.
 - .2 Provide 27mm conduit from speaker outlet box to audio-visual rack back box.
 - .3 If the room does not have a rack, then conduit shall run to an additional wall or ceiling mount 2-gang outlet box mounted adjacent to the local display device.
 - .4 Multiple speaker outlet boxes can be daisy chained but conduit size may need to be increased to accommodate the additional cabling.
- .13 Wall Mount Speaker
 - .1 Provide wall mount single-gang speaker outlet box.
 - .2 Provide 21mm conduit from speaker outlet box to audio-visual rack back box.
 - .3 If the room does not have a rack, then conduit shall run to an additional wall or ceiling mount 2-gang outlet box mounted adjacent to the local display device.
 - .4 If required by system design, provide duplex receptacle adjacent to speaker outlet box (to support the use of active speakers).
- .14 Wall Mount Button Control Panel
 - .1 Provide wall mount 3-gang outlet box.
 - .2 Provide 27mm conduit from control panel outlet box to audio-visual rack back box.
 - .3 If the room does not have a rack, then conduit shall run to local display device outlet box.
- .15 Wall Mount Touch Control Panel
 - .1 Provide wall mount 2-gang outlet box.
 - .2 Provide 27mm conduit from control panel outlet box to audio-visual rack back box.
 - .3 If the room does not have a rack, then conduit shall run to local display device outlet box.

- .16 Wall Mount Audio-Visual Input Plate
 - .1 Provide wall mount multi-gang outlet box as defined by system requirements.
 - .2 Provide 41mm conduit from input plate outlet box to audio-visual rack back box.
 - .3 If the room does not have a rack, then conduit shall run to local display device outlet box.
 - .4 Refer to AVSK-02 for AV input plate L-hook installation detail.
 - .5 L-Hook shall be installed with two (2) toggler bolts and (2) 3/16" flat head screw to secure to dry wall.
 - .6 L-Hook shall be installed at 25-3/4" AFF.
- .17 Table Mount Audio-Visual Devices
 - .1 Provide floor box c/w with double duplex receptacle and 41mm conduit from floor box to audio-visual rack back box.
 - .2 If the room does not have a rack, then conduit shall run to local display device outlet box.
- .18 Audio-Visual Equipment Rack (each)
 - .1 Provide wall mount double duplex receptacle on dedicated 20A circuit.
 - .2 Provide wall mount data outlet box adjacent to power receptacle.
 - .3 Provide wall mount 300mm x 300mm rack back box.
 - .4 If the rack is wall mounted, provide plywood backing.
- .19 Fixed Instructor Lectern
 - .1 Provide four (4) double duplex receptacles on two (2) 15A circuits.
 - .2 Provide data outlet box adjacent to each rack power receptacle.
 - .3 Provide data outlet box adjacent to power receptacle in trough.
 - .4 All conduits for power, communications and audio-visual shall stub up below lectern trough. Stubs shall never be installed underneath lectern rack bay locations.
- .20 Mobile Instructor Lectern
 - .1 Provide wall mount duplex receptacle on dedicated 15A circuit.
 - .2 Provide wall mount data outlet box adjacent to duplex receptacle.
 - .3 Provide wall mount 3-gang furniture whip outlet box mounted adjacent to duplex receptacle.
 - .4 Provide 41mm conduit from outlet box to audio-visual rack back box
- .21 Lighting Integration
 - .1 Provide 2-gang outlet box adjacent to the local low-voltage lighting controller.
 - .2 Provide 27mm conduit from lighting integration point outlet box to audio-visual rack back box.
- .22 Electric Window Blind Integration
 - .1 Provide 2-gang outlet box adjacent to the blind controller.
 - .2 Provide 27mm conduit from blind integration point outlet box to audio-visual rack back box.
 - .3 Blind shall have a LAN or RS-232 port for control by a 3rd party controller.

2.5 Typical Room Power, Data and Pathway Requirements

- .1 This section will aid Consultants and Contractors with infrastructure requirements for typical audio-video systems. UBC IT Audio Visual shall be consulted to confirm which system type applies to the given project rooms. UBC IT Audio Visual shall verify final infrastructure requirements prior to finishing design or pricing scope of work.
- .2 Typical Rooms:
 - .1 Bring-Your-Own-Device (BYOD) Projector System
 - .1 **Description:** This system has a single projector and screen and allows for connection of a personal device such as laptop or tablet. Wall mounted speakers flanking the screen drive program audio.
 - .2 Refer to AVSK-08 for typical BYOD projector system riser diagram.
 - .2 Bring-Your-Own-Device (BYOD) Flat Panel Display (FPD) System
 - .1 **Description:** This system has a single flat panel display and allows for connection of a personal device such as laptop or tablet. A sound bar mounted below the display drives program audio.
 - .2 Refer to AVSK-09 for typical BYOD FPD system riser diagram.
 - .3 Single Screen Video Conferencing (VC) System
 - .1 **Description:** This system has a single flat panel display, camera and microphone to allow live, real-time two-way communication between two or more geographically separated parties using a hardware-based endpoint. Presentation material can be transmitted from any personal device such as a laptop or tablet. Program audio is typically driven from the all-in-one camera, sound bar and microphone.
 - .2 Refer to AVSK-10 for typical single screen VC system riser diagram.
 - .4 Dual Screen Video Conferencing (VC) System
 - .1 **Description:** This system has two flat panel displays, a camera and microphones to allow live, real-time two-way communication between two or more geographically separated parties using a hardware-based endpoint. Presentation material can be transmitted from any personal device such as a laptop or tablet. Program audio is typically driven from the all-in-one camera, sound bar and microphone.
 - .2 Consult with UBC IT Audio Visual for system riser diagram.
 - .5 Web Conferencing System
 - .1 **Description:** This system has a single flat panel display, web camera and microphone to allow live, real-time two-way communication between two or more geographically separated parties using a PC running web conferencing software. Presentation material can be loaded to the PC to transmit. Program audio is typically driven from the all-in-one camera, sound bar and microphone.

- .2 Consult with UBC IT Audio Visual for system riser diagram.

.6 Single Screen Projector System

- .1 **Description:** This system has a single projector and screen and allows for connection of a personal device such as laptop or tablet, or presentation from a built-in PC or document camera. Wall mounted speakers flanking the screen drive program audio.
- .2 Consult with UBC IT Audio Visual for system riser diagram.

.7 Dual Screen Projector System

- .1 **Description:** This system has two projectors and screens and allows for presentation from two sources concurrently. Connections can be made from a personal device such as laptop or tablet, or built-in PC or document camera. A lectern provides a work surface and a location to house the audio-video equipment. Wall mounted speakers flanking the screens drive program audio.
- .2 Consult with UBC IT Audio Visual for system riser diagram.

.8 Lecture Theatre System

- .1 **Description:** This system has two projectors installed in a projection booth that allow presentation from two sources concurrently on two screens at the front of room. Connections can be made from a personal device such as laptop or tablet, or built-in PC or document camera. A lectern provides a work surface and a location to house audio-video equipment. The projection booth will house audio-video equipment that is not required at the lectern. Wall mounted line array speakers flanking the screens drive program audio and ceiling mounted speakers drive microphone audio.
- .2 Consult with UBC IT Audio Visual for system riser diagram.

.9 Collaboration Lab System

- .1 **Description:** This system has a flat panel display for the instructor and at each student pod allowing presentation from any single display to all the other displays. The instructor has connections for a personal device such as laptop or tablet, or built-in PC or document camera. Each student pod has connections for a personal device such as laptop or tablet. A lectern provides a work surface and a location to house audio-video equipment. An audio-video equipment closet will house equipment that is not required at the lectern. Ceiling mounted speakers will drive program and microphone audio.
- .2 Consult with UBC IT Audio Visual for system riser diagram.
- .3 Collaboration Lab systems require an audio-video equipment closet to house at minimum one (1) back-end audio-video equipment rack. The closet shall provide acoustic isolation from the lab and adequate ventilation or cooling for the heat generated by the audio-video equipment. Dimensions, power, data and HVAC requirements shall be verified by UBC IT Audio Visual.

.10 Digital Signage System

- .1 **Description:** This system has a flat panel display with digital signage player PC mounted behind the display.
- .2 Consult with UBC IT Audio Visual for system riser diagram.

2.6 Projection Booth Infrastructure Requirements

- .1 Projection booths are required in lecture theatres to house projectors and back-end audio-video equipment racks.
- .2 Projection booths require coordination with architecture, electrical and mechanical to ensure the booth location, dimensions, power, data and HVAC support the needs of the audio-video system.
- .3 Refer to AVSK-11 for an example layout of a typical projection booth with three (3) projectors (left, right and centre), and two (2) audio-video equipment racks.
- .4 Architectural Requirements
 - .1 The projection booth shall be sized at a minimum for two (2) projectors and one (1) full height swing-out audio-video equipment rack. Additional equipment racks and projectors may be required for the audio-video system. Quantities shall be confirmed by UBC IT Audio Visual.
 - .2 The projection booth shall be located such that all projectors are aligned centred to their corresponding projection screen at the front of room. The projection screens can be angled to reduce the width of the projection booth. Angled screen must adhere to the horizontal viewing angle defined in the UBC Learning Space Design Guidelines.
 - .3 The audio-video equipment racks shall have a minimum clearance of 1500mm in front, 1000mm on one side, and 150mm on the other side.
 - .4 The projectors shall have a minimum clearance of 500mm on the back, and both sides from walls or any other audio-video components.
 - .5 The projection booth shall have a minimum depth of 2900mm. Final depth of room shall be confirm by UBC IT Audio Visual to suit the needs of the audio-video system requirements.
 - .6 The projection booth shall be accessible from the entry vestibule or foyer outside the lecture theatre for support staff to be able to access the booth without disrupting a session.
 - .7 The projection booth shall be designed to provide the required structural support for the projectors and should include any required vibration isolation measures to prevent the projectors from shaking. In addition to vibration caused by HVAC, movements in the building such as doors opening and closing shall not cause the projectors to shake. Refer to AVSK-12 for example projector mounting structure.
 - .8 The projection booth shall have a window spanning the full width of all projectors in the booth. The window shall be designed for projection allowing optimal transmission of light, contrast and colour. The window shall be clear, colourless glass with a 2-

sided, multi-layer broadband anti-reflective coating. Transmission rate shall be 95% or better. The window shall be installed on 2 degree angle to minimize ghosting.

.1 Typical product is Abrisa Technologies CPG series.

.5 Electrical Requirements

- .1 Provide one (1) wall mounted double duplex receptacle on dedicated 20A circuit for each audio-video equipment rack.
- .2 Provide one (1) ceiling mounted duplex receptacle on dedicated 20A circuit for each projector.
- .3 Provide one (1) wall mounted data outlet with two (2) data drops for each audio-video equipment rack.
- .4 Provide surface mounted light fixtures in the projection booth. The location of the fixtures shall not affect the location of the racks and projectors as well as the swing of the racks.
- .5 Provide minimum 150mm wide basket tray around the perimeter of the projection booth to support the audio-video cabling to the equipment racks and projectors.
- .6 Provide adequate wall space, unimpeded from audio-video equipment rack location and swing, for lighting controller panel and electrical panel board as required.
- .7 For UBCO provide the following additional data drops:
 - .1 One (1) ceiling mounted data outlet with one (1) data drop for each projector.
 - .2 Four (4) data drops in addition to those required above for each audio-video equipment.

.6 Mechanical Requirements

- .1 Ventilation or cooling shall be provided in the projection booth to manage the heat gain produced by the audio-video equipment and projectors without adversely affecting the functionality of the audio-video system through factors such as condensation and vibration.
- .2 The projection booth shall be kept at a temperature range between 21 and 24 degrees Celsius with a relative humidity level between 30 and 50 percent.
- .3 The total amount of heat gain in the projection booth shall be calculated by allowing 4000 BTU/h per projector and 4000 BTU/h per audio-video equipment rack.

2.7 Stage Lighting

- .1 Stage lighting shall be provided by the audio-visual contractor unless indicated otherwise by UBC IT Audio Visual.
- .2 Stage lighting installation methods include flexible truss mount, flexible pole mount or fixed surface mount.
- .3 The stage lighting installation requires the following infrastructure:

- .1 Pathway from stage light fixtures to audio-visual equipment rack for DMX control cable
- .2 One (1) 20A receptacle on dedicated circuit for every nine (9) fixtures
- .3 Pathway from chain hoists to wall mounted connection point for remote plug station if applicable
- .4 One (1) 20A receptacle on dedicated circuit for each pair of chain hoists if applicable
- .4 Refer to Section 27 41 16.15 for Stage Lighting requirements.

3.0 **EXECUTION**

3.1 **Electric Screen Mounting**

- .1 Electric screen shall be mounted at a height such that the bottom edge of the image is at 1220mm for applications where the viewers are typically seated. The screen may need to be higher if the viewers are standing or the room geometry requires adjustments.
- .2 The following table provides a guide for electric screen case mounting height by typical screen size. The exact mounting height shall be confirmed onsite prior to installation and shall account for non-standard black drop height as indicated in the design.

Image Size			Case Size		Bottom of Image Height Above Finished Floor	Black Drop	Top of Case Height Above Finished Floor
Height	Width	Diagonal	Height	Width			
50"	80"	94"	6"	92"	48"	2"	106"
57.5"	92"	109"	6"	104"	48"	2"	113.5"
60"	96"	113"	6"	108"	48"	2"	116"
65"	104"	123"	6"	116"	48"	2"	121"
69"	110"	130"	6"	122"	48"	2"	125"
72.5"	116"	137"	6"	128"	48"	2"	128.5"
87"	139"	164"	6"	152"	48"	2"	143"
100"	160"	189"	9"	173.5"	48"	2"	159"
110"	176"	208"	9"	189.5"	48"	2"	169"
117.5"	188"	222"	9"	201.5"	48"	2"	176.5"

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General

- .1 UBC IT Audio Visual has certified Biamp and Crestron programmers on staff to manage and maintain the Digital Signal Processors. DSP's must be Biamp or Crestron, unless otherwise specified in this Section, to allow for internal support and maintenance, and include Acoustic Echo Cancellation as required for the specific application.
- .2 All audio equipment, with the exception of microphone inputs, loudspeaker outputs, and consumer (IHF) items in approved usage, is intended to operate at a nominal level of -20 dBm to +4 dBm on balanced floating 600 ohm lines. Provide buildouts, terminations, interstage attenuators and decoupling transformers as required.
- .3 Consumer items are nominally intended to operate at 200 mV on unbalanced high-impedance lines. Provide buildouts, terminations, interstage attenuators and decoupling transformers as required.
- .4 All digital audio equipment should have a minimum sampling rate of 44.1kHz and a bit depth of 16bits.
- .5 Wireless microphone systems shall be designed with an antenna distribution system to provide uninterrupted 100% coverage in the area of usage. To ensure good signal strength, the transmitter should be line of sight to the receiving antenna.

2.2 Performance Criteria

- .1 Sound systems intended for AV playback support must provide a minimum speech intelligibility of 0.56 STI throughout the student seating area.
- .2 Sound systems intended for speech reinforcement must provide a minimum speech intelligibility of 0.67 STI throughout the student seating area.
- .3 Coverage uniformity from 500Hz-2000Hz should be within 6dB (+/- 3dB) in the listening plane throughout the seating area for any sound system in any application. The coverage uniformity below 500Hz should be within 10dB (+/- 5dB) in the listening plane throughout the seating area. The coverage uniformity above 4000Hz should be within 8dB (+/- 4dB) in the listening plane throughout the seating area.
- .4 Sound systems should be calibrated to output at a minimum of 20 dBa over the ambient sound levels of the enclosing space (as measured during typical use), and should be capable of delivering no less than 75dBa sound level at the most distant seat in the classroom.
- .5 When AV playback is provided, the sound system shall provide complete coverage of the seating area. For AV systems with stereo audio, the left channel audio shall be routed to "audience left speaker" and the right channel audio shall be routed to "audience right speaker". For AV systems with summed mono, both left and right audio channels shall be reproduced at equal volume.

- .6 Feedback Stability Margin should be a minimum of 6dB when the classroom acoustics are within the criteria set by the UBC Classroom Acoustical Standards.
- .7 Provide loudspeaker modelling coverage results, and STI predictions, for review with Design Development submission before tendering sound or AV package.
- .8 The audio DSP shall eliminate acoustic echo in a full-duplex video conference. Ensure that the AEC has a strong signal of the incoming audio as a reference. An incoming signal that is weak could cause the AEC to miss elements that should be eliminated from the outgoing signal. The following settings shall assure the acoustic echo cancelling is working properly:
 - .1 The audio used in a reference signal shall be post-process audio. The cancellation reference should be a sample of the signal being sent to the power amplifier.
 - .2 Avoid routing far-end audio through dynamic feedback controllers. This could give a false acoustic picture of the room to the AEC.
 - .3 As the audio signal is acquired from a microphone, assure the AEC function is completed prior to any automatic gain control, noise cancelling, muting, or microphone mixing. Applying any of these functions prior to the AEC activity could cause a false acoustic picture of the room.

2.3 Lavalier Wireless Microphone Systems

- .1 UHF band FM diversity wireless microphone systems, with frequency agile transmitters/receivers.
- .2 Audio Frequency Response 80 to 15,000 Hz, +/-2 dB, with high pass filter.
- .3 Gain Adjustment Range transmitter 0 to 40 dB.
- .4 Modulation +/-15 kHz deviation compressor expander system with pre and de-emphasis.
- .5 RF Power Output 12 mW minimum, 30 mW maximum.
- .6 Dynamic Range >100 dB, A weighted.
- .7 RF Image Rejection 55 dB typical.
- .8 Spurious Rejection 75 dB typical.
- .9 The minimum effective range of the wireless system, receiver to transmitter, must be 75 meters (225 ft.) in its specified use case.
- .10 The receivers will be mounted in the equipment rack with the antennae mounted externally from the rack and extended using 50 ohm coaxial cable.
- .11 Include a lavalier type cardioid condenser microphone with appropriate wireless connector, tie clip mount and windscreen.
- .12 Battery life to be a minimum of 8 hours with AA Lithium Alkaline batteries.
- .13 The wireless system must have a minimum of 100 channels available in their operating band, or more as required by the local operating environment.
- .14 Wireless systems used within the same building must have frequency blocks selected to be compatible.

- .15 Select clear frequencies on site based on RF site survey using wireless receiver.
- .16 Typical manufacturers are:
 - .1 Shure

Shure Band	
Band G50	(470 MHz – 534 MHz)

2.4 Talkback Handheld Wireless Microphone Systems

- .1 UHF band FM diversity wireless microphone systems, with frequency agile transmitters/receivers operating.
- .2 Audio Frequency Response 80 to 15,000 Hz, +/-2 dB, with high pass filter.
- .3 Gain Adjustment Range transmitter 0 to 40 dB.
- .4 Modulation +/-15 kHz deviation compressor expander system with pre and de-emphasis.
- .5 RF Power Output 12 mW minimum, 30 mW maximum.
- .6 Dynamic Range >100 dB, A weighted.
- .7 RF Image Rejection 55 dB typical.
- .8 Spurious Rejection 75 dB typical.
- .9 The minimum effective range of the wireless system, receiver to transmitter, must be 75 meters (225 ft.) in its specified use case.
- .10 The receivers will be mounted in the equipment rack with the antennae mounted externally from the rack and extended using 50 ohm coaxial cable.
- .11 Include a handheld cardioid dynamic microphone integrated into the transmitter.
- .12 Battery life to be a minimum of 8 hours with AA Lithium Alkaline batteries.
- .13 The wireless system must have a minimum of 100 channels available in their operating band, or more as required by the local operating environment.
- .14 Wireless systems used within the same building must have frequency blocks selected to be compatible.
- .15 Select clear frequencies on site based on RF site survey using wireless receiver.
- .16 Typical manufacturers are:
 - .1 Shure

Shure Band	
Band G50	(470 MHz – 534 MHz)

2.5 Gooseneck Microphone

- .1 Fixed microphones mounted on the lectern will be equipped with a flexible gooseneck.
- .2 The microphone will feature an outboard preamplifier.
- .3 The microphone will feature a cardioid condenser microphone capsule with a response of 80Hz to 20,000kHz with high pass filter engaged.
- .4 Minimum output impedance will be 150 ohms balanced, and it will have a minimum open circuit output sensitivity of 10mV/Pa.
- .5 The microphone will be usable with phantom power from 11 to 52V.
- .6 The microphone will have a matte black finish, and will be equipped with a windscreen.
- .7 Gooseneck microphones will be equipped with a fixed mounting to permanently mounted shockmount, removable microphones will not be acceptable.
- .8 Typical manufacturers are:
 - .1 Audio-Technica
 - .2 Shure
 - .3 Beyerdynamic
 - .4 Clock Audio
 - .5 AKG Harman

2.6 Ceiling Condenser Microphones

- .1 Microphones intended for ceiling mounting.
- .2 The microphone will feature a condenser microphone capsule with a response of 100Hz to 10kHz with high pass filter engaged along with all recommended manufacturer filters.
- .3 Minimum output impedance will be 150 ohms balanced, and it will have a minimum open circuit output sensitivity of 37mV/Pa.
- .4 The microphone will be usable with phantom power from 11 to 52V.
- .5 Typical manufacturers are:
 - .1 Audix
 - .2 Audio Technica
 - .3 Biamp
 - .4 Clear One
 - .5 Shure

2.7 Ceiling Tile Microphones

- .1 Microphones intended for mounting in rooms with ceiling tile ceilings.
- .2 The microphone will fit in 2'x2' ceiling tile grids and have a frequency response of 180Hz to 15 kHz with high pass filter engaged along with all recommended manufacturer filters.
- .3 The microphone will have a signal to noise ratio of 83 dB(A) and a minimum dynamic range of 82 dB(A).
- .4 The microphones will be powered via PoE.

- .5 The microphone audio output will be Digital Dante Network Audio.
- .6 Typical manufacturers are:
 - .1 Sennheiser
 - .2 Shure

2.8 Digital Audio Processor (Large Expandable)

- .1 DSP-based software configurable audio processor with a modular input and outputs, with a minimum capacity of 12 dual input or output modules, usable for inputs or outputs.
- .2 Compatible input modules with Acoustic Echo Cancelling must be available.
- .3 The DSP programming will not be limited by a fixed signal flow architecture, but fully configurable using a modular object interface.
- .4 Expandability will utilize an AVB or Dante backbone, allowing input and output expansion and shared DSP resources over an Ethernet network.
- .5 The mixer shall have a: frequency response within +/- 0.5dB between 20Hz-20kHz; signal-to-noise ratio of >80dB; output level of +24dB with less than 0.15%THD.
- .6 The unit will be configured through computer software, but a computer will not be required for operation.
- .7 The unit will be controllable through the AV control system via RS-232 or Ethernet.
- .8 Approved products are:
 - .1 Biamp Tesira

2.9 Digital Audio Processor (Small Expandable)

- .1 DSP-based software configurable audio processor with a fixed input and output configurations, with the option of local connections to other units over a proprietary expansion bus on short multiconductor cables or AVB.
- .2 The DSP programming will not be limited by a fixed signal flow architecture, but fully configurable using a modular object interface.
- .3 The mixer shall have a: frequency response within +/- 0.5dB between 20Hz-20kHz; signal-to-noise ratio of >80dB; output level of +24dB with less than 0.15%THD.
- .4 The unit will be configured through computer software, but a computer will not be required for operation.
- .5 The unit will be controllable through the AV control system via RS-232 or Ethernet.
- .6 Approved products are:
 - .1 Biamp Tesira Forte Series

2.10 Digital Audio Processor Fixed Application

- .1 DSP-based software configurable audio processor with a fixed input and output configurations.
- .2 The DSP programming may have a fixed signal flow architecture.

- .3 The mixer shall have a: frequency response within +/- 0.5dB between 20Hz-20kHz; signal-to-noise ratio of >80dB; output level of +24dB with less than 0.15%THD.
- .4 The unit will be configured through computer software, but a computer will not be required for operation.
- .5 The unit will be controllable through the AV control system via RS-232 or Ethernet.
- .6 Typical products are:
 - .1 Extron DMP series
 - .2 Extron MVC series
 - .3 Biamp Tesira
 - .4 Crestron Avia

2.11 USB Audio Mixer Fixed Application

- .1 The USB mixer shall have microphone and/or line level inputs with +48 volt phantom power, one USB 2.0 and one line level output
- .2 The USB mixer shall have a: frequency response within +/- 0.5dB between 20Hz-20kHz; signal-to-noise ratio of >80dB; output level of +24dB with less than 0.15%THD
- .3 The USB mixer input level and master volume level shall be manually adjustable control.
- .4 The USB mixer USB 2.0 output shall be Windows and Mac compatible.
- .5 Approved product manufacturers are Crestron and Art.

2.12 Power Amplifiers (70V)

- .6 Amplifiers for driving 70V ceiling loudspeakers or other distributed loudspeaker systems.
- .7 Amplifier power should be selected to have at least 2dB of headroom above the calculated load of loudspeaker taps plus insertion loss of speaker transformers, and should have a minimum of 30% more power than the sum total of all loudspeaker taps.
- .8 Amplifiers may have 70V output transformers, or may be a direct coupled constant voltage output. Amplifiers that use 70V transformers must include suitable high pass filtering to prevent output transformer saturation.
- .9 Amplifiers may be single channel or multi-channel, as best suits the particular needs of the project and the power density needed.
- .10 Amplifiers should have a minimum frequency response of 50Hz-15,000Hz including the output transformer.
- .11 Total Harmonic Distortion (THD) should be under 0.5% at full rated power including the output transformer.
- .12 Input connections by terminal strip, Phoenix connector, or XLR connector. ¼" TRS phone jacks are not acceptable.
- .13 Output connections by terminal strip, 5 way binding posts or Neutrik Speak-On.
- .14 Typical manufacturers are:
 - .1 Crestron
 - .2 Crown

- .3 TOA
- .4 Extron
- .5 QSC
- .6 Kramer

2.13 Power Amplifiers 50W and Up (Low Impedance)

- .1 Amplifiers for driving low impedance loudspeakers directly in medium to high power applications (50W or higher).
- .2 Amplifier power should be selected to have at least 3dB of headroom above the maximum expected power demands.
- .3 Amplifiers that are direct coupled low impedance output should have a minimum load impedance below 4 ohms and feature protection against short circuits and overheating.
- .4 Amplifiers may be single channel or multi-channel, as best suits the particular needs of the project and the power density needed.
- .5 Amplifiers should have a minimum frequency response of 50Hz-15,000Hz including the output transformer.
- .6 Total Harmonic Distortion (THD) should be under 0.5% at full rated power including the output transformer.
- .7 Input connections by terminal strip, Phoenix connector, or XLR connector. ¼" TRS phone jacks are not acceptable.
- .8 Output connections by terminal strip, 5 way binding posts or Neutrik Speak-On.
- .9 Typical manufacturers are:
 - .1 Crestron
 - .2 Crown
 - .3 Extron
 - .4 QSC
 - .5 Ashley
 - .6 Kramer

2.14 Power Amplifiers 2W – 50W (Low Impedance)

- .1 Amplifiers for driving low impedance loudspeakers directly in medium to high power applications (2W – 50W).
- .2 Amplifier power can be selected to match the maximum expected power demands.
- .3 Amplifiers that are direct coupled low impedance output should have a minimum load impedance below 4 ohms and feature protection against short circuits and overheating.
- .4 Amplifiers may be single channel or multi-channel, as best suits the particular needs of the project and the power density needed.
- .5 Amplifiers should have a minimum frequency response of 50Hz-15,000Hz including the output transformer.
- .6 Total Harmonic Distortion (THD) should be under 0.5% at full rated power including the output transformer.
- .7 Input connections by terminal strip, Phoenix connector, or XLR connector. ¼" TRS phone jacks are not acceptable.

- .8 Output connections by terminal strip, 5 way binding posts or Neutrik Speak-On.
- .9 Approved manufacturers are:
 - .1 Extron
 - .2 Crestron
 - .3 Stewart
 - .4 Kramer

2.15 Ceiling Loudspeakers for Learning space Speech Reinforcement Systems

- .1 Ceiling loudspeakers used in speech reinforcement systems must exhibit uniform 1/3 octave directivity from 1000Hz - 4000Hz with a nominal directivity index of 6 (+/- 4). The coverage pattern should never be narrower than 90 degree conical in that 1-4kHz bandwidth.
- .2 Speech reinforcement ceiling speakers should be concentric coaxial rather than "tweeter on a post" construction to meet the above directivity requirement.
- .3 Frequency response for ceiling speakers should be 90Hz to 18,000Hz +/- 3dB.
- .4 Ceiling speakers should include 70V transformers with a minimum of a 9dB range of taps. Wattage taps to be verified prior to install.
- .5 Ceiling speakers should have a minimum sensitivity of 85dB @ 1W @1 m.
- .6 Ceiling speakers must be seismically restrained in suspended ceilings.
- .7 Typical manufacturers are:
 - .1 Crestron
 - .2 Tannoy
 - .3 Community
 - .4 JBL
 - .5 Soundtube
 - .6 Kramer

2.16 Ceiling Loudspeakers for General Purpose Use

- .1 Ceiling loudspeakers used in general purpose paging systems must have a frequency response of 90Hz to 15,000Hz +/- 5dB.
- .2 Ceiling speakers should include 70V transformers with a minimum of a 12dB range of taps. Wattage taps to be verified prior to install
- .3 Ceiling speakers should have a minimum sensitivity of 85dB @ 1W @1 m.
- .4 Ceiling speakers must be seismically restrained in suspended ceilings.
- .5 Typical manufacturers are:
 - .1 [Community](#)
 - .2 [Tannoy](#)
 - .3 Crestron
 - .4 JBL
 - .5 Extron
 - .6 Kramer

2.17 AV Playback Loudspeakers for Small Learning spaces

- .1 AV playback speakers for use in learning spaces under 50 seats.

- .2 Playback speakers should be able to provide a sound level of 75dBA in the most distant seats in the classroom, and should have a wide enough coverage that all students can hear both stereo channels.
- .3 Loudspeakers should have a frequency response of 90Hz to 18,000Hz +/- 5dB.
- .4 Loudspeakers should have a minimum sensitivity of 85dB @ 1W @1 m.
- .5 Typical manufacturers are:
 - .1 Crestron
 - .2 JBL Control series
 - .3 Tannoy
 - .4 Kramer

2.18 AV Playback Loudspeakers for Large Learning spaces

- .1 AV playback speakers for use in learning spaces over 50 seats.
- .2 Loudspeakers for use in learning spaces and lecture theatres over 50 seats should be chosen based on the coverage uniformity results of a loudspeaker modelling package to provide performance as outlined in section 2.2
- .3 Playback speakers should be able to provide a sound level of 75dBA in the most distant seats in the learning spaces, and should have a wide enough coverage that all students can hear both stereo channels.
- .4 Loudspeakers should have a frequency response of 60Hz to 18,000Hz +/- 5dB.
- .5 Loudspeakers should have a minimum sensitivity of 85dB @ 1W @1 m.
- .6 Typical manufacturers are:
 - .1 Crestron
 - .2 Community
 - .3 JBL Pro
 - .4 Tannoy
 - .5 Bose
 - .6 TOA

3.0 EXECUTION

3.1 Mounting, Rigging and Seismic Restraint

- .1 Where the Sound Contractor uses loudspeaker enclosures or systems that are factory equipped with rigging or mounting points, the rigging or mounting hardware and the attachment to the building or support structure must be certified. Component mounting in the enclosures must make use of bolts and threaded inserts or locknuts. Self-threading wood or sheet metal screws are not acceptable for driver mounting to the baffle. Loudspeaker mounting clamps that grip the edge of the loudspeaker frame, and are put in compression by a through bolt are not acceptable. All loudspeakers must be mounted by bolts through mounting holes in the frame.
- .2 Loudspeaker components such as moulded fibreglass horns, cast or injection moulded plastic speaker enclosures or horns, etc. must never be supported by a system using the drilled or moulded holes through the plastic material. All mounting holes or attachment points must have aluminium or steel reinforcement to prevent breakaway or tear-out of the

material surrounding the holes.

- .3 All loudspeakers installed in acoustic ceiling tile grids must use appropriate tile bridge hardware, and be seismically restrained to building structure.

3.2 Wiring

- .1 Route microphone cables in separate conduit or raceways and maintain separation of all other cables in tray system and equipment racks by level and function: microphone circuits, line level circuits, foldback circuits, loudspeaker circuits, intercom circuits, video circuits, control circuits and 120 volt AC power circuits.
- .2 All connections using shielded pair audio cable should include cable dressing as follows.
 - .1 The shield, or drain wire should have a clear Teflon, or green PVC, or heatshrink sleeve covering exposed conductor between the connector, or termination and the cable jacket.
 - .2 A heat shrink boot, or Hellerman sleeve should be used on any cable that uses a braided shield or spiral wrap shield where the cable is dressed for termination.
- .3 All audio circuits, unless otherwise specified, shall be balanced, floating and shielded two wire circuits with the red or white wire hot (connected to pin 2 of XLR3 connectors and to the Tip of phone connectors) and the black wire cold (connected to pin 3 of XLR3 connectors and to the Ring of phone connectors).
- .4 Make input connections to power amplifiers with XLR3 connectors, or with spade lugs on barrier terminal strips, or Phoenix connectors. Do not make input connections with 1/4 inch phone plugs.
- .5 Use ring lugs or high current locking connectors, such as Neutrik Speakons for connections to enclosed loudspeaker systems.

3.3 Grounding and Shielding

- .1 Connect all racks containing sound system equipment to only the dedicated sound system ground point.
- .2 For microphone cables, provide continuous shield from microphone receptacle to microphone mixer input. Ground only at mixer.
- .3 Pin 1 on XLR type connectors must not be connected to the connector barrel or shell.

3.4 Testing

- .1 Conduct tests to demonstrate that the sound system is properly functional:
 - .1 After installation, measure and document the sum of the harmonic distortion, noise floor and gain for a typical path from microphone level input to amplifier output.
 - .2 Measure and document gain structure through the signal path from input to output for each typical signal level. Repeat with sine wave sweep from 50 Hz to 15kHz to record any additional adjustments required by equalization. Repeat with full bandwidth pink

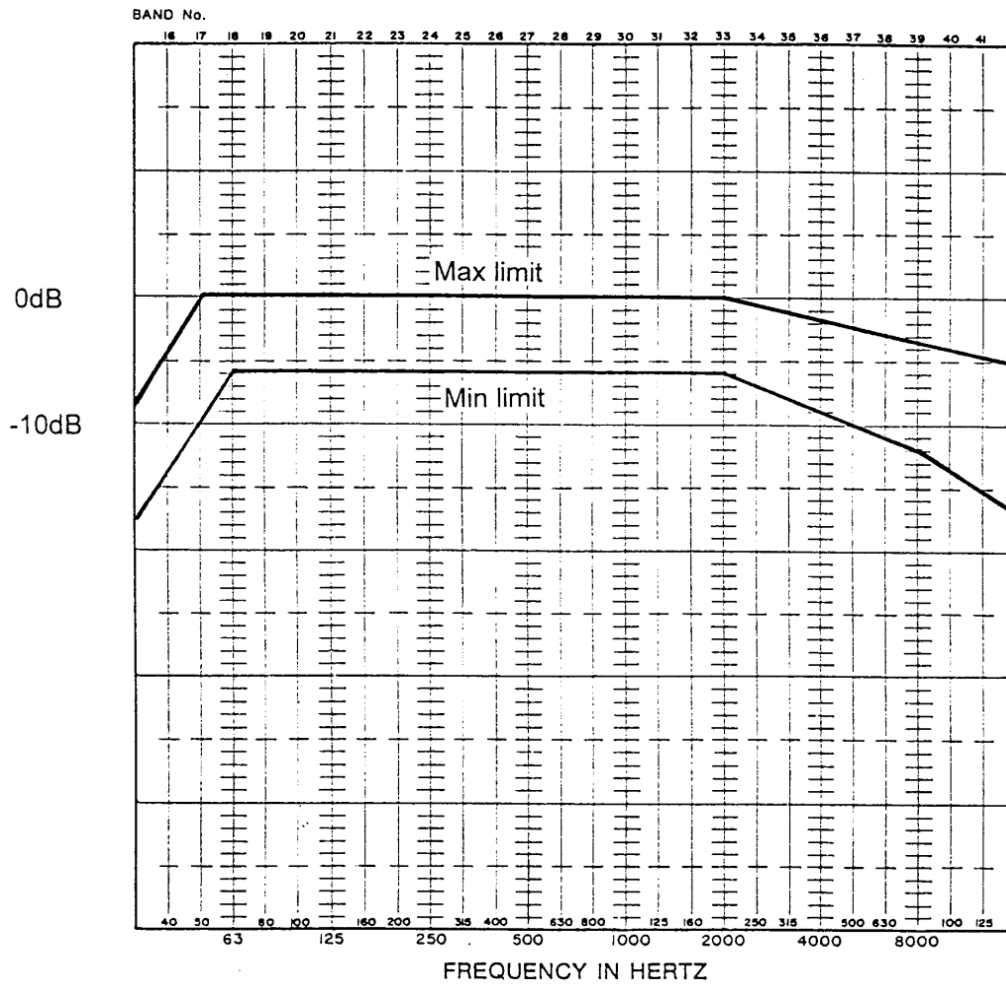
noise signal, or swept test signal to record equalizer wide-band gain.

- .3 Ensure that system is free of spurious oscillation and RF noise up to 5 MHz.
- .4 Test polarity of microphones, microphone cables, and signal wiring: pin 1 = shield, pin 2 = hot, pin 3 = cold. Test polarity of connector plate plugs and jacks: sleeve = shield, ring = cold, tip = hot. Test polarity of signal equipment and amplifiers. Test polarity of loudspeaker wiring: red = (+), black = (-). Drive all loudspeakers in polarity, and in absolute polarity. Test absolute polarity of the voice and playback systems, input to output, and ensure that the sum of all signal paths is in polarity. If it is necessary to invert signal polarity at any stage or interconnect point to preserve system polarity, document that polarity change on as-built drawings.
- .5 Measure uncorrected direct sound response of the loudspeakers at no less than three (3) positions representative of the middle and edges of the seating. Adjust equalization to shape house response. Measured response after equalization shall fall within the limits defined on Figure #1.
- .6 With pink noise input, record maximum sound pressure level after equalization.

3.5 Test Equipment

- .1 Provide the following audio test equipment on site during check-out where necessary to measure and document the system performance outlined in section 3.8:
 - .1 Time domain measurement system (**TEF** or JBL/EAW Smaart or EASERA) for setting of direct sound equalization.
 - .2 Sound level meter with linear response and 1/2 inch free field microphone.
 - .3 Audio test set with low distortion signal generator, true RMS meter, and facility to measure THD. (Audio Precision, Neutrik, HP, etc.)
 - .4 5 MHz oscilloscope.
 - .5 Pink noise generator.
 - .6 All cables, connectors and adaptors necessary to interface with the sound system.
- .2 Provide test equipment of professional quality and in good working order. Substandard equipment will be cause for rejection. The Owner, or their designated Consultant reserves the right to demand proof of equipment accuracy.

Figure # 1 Sound System Response Limits



*** END OF SECTION***

1.0 **GENERAL**

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 Design Criteria

- .1 All video outputs to display devices shall be digital outputs, with scaling capability provided either by the display device itself or by an external scaler located immediately prior to the display device input. The scalers must be able to maintain the original signal aspect ratio (4:3, 16:10 or 16:9), and should support HDTV and 4K resolutions (720P, 1080i, 1080P, Ultra HD, 4K DCI).
- .2 All digital video sink equipment will be HDCP compliant, communicate EDID status and accept signals with a minimum bit depth of 24bits at a resolution of 1920 x1080 pixels @60Hz or 1080P. Equipment that is not HDCP compliant, such as a video conferencing codec or lecture capture recorder, shall be reviewed with UBC IT Audio Visual for approval.
- .3 Video switching infrastructure will be required to support TMDS digital inputs (DVI-D/HDMI) with minimum resolution of 4K. The digital signal input, switching and distribution system must be HDCP compliant (minimum of HDCP2.2).
- .4 Video projection systems must be designed to deliver a minimum of 60 Lumens/sq.ft in typical learning spaces with multiple zone lighting and typical blind systems. In very large lecture theatres with screens over 14m² image areas, and complete ambient lighting control to a full blackout, special project by project allowances may be considered to reduce that requirement to balance projector cost versus performance.
- .5 The following table provides a guide for selecting a laser projector brightness in lumens by typical screen size. As per ANSI/INFOCOMM 3M-2011, the contrast ratio is minimum 15:1 for classroom content and a constant light output percentage of 80%. The ambient light Lux values are the approximate sunlight and artificial light shining on the projection surface. These brightness values are suggestions for high-level discussions and design – the AV designer shall validate brightness requirements for each application.

Image Size			Projector Lumens by Ambient Light					
			Good 0 – 50 Lux		Better 51 – 65 Lux		Best > 65 Lux	
Height	Width	Diagonal	Lm	Lm/Ft ²	Lm	Lm/Ft ²	Lm	Lm/Ft ²
50"	80"	94"	5,000	144.0	5,000	144.0	5,000	144.0
57.5"	92"	109"	5,000	108.9	5,000	108.9	5,000	108.9
60"	96"	113"	5,000	100.0	5,000	100.0	5,500	110.0
65"	104"	123"	5,000	85.2	5,000	85.2	6,500	110.8
69"	110"	130"	5,000	75.9	5,500	83.5	7,000	106.2
72.5"	116"	137"	5,000	68.5	6,500	89.0	9,000	123.3
87"	139"	164"	7,000	66.7	9,000	85.7	12,000	114.3
100"	160"	189"	9,000	64.8	12,000	86.4	15,000	108.0
110"	176"	208"	10,000	59.5	15,000	89.3	20,000	119.0
117.5"	188"	222"	12,000	62.6	15,000	78.2	20,000	104.3

- .6 Video projectors must be mounted to minimize risk of vibration or shake, either initiated by mechanical systems or from wall movement caused by doors closing or people walking on the floors above the projector mounts. Structural rigidity should be raised with project structural engineer, especially where lightweight construction methods are being employed.
- .7 Projectors and displays will be equipped with 4-digit combination padlocks, and anti-theft fittings and hardware.
- .8 Projection booth glazing and projection ports must have glass with anti-reflective coating on both sides. Use angled glass to prevent a reflected image from being sent back into the projector lens. A seven degree outward tilt from the perpendicular plane of the projector is recommended.

2.2 Video Source Equipment

.1 Robotic Video Camera

- .1 Where robotic PTZ cameras are used in classrooms for lecture capture, overflow connectivity, or remote audiences the cameras will have HD resolution to 1080P, and the output will be available on a suitable TMDS connector (HDMI/DVI-D).
- .2 The units should use a VISCA RS-232/RS-485 or Ethernet control protocol and should feature at least 6 internal presets that include PTZ settings and focus.
- .3 The units should feature an adequately large optical zoom range so that the widest to narrowest shots required can be achieved without using digital zoom.
- .4 The cameras should be usable when mounted upright or inverted.
- .5 Approved manufacturers are:
 - .1 Panasonic
 - .2 Sony
 - .3 Vaddio
 - .4 Clearone
 - .5 AVer

.2 Robotic Tracking Video Camera

- .1 Where robotic tracking PTZ cameras are used in classrooms for lecture capture, overflow connectivity, or remote audiences the cameras will have HD resolution to 1080P, and the output will be available on a suitable TMDS connector (HDMI/USB/RJ-45).
- .2 The units should use a VISCA RS-232/RS-485 or Ethernet control protocol and should feature at least 6 internal presets that include PTZ settings and focus.
- .3 The units should feature an adequately large optical zoom range so that the widest to narrowest shots required can be achieved without using digital zoom.
- .4 The cameras should be usable when mounted upright or inverted.
- .5 The cameras should have multiple tracking modes including People Tracking, Zone Tracking, Voice tracking and Hybrid mode that switches between People & Zone tracking modes.

- .6 Approved manufacturer is Aver.

.3 Document Camera

- .1 Table top mounted document cameras will have a collapsible camera arm and will have integrated top lighting for the object table.
- .2 Document cameras will have a minimum resolution capability of 1280x720 on [HDBaseT](#) or HDMI outputs. The output signal should not be HDCP protected.
- .3 The document camera must include secure table top mounting brackets to reduce risk of theft.
- .4 Approved manufacturers are:
 - .1 Elmo
 - .2 Epson (additional UBCO option)

.4 Computer Inputs

- .1 Input panels mounted on walls, in racks, in lectern troughs, in meeting room tables and any other location must use industry standard Extron modular input plates, in either MAAP or AAP format.
- .2 Digital inputs will use panel mounted HDMI connectors, mounted face up or at 90 degrees, and in such a fashion as to relieve stress on HDMI connector when the cable is inserted.
- .3 HDMI inputs must include highly flexible connection cables between plates and laptops. Overly rigid, thick, or otherwise difficult to manage cable types will be rejected.
- .4 Laptop cables must include a strain relief and a cable locking system to keep cables attached to AV input plates. When input plates are wall mounted, wall mounted J-hooks will be installed for cable storage. These hooks are to be mounted securely, adjacent the input plate, at a distance of approximately 18" apart. Hooks should be mounted at a comfortable height that is easily accessible, and in such a way that cable loops do not drape over/impede access to either the AV input plate, or nearby power or data outlets.

.5 Wireless Presentation Gateway

- .1 The presentation gateway shall provide Ethernet to HDMI conversion of audio and video signals. Portable devices shall be able to connect to the gateway through the local Wi-Fi network.
- .2 The presentation gateway shall support up to ten (10) user connections.
- .3 The presentation gateway shall support the following operating systems:
 - .1 Windows 10
 - .2 Mac OS X (v10.10 or higher)
 - .3 Apple iOS
 - .4 Android
- .4 The presentation gateway shall support Apple AirPlay mirroring.

- .5 The presentation gateway shall support USB web conferencing peripherals such as soundbars, & cameras. USB connection to be USB2.0 type A or USB3.0 type A. Must be compatible with Microsoft Teams and Zoom software.
- .6 Video Output Resolution, 1280x720@60Hz (720p60), 1280x800@60Hz, 1280x1024@60Hz, 1366x768@60Hz, 1440x900@60Hz, 1600x1200@60Hz, 1600x900@60Hz, 1680x1050@60Hz, 1920x1080@60Hz (1080p60), 3840x2160@30Hz (2160p30), 3840x2160@60Hz (2160p60).
- .7 Audio Standards:
 - .1 PCM 2-channel
- .8 Audio/Video Connector:
 - .1 One (1) female 19-pin Type A HDMI
 - .2 One (1) HD15 female
 - .3 One (1) 3.5 mm TRS mini phone jack
- .9 Network Interface:
 - .1 One (1) LAN/Ethernet, RJ-45, 10/100/1000 Mbit
- .10 Power supply:
 - .1 Local DC power source.
- .11 Mounting:
 - .1 Freestanding.
 - .2 Surface mount.
 - .3 Built-in to DigitalMedia Presentation System.
- .12 Product shall be the following or Approved Equal:
 - .1 Crestron AM-3200
 - .2 Crestron DMPS3-4K-250-C
 - .3 Crestron DMPS3-4K-350-C

2.3 Networked Audio-Video over IP Switching and Distribution Equipment

.1 Basic Function

- .1 The system shall be able to facilitate audio and video distribution over a standard 1 gigabit network. The system components shall include support for real-time signal up to 4K60.
- .2 The system shall be composed of endpoints (hardware encoders and decoders) and network switches.
- .3 The system shall be capable of supporting an unlimited number of endpoints.
- .4 The maximum bandwidth requirement per endpoint stream shall be 1 gigabit.

.2 Transmission

- .1 1 gigabit transmission of video over Ethernet with support for resolutions up to 4K60.
- .2 The endpoints shall support automatic bit rate adjustment set by the resolution of the stream.

.3 Network Requirements

- .1 The system shall operate on Category 5e or better infrastructure.
- .2 The system shall utilize standard 1 gigabit Ethernet.
- .3 The system shall support unicast or multicast traffic to distribute streams across a network.
- .4 The system shall not require proprietary network management software or hardware, Ethernet switches or network protocol.
- .5 All switches must be non-blocking and configured in such a way to meet all AV-over-IP protocol requirements including but not limited to IGMP, Multicast, PIM-SM and QoS.
- .6 Approved Audio-Video over IP switches are Cisco and Netgear.

.4 System Integration

- .1 The system shall support integration with a single software management platform to provide complete system monitoring, management and control.
- .2 The management platform shall support the following functions:
 - .1 Automatic device configuration including firmware updates, security patches, and device settings
 - .2 Manage feature licences

.5 Audio-Video over IP Endpoints

- .1 Endpoints shall allow encoding or decoding of up to 4K60 video signal and stereo audio signal.
- .2 Endpoints shall require a maximum bandwidth of 1 gigabit.
- .3 Endpoints shall support web-based control and management.
- .4 Endpoints shall have the following video features:
 - .1 One (1) HDMI video connection
- .5 Endpoints shall have the following audio features:
 - .1 Two-channel Dante network audio, Two-channel AES67 network audio or two-channel balanced analog audio
- .6 Endpoints shall have the following control features:
 - .1 One (1) 1000-BASE-T Ethernet port for stream connection
 - .2 One (1) 100-BASE-T or faster Ethernet port or one (1) RS-232 port for device control
- .7 Endpoints shall support local or remote DC power source and PoE+ via network switch or power injector.

- .8 Approved manufacturers are:
 - .1 Crestron NVX, Kramer KDS-7 Series, and Atlona Omnistream

2.4 Point-to-Point Video Switching and Distribution Equipment

.1 Fiber Optic HDMI Extender Transmitter

- .1 Fiber optic HDMI input extenders will have at least one HDMI input connector, an HDMI loop thru connector for a local display, a stereo audio input, and a set of multi-mode fiber output connectors. Must be at least HDMI 2.0 compatible.
- .2 The unit must be HDCP 2.2 compliant and have the option for EDID management or emulation at the transmitter.
- .3 Crestron fiber optic distribution does not support 4K resolution. Fiber optic video distribution shall only be implemented when transmission distance is more than 100m or integrating with an existing fiber optic system, and 4K resolution is not an essential system requirement.
- .4 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series
 - .3 Kramer Ultra-Reach

.2 Fiber Optic HDMI Extender Receiver

- .1 Fiber optic HDMI output extenders will have at least one HDMI output connector, a stereo audio output, and a set of multi-mode fiber input connectors. Must be at least HDMI 2.0 compatible.
- .2 The unit must be HDCP 2.2 compliant and have the option for HDCP key management.
- .3 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series
 - .3 Kramer Ultra-Reach

.3 Fiber Optic HDMI Extender Scaler Receiver

- .1 Fiber optic HDMI output extenders will have at least one HDMI output connector, a stereo audio output, and a set of multi-mode fiber input connectors. Must be at least HDMI 2.0 compatible.
- .2 The unit must be HDCP 2.2 compliant and have the option for HDCP key management.
- .3 The receiver will have a built in scaler to allow resolutions of different display devices to be matched to the system resolution. The scaler must provide an option to maintain the original source aspect ratio.
- .4 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series

.4 Fiber Optic Digital Video Matrix Switcher

- .1 Fiber optic digital video switcher will accept multi-mode fiber inputs and provide multi-mode fiber outputs. Matrix sizing will depend on system complexity, and should be sized to allow for future expansion.
- .2 The unit will switch TMDS video signals and be HDCP compliant.
- .3 The switcher frame will include power supplies and necessary fiber input and output cards.
- .4 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series

.5 Hybrid Digital Video Matrix Switcher

- .1 Hybrid switchers may combine fiber optic digital video multi-mode fiber inputs and provide multi-mode fiber outputs with copper Shielded Twisted Pair digital video inputs and outputs in the same chassis. Matrix sizing will depend on system complexity, and should be sized to allow for future expansion.
- .2 The unit will switch TDMS video signals and will be HDCP compliant.
- .3 The switcher frame will include power supplies and necessary fiber or copper input and output cards.
- .4 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series

.6 Copper Shielded Twisted Pair Digital Video Matrix Switcher

- .1 Switchers using STP copper digital video inputs and outputs. Matrix sizing will depend on system complexity, typically 8x8 to 32x32.
- .2 The unit will switch TDMS video signals and will be HDCP compliant.
- .3 The switcher frame will include power supplies and necessary fiber or copper input and output cards.
- .4 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series

.7 UTP HDMI Extender Transmitter

- .1 UTP HDMI input extenders will have at least one HDMI input connector, an HDMI loop thru connector for a local display, a stereo audio input, and UTP output connectors. Must be at least HDMI 2.0 compatible.
- .2 The unit must be HDCP 2.2 compliant and have the option for EDID management or emulation at the transmitter.

- .3 The extender transmitter will require only one UTP cable, and must support signal transmission over distances of up to 100 meters.
- .4 The extender transmitter must support a minimum resolution of 4k at 60hz
- .5 Approved manufacturers are:
 - .1 Crestron Digital Media
 - .2 Extron
 - .3 Kramer

.8 UTP HDMI Extender Receiver

- .1 UTP HDMI output extenders will have at least one HDMI output connector, a stereo audio output, and a UTP input connectors. Must be at least HDMI 2.0 compatible.
- .2 The unit must be HDCP 2.2 compliant and have the option for HDCP key management.
- .3 The extender receiver will require only one UTP cable, and must support signal transmission over distances of up to 100 meters.
- .4 The extender receiver must support a minimum resolution of 4k at 60hz.
- .5 Approved manufacturers are:
 - .1 Crestron Digital Media
 - .2 Extron
 - .3 Kramer

2.5 Laser Projectors

- .1 The projector must have at least one (1) HDCP compliant digital input, preferably HDMI 2.0. Displays should be specified with adequate input counts for the application.
- .2 The projector must have at least one (1) HDMI input, one (1) HDBaseT input, [one \(1\) LAN control port](#) and one (1) RS-232 port.
- .3 The projector must have a minimum of 1920 x 1200 native resolution, and support all HDTV resolutions plus standard computer resolutions.
- .4 DLP based projectors are preferred, but LCD and other technologies will be considered, as long as they are field serviceable by UBC.
- .5 The projectors light source shall be laser diode with an expected half luminance life of 10,000 hours when running in normal mode. The projector shall be minimum 5,000 ANSI lumens.
- .6 The projectors will have the ability to have custom UBC logo start-up/no-signal screens loaded by users in the field.
- .7 The projectors will have interchangeable lens, and be equipped with horizontal and vertical lens shift as required.
- .8 The projectors used in learning spaces must have a noise level of less than 35dBA.
- .9 The projectors must be controllable via 3rd party control systems using RS-232, Ethernet or HDBaseT. Crestron Connected products are preferred.

- .10 The projectors must have a minimum of a 3 year warranty.
- .11 Approved manufacturers:
 - .1 Panasonic
 - .2 Sony

2.6 Flat Panel Displays

- .1 The flat panel displays must have at least the following:
 - .1 One (1) HDCP compliant digital input, preferably HDMI 2.0.
 - .2 One (1) variable audio output.
- .2 Displays should be specified with adequate input counts for the application.
- .3 The digital inputs must be HDCP compliant
- .4 The flat panel displays must have a minimum of 1920 x 1080 native resolution, and support all HDTV resolutions plus standard computer resolutions.
- .5 The display brightness should be a minimum of 400 Nits at full white.
- .6 The displays should be LED array backlit LCD display
- .7 The display must be controllable via 3rd party control systems, such as Crestron. Crestron Connected products are preferred. RS-232 or Ethernet is accepted as a control interface.
- .8 Professional displays must have a minimum of a 3 year warranty, and consumer or prosumer displays must have a minimum of 1 year warranty.
- .9 Typical manufacturers are:
 - .1 Panasonic
 - .2 Sharp
 - .3 NEC
 - .4 LG
 - .5 Sony

2.7 Manual Projection Screens

- .1 Manual projection screens should only be used for screen widths less than 96" or 2450mm wide.
- .2 Manual screens of any size must have a controlled spring return option included.
- .3 Manual screens must have a matte white fibreglass screen with a black backside.
- .4 For screen sizing calculations refer to the UBC Classroom Design Guidelines.
- .5 Typical manufacturers are:
 - .1 Da-Lite

2.8 Motorized Projection Screens

- .1 Motorized projection screens must be used for screen widths over 96" or 2450mm wide.

- .2 Motorized screens that will be integrated into an AV system with a control system must include LV control, integrated with a standard electrical plug. In the case of very large screens that do not allow this option, a power disconnect switch must be installed between the LVC and building power.
- .3 Motorized screens must have a matte white fibreglass screen with a black backside.
- .4 Screens that are recessed within a finished ceiling must include appropriate trim kit or recessed housing, to allow servicing and replacement from below, without a requirement to modify or damage ceiling.
- .5 For screen sizing calculations refer to the UBC Classroom Design Guidelines.
- .6 Typical manufacturers are:
 - .1 Da-Lite

2.9 Soft Codec Endpoints

- .1 The Soft Codec Endpoint PC shall be a Windows 11 based PC with minimum two Digital Video (HDMI/DP/USB-C) outputs, two USB-A 2.0, two USB-A 3.0, 3.5mm audio jack and one network port
- .2 The Soft Codec Endpoint PC shall have as a minimum spec Intel Core i5-14500T Processor, Windows 11 Pro 64, 8 GB RAM, 256 GB SSD Hard drive, Integrated Graphic Card and Integrated Gigabit Ethernet Port
- .3 The Soft Codec Endpoint PC shall be compatible with Microsoft Teams and Zoom conferencing software and capable of either single or dual screen conferencing
- .4 Approved product is Lenovo Thinkcentre Tiny (Intel) Desktop

2.10 Interactive Display System

- .1 The interactive display must have at least one (1) HDCP compliant digital input, preferably HDMI 2.0. Display should be specified with adequate input counts for the application.
- .2 The interactive display must have a minimum of 1920 x 1080 native resolution, and support all HDTV resolutions plus standard computer resolutions.
- .3 The interactive display should have an average brightness of 300 cd/m2.
- .4 The interactive display should be LED array backlit LCD display.
- .5 The interactive display system shall have 10-point capacitive multi-touch.
- .6 The writing surface shall have fingerprint and scratch resistance.
- .7 The interactive display must be controllable via 3rd party control systems using Ethernet or RS-232.
- .8 The interactive display must have a minimum of a 3-year warranty.
- .9 The interactive display size shall be minimum of 65" diagonal.
- .10 The interactive display shall be mounted using an appropriate wall mount tilt bracket or motorized mount if size makes top edge unreachable for user. The product manufacturer for the mount shall be Chief, LOFT or Jiro Pro-Lift.

- .11 Product shall be [ViewSonic IFP](#), LOFT D3xx or Approved Equal.

3.0 **EXECUTION**

3.1 **Wiring**

- .1 Isolate all BNC video connectors from building ground on all panels, plates and bulkheads.
- .2 Install video cable in a manner that will prevent sharp bends or kinks. Use right angle BNC connectors where necessary to prevent cable kinking in shallow electrical boxes.

3.2 **Test Equipment**

- .1 Provide video test equipment on site during check-out where necessary to measure and document the system performance outlined in section 3.8:
 - .1 800 MHz oscilloscope
 - .2 Video test generator with digital video signal resolutions up to 1920x1200 pixels, as well as 720P and 1080P HDTV signals
- .2 Provide the following fiber optics test equipment on site during check-out where necessary to measure and document the system performance outlined in section 3.8:
 - .1 Optical meter, optical sources, two test jumpers & adapters, for 850nm & 1310nm multimode & single mode fiber optical systems testing
 - .2 Optical Time Domain reflectometer (OTDR) and test fiber box for 850nm & 1310nm multimode & single mode fiber optical systems testing
 - .3 Fiber termination microscope
- .3 Provide test equipment of professional quality and in good working order. Substandard equipment will be cause for rejection. The Owner, or their designated Consultant reserves the right to demand proof of equipment accuracy.

END OF SECTION

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 [UBC Learning Space Design Guidelines](#)
- .2 UBC Technical Guidelines Interior Building Lighting Section 26 51 00

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **General**

- .1 UBC IT Audio Visual has trained Crestron programmers on staff to manage and maintain the learning space AV control systems. All control systems must be Crestron to allow internal support and maintenance
- .2 UBC IT Audio Visual has a campus wide learning space AV monitoring desk. All control systems must be connected to the building network and must be remotely accessible from the monitoring desk.
- .3 UBC IT Audio Visual has standardized GUI style guides and examples for standard touch panels that will be provided to the Crestron programmer. These standards and templates will form the basis of most projects, however any additional graphical elements or alternate GUI types required for unique situations will be considered within the control system programming scope of work. In cases where faculties provide their own GUI spec, the faculty GUI spec will be implemented in place of the UBC IT AV GUI standard.
- .4 UBC IT Audio Visual has a comprehensive Crestron programming guideline that indicates how systems operate, and how features are to be implemented in programming. These must be followed for any control system.
- .5 UBC IT Audio Visual will coordinate all UBC network configuration and IP address assignment for all control systems. Non-UBC network configurations will be coordinated with faculty network staff, or directly with third party network owners.
- .6 UBC IT Audio Visual employs a team of dedicated in house AV control system programmers, and wherever feasible the utilization of these internal UBC resources for AV control system programming functions is preferred.
- .7 Prior to final acceptance, UBC IT Audio Visual shall be consulted and have the opportunity to comment as well as perform quality control testing on any and all control system programming and user interfaces implemented at UBC.
- .8 The UBC Point Grey campus implements the following virtual local area networks (VLANs) for audio-video systems:
 - .1 AV Control (trunkable on network switch)
 - .2 Video Conferencing (trunkable network switch)
 - .3 Media Capture (trunkable network switch)
 - .4 Room PC (requires dedicated data port)
 - .5 Digital Signage (requires dedicated data port)
- .9 The UBC Okanagan campus implements the following VLANs for audio-video systems:

- .1 AV Control (requires dedicated data port, per-building subnets)
- .2 Video Conferencing (requires dedicated data port)
- .3 Room PC (requires dedicated data port)
- .4 Digital Signage (requires dedicated data port)

2.2 Intellectual Property

- .1 It is understood that the machine language or high level programming language will remain the property of the particular audio, video or control system product manufacturer, and the University of British Columbia will have the use and benefit of this hardware/software for as long as they own this equipment.
- .2 The University of British Columbia will become the outright owner of all value-added intellectual property in the form of all audio, video or control system programming (including objects, modules and macros) to adapt and configure the equipment for the specific functions and performance required by this specification, whether performed by the Audio-Visual Contractor or the product manufacturer. No password protection or other locking mechanism is permitted for all control code, modules, or macros. Supply one copy of the compiled and uncompiled source code for all the audio, video and control system value-added programming. All subsequent revisions of control code must be provided under the same guidelines as described above. Any raw graphics, custom themes, and other graphical elements implemented within the control system shall be provided, under the same stipulations as above.

2.3 Control System Processor

- .1 Each control processor will have suitable control ports and connections for the scale of the project or ethernet control field devices.
- .2 Every control processor will have Ethernet connectivity for connection to campus AV control LAN. Rooms implemented off campus will be evaluated on a room by room basis considering available infrastructure.
- .3 Include Cresnet Distribution Blocks as required to avoid stacking Cresnet cables in terminal blocks.
- .4 Virtual Control Processor shall have the following features:
 - .1 Server-based control platform for enterprise applications that can be used in place of hardware-based Crestron control systems. The platform runs programs to control multiple rooms over the network from a single, centralized location.
 - .2 Access to XiO Cloud to validate its licenses.
 - .3 Network connected devices to be controlled and integrated into a pre-programmed system.
 - .4 Single server shall be capable of controlling up to 500 rooms.
 - .5 Software shall run on the following platforms:
 - .1 Red Hat Enterprise Linux 8.2 software (64-bit version) or greater;
 - .2 AlmaLinux OS 8.2 software (64-bit version) or greater;
 - .3 Rocky Linux OS 8.2 software (64-bit version) or greater.

- .5 The control software shall support the following programming languages:
 - .1 C#
 - .2 SIMPL
 - .3 SIMPL#PRO
- .6 All control processors shall be minimum 4-series.
- .7 Approved manufacturer is:
 - .1 Crestron

2.4 Touchscreen Panel

- .1 All wired touch screen shall be 10" diagonal in size, colour display, installed [with](#) locking system or suitable cable lock restraint. [Minimum](#) 15" diagonal size touch screens shall be provided for Collaboration Labs. 7" diagonal size touch screens can be used for basic AV systems with approval from UBC IT Audio Visual.
- .2 The unit will have video preview capability, either via dedicated video input or via H.264 streaming [when used in conjunction with HDMI output type pan-tilt-zoom camera controls](#).
- .3 Provide all required video interface hardware when required.
- .4 Provide Ethernet interconnection between the touch panel and control central processor and suitable power supply or PoE Injector as conditions require.
- .5 Provide programming to implement the touch panel layouts in the UBC Touch panel programming guidelines or applicable faculty GUI requirements.
- .6 Approved manufacturers are:
 - .1 Crestron
 - .2 [Neat](#)
 - .3 ELO touchscreen with embedded windows running executable GUI
 - .4 ELO touchscreen with Crestron DGE graphics engine

2.5 Integrated Button Control Processor

- .1 Small room wall mount applications typically use wired button panel with integrated control processor for RS-232 or Ethernet control of single display device (and motorized screen where needed).
- .2 Provide Ethernet interconnection to the button panel control central processor and suitable power supply as conditions require.
- .3 Provide programming to implement the functions in the UBC programming guidelines.
- .4 All control processors shall be 3-series or higher.
- .5 Approved manufacturers for UBC Point Grey are:
 - .1 Crestron
 - .2 AMX
 - .3 Biamp
- .6 Approved manufacturers for UBC Okanagan are:
 - .1 Crestron

2.6 Remote Button Control Panel

- .1 Wired button panels without integrated control processors may be paired with a separate control processor, to act as either a primary or secondary control interface.
- .2 Provide wired interconnection to the central processor and suitable power supply as conditions require.
- .3 Provide programming to implement the functions in the UBC programming guidelines.
- .4 Approved manufacturers are:
 - .1 Crestron

2.7 Wireless Tablet Control Panel

- .1 Wireless tablet control panels may be paired with a separate control processor, to act as either a primary or secondary control interface.
- .2 Wireless tablet must be configurable to operate on UBC wireless network, including password authentication.
- .3 Wireless tablet control must be configured to run current xPnael. 3rd party apps are not permitted.
- .4 Provide programming to implement the functions in the UBC programming guidelines.
- .5 Provide compatible docking station for storage and charged, in either wall mounted or table top mounted form.
- .6 Approved manufacturers are:
 - .1 Microsoft Surface

2.8 Low-Voltage Projection Screen Controls

- .1 Where LV projection screen controls are included in a project, include connections between AV control system LV control and the screen LV controls so that the screens may be operated from wall mounted screen button panel or the AV control system.

2.9 AVB/Dante/AV-Over-IP Network Switch

- .1 The network switch shall provide 1000 Mbps ports for high-speed network connectivity.
- .2 The network switch shall provide 10 Gbps ports where interconnecting network switches.
- .3 The network switch shall automatically identify and determine the correct transmission speed and duplex mode of the attached devices.
- .4 The network switch shall be managed providing non-blocking switch fabric and wire-speed throughput with minimum of 56 Gbps.
- .5 The network switch shall support IEEE AVB standards to enable reliable real-time audio-video transmissions over Ethernet.

- .6 The network switch will remain isolated from all other networks unless required to connect to an additional audio switch in support of the system design.
- .7 Product shall be Biamp TesiraConnect or Netgear M4250 Series.

2.10 Network Switch

- .1 The network switch shall provide 10/100/1000 Mbps ports for high-speed network connectivity.
- .2 The network switch shall be fully managed with layer 2 and layer 3 features.
- .3 The network switch shall have per-port broadcast, multicast and unicast storm control, and VLAN trunking protocol.
- .4 The network switch shall automatically identify and determine the correct transmission speed and duplex mode of the attached devices.
- .5 The network switch shall have Power-over-Ethernet 802.3at (PoE+) support.
- .6 The network switch shall be connected and configured to use the last port for the trunk.
- .7 The network switch shall have one (1) unused port configured to the AV Control VLAN used by the service team to connect a field laptop for troubleshooting the AV system.
- .8 Product shall be Cisco, or Approved Equal.

2.11 Ethernet Control Field Devices

- .1 The ethernet control field device shall provide RS-232, relay closures or IR to control devices.
- .2 The ethernet control field device shall be used for the following applications:
 - .1 Systems need to be expanded or upgraded with minimal cost or infrastructure coordination.
 - .2 Dedicated control device requires additional functionality.
 - .3 Infrastructure and/or space constraints necessitate deploying a networked device with a single cable.
 - .4 Control processor does not have built-in control ports.
- .3 Approved Manufacturers are Crestron and Global Cache

END OF SECTION

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 [UBC Learning Space Design Guidelines](#)

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **General**

- .1 All materials, equipment, devices, components, wire and cable provided under this contract shall be new CSA approved and listed with ULC as required by AHJ.
- .2 Contractor shall provide secondary seismic restraint for devices, and racks as required by code and as directed by Consultant.

2.2 **Lectern Rack**

- .1 The lectern rack shall be slide-out rotating type.
- .2 The rack shall provide front and rear access using minimal floor space.
- .3 The rack shall have the following minimum characteristics:
 - .1 EIA compliant 19-inch panel width
 - .2 14 useable rack spaces (14U)
 - .3 19-1/4" useable depth
 - .4 250 lb. weight capacity
 - .5 Front and rear rack rails:
 - .1 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing.
 - .2 Black coated finished
 - .3 Rack spaces marked
 - .6 Cooling fan for active ventilation
 - .7 Provide all rack accessories as required for a complete racking solution.
- .4 Product shall be Middle Atlantic SRSR series or Approved Alternative.

2.3 **Half Height Wall Mounted Rack**

- .1 The pivoting rack enclosure shall be a wall mount type.
- .2 The rack shall have the following minimum characteristics:
 - .1 EIA compliant 19-inch panel width
 - .2 Useable rack spaces shall be sized to ensure adequate spacing between devices and air flow for ventilation
 - .3 Useable depth shall be sized to allow adequate space behind the devices for cabling and connectors
 - .4 Minimum weight capacity of 200 lbs
 - .5 *Front and rear* rack rails:
 - .1 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing.

- .2 Black coated finished
 - .3 Rack spaces marked
- .6 Cooling fans for active ventilation as required
- .3 Provide all rack accessories as required for a complete racking solution.
- .4 Product shall be Middle Atlantic DWR series or Approved Alternative.

2.4 Low-Profile Wall Mounted Rack

- .1 The low-profile vertical rack enclosure shall be a wall mount type.
- .2 The rack shall have the following minimum characteristics:
 - .1 EIA compliant 19-inch panel width
 - .2 Useable rack spaces shall be sized to ensure adequate spacing between devices and air flow for ventilation.
 - .3 Useable depth shall be sized to allow adequate space behind the devices for cabling and connectors.
 - .4 Minimum weight capacity of 150 lbs
 - .5 Rack rail: 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing.
 - .6 Cooling fans for active ventilation as required.
 - .7 Lockable front door for access to front and back of equipment.
- .3 Provide all rack accessories as required for a complete racking solution.
- .4 Product shall be Tripp-Lite SRWF series or Approved Alternative.

2.5 Full Height Wall Mounted Rack

- .1 The pivoting rack enclosure shall be a wall mount type.
- .2 The rack shall have the following minimum characteristics:
 - .1 EIA compliant 19-inch panel width
 - .2 Useable rack spaces shall be sized to ensure adequate spacing between devices and air flow for ventilation
 - .3 Useable depth shall be sized to allow adequate space behind the devices for cabling and connectors
 - .4 Minimum weight capacity of 500 lbs
 - .5 Rack rail:
 - .1 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing.
 - .2 Black coated finished
 - .3 Rack spaces marked
 - .6 Cooling fans for active ventilation as required
- .3 Provide all rack accessories as required for a complete racking solution.
- .4 Product shall be Middle Atlantic SR series or Approved Alternative.

2.6 Cabinet/Credenza

- .1 The audio visual cabinet or credenza shall be free-standing on casters.

- .2 The cabinet or credenza shall be functionally and aesthetically incorporated into spaces while maintaining proper ventilation, sound isolation, and serviceability.
- .3 The cabinet or credenza shall have the following features:
 - .1 EIA compliant, threaded rack rails, 10-32 screws
 - .2 Front door with ability to lock
 - .3 Rear access panel or door
 - .4 Useable rack spaces shall be sized to ensure adequate spacing between devices and air flow for ventilation
 - .5 Useable depth shall be sized to allow adequate space behind the devices for cabling and connectors
 - .6 Variety of finish options to suit application
 - .7 Cooling fans for active ventilation as required
- .4 Provide all rack accessories as required for a complete racking solution.
- .5 Product shall be one of the following manufacturers:
 - .1 Middle Atlantic
 - .2 AVFI

2.7 Rack Accessories

- .1 All racks shall have blank plates, vent plates, shelves, drawers and all accessories as required for a complete racking solution.
- .2 Fine perforation security covers shall be installed for all equipment not intended for user access
- .3 **Security Covers:** Middle Atlantic SF series.
- .4 **Blanks:** Middle Atlantic EB series.
- .5 **Vents:** Middle Atlantic VT1.
- .6 **Shelves:** Middle Atlantic U1V.
- .7 **Drawers:** Middle Atlantic D2.
- .8 **Fans:** Middle Atlantic CAB-COOL series.

2.8 Mobile Instructor Station

- .1 The mobile instructor station shall have built-in rack and sufficient work surface area for presentation equipment such as document cameras, laptops, touch panels, keyboards, mice and preview monitors.
- .2 The mobile instructor station shall have the following features:
 - .1 Modesty panel with cable management system
 - .2 Resilient thermowrap working surface available in a variety of colours

.3 Casters

.3 Finish colour shall be confirmed with UBC IT Audio Visual.

.4 Product shall be KI All Terrain Mobile Instructors' Desk or Approved Alternative.

2.9 Height Adjustable Instructor Table

.1 The height adjustable instructor table shall be ADA compliant and have sufficient work surface area for presentation equipment such as document cameras, laptops, touch panels, keyboards, mice and preview monitors.

.2 The height adjustable instructor table shall have the following features:

.1 Electric actuators with push button for height adjustment

.2 Modesty panel with cable management system

.3 Resilient thermowrap working surface available in a variety of colours

.3 Finish colour shall be confirmed with UBC IT Audio Visual.

.4 Product shall be AVFI DS6330-LFT or Approved Alternative.

2.10 Fixed Lectern

.1 UBC IT Audio Visual implements a custom millwork solution for classroom fixed lecterns.

.2 The lectern shall have a single bay or dual bay configuration for the audio visual racks as required by the system design.

.3 The work surface shall have sufficient work surface area for presentation equipment such as document cameras, laptops, touch panels, keyboards, mice and preview monitors. The lectern will have two (2) width options for a single or dual document camera system.

.4 The raised podium unit with touch panel location, either stage left or right, shall be confirmed with UBC IT Audio Visual.

.5 The height adjustable instructor table shall be ADA compliant using electric actuators with push button.

.6 Conduit stub ups for power, data and audio visual cabling shall align with the rear section behind the bays and/or underneath the trough. The conduit stubs shall not be located beneath the bay rack locations or work surface.

.7 Lectern shall have at minimum two (2) dedicated 15A circuits for AV rack and convenience power receptacles.

.8 Refer to Section 27 40 00 for fixed lectern infrastructure requirements.

.9 Refer to AVSK-14 and AVSK-15 for lectern millwork sketches.

2.11 Confidence Monitor Shroud

- .1 The confidence monitor shroud shall provide a means to mount a confidence monitor on the front side of the first row of seating. The shroud shall offer protection from inadvertent liquid spills.
- .2 The shroud shall have the following features:
 - .1 6mm thick aluminium plate
 - .2 Clear, colourless satin anodized finish
- .3 The shroud shall be sized to accommodate the confidence monitor size in the system design and shall be confirmed by UBC IT Audio Visual.
- .4 Refer to AVSK-16 for an example 43" confidence monitor shroud

2.12 Display Slide-Out Shelf

- .1 Audio visual systems may require installation of equipment behind flat panel displays. Equipment should be accessible to support staff and slide-out shelf provided as required.
- .2 Approved slide-out shelf products are as follows:
 - .1 B-Tech BT7885 – screen size 49" - 86"
 - .2 B-Tech BT7883 – screen size 46" - 75"
 - .3 Chief CSSMP15X0

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General

- .1 All materials, equipment, devices, components, wire and cable provided under this contract shall be new CSA approved and listed with ULC as required by AHJ.

2.2 DMX Ethernet Gateway

- .1 The gateway shall provide an Ethernet interface to an isolated DMX/RDM universe.
- .2 The gateway shall be compatible with Art-Net, sACN and ESP DMX over Ethernet protocols.
- .3 The gateway shall be powered via PoE 802.3af standard and DC power supply.
- .4 The gateway shall have the following features:
 - .1 Output type: one (1) 5-pin XLR DMX
 - .2 DMX universes: 1 (512 channels)
 - .3 Input type: one (1) RJ-45 Ethernet connection
- .5 Product shall be Enttec 70406 ODE MK2 POE or Approved Alternative.

2.3 DMX Splitter

- .1 The splitter shall provide four (4) isolated DMX/RDM ports for distribution.
- .2 The splitter shall have the following features:
 - .1 Input: one (1) DMX input on 3-pole screw connector
 - .2 Output: four (4) DMX output each on 3-pole screw connector
 - .3 Power: provide external DC power supply as required
- .3 Product shall be Enttec 71004 DIN-RDS4 or Approved Alternative.

2.4 DMX LED Profile Fixture

- .1 The fixture shall be a colour-mixing high-intensity LED illuminator with DMX control of intensity and colour.
- .2 The fixture shall be UL 1573 listed for stage and studio use
- .3 The fixture shall comply with the USITT DMX-512A standard
- .4 Fixture Physical Features:

- .1 The unit shall be constructed of rugged, die cast aluminium, free of burrs and pits, finished in white.
 - .2 Lens secured with silicone shock mounts
 - .3 Shutter assembly shall allow for +/-25 degree rotation
 - .4 20 gauge stainless steel shutters
 - .5 Interchangeable lens tubes for different field angles with Teflon guides for smooth tube movement
 - .6 Safety cable mounted to anchor on fixture shall be provided
- .5 Fixture Optical Features:
 - .1 The light beam should have a 2-to-1 centre-to-edge drop-off ratio
 - .2 Sharp imaging through a three-plane shutter design
 - .3 Sharp shutter cuts without halation
 - .4 Shutter warping and burnout in normal use shall be unacceptable
 - .5 Adjustable hard and soft beam edges
 - .6 19, 26, 36, and 50 degree units shall have optional lens tubes available for precision, high-contrast imaging.
- .6 Fixture Thermal Features:
 - .1 Fixture shall be equipped with a cooling fan.
 - .2 Fan speed control via a DMX channel shall be possible.
 - .3 Fan speed software shall permit the fixture to override DMX fan speed setting to prevent heat damage to the fixture.
 - .4 The fixture shall utilize thermal management to maintain LED life to an average of 70% intensity after 50,000 hours of use.
 - .5 The fixture shall operate in an ambient temperature range of 0°C minimum, to 40° C maximum ambient temperature.
- .7 Fixture Electrical Features:
 - .1 The fixture shall be equipped with a 120V, 60Hz internal power supply.
 - .2 The fixture shall support power in and thru operation with Neutrik PowerCon connectors.
 - .3 Power supply outputs shall have self-resetting current-limiting protection.
 - .4 Power supply shall have power factor correction.
- .8 Fixture LED Emitter Features:
 - .1 The fixture shall contain a minimum of five different LED colours.
 - .2 All LEDs used in the fixture shall be high brightness.
 - .3 LED emitters should be rated for nominal 50,000-hour LED life to 70% intensity.
 - .4 All LED fixtures shall undergo a minimum eight-hour burn-in test during manufacturing.
- .9 Fixture Colour Features:
 - .1 The fixture shall utilize a minimum of 60 LED emitters.
 - .2 The fixture shall have an LED array with red, amber, green, cyan, blue, indigo and white LED for broad spectrum colour, light tints, and variable whites.
 - .3 Measured brightness of the LED array shall be greater than 4,000 field lumens

- .10 Fixture Dimming Features:
 - .1 The LED system shall have high-resolution dimming.
 - .2 The fixture shall have the following dimming curve options: incandescent, standard, linear, quick.
- .11 Fixture Control and User Interface Features:
 - .1 The fixture shall be USITT DMX 512A-compatible via In and Thru 5-pin XLR connectors.
 - .2 The fixture shall be compatible with the ANSI RDM E1.20 standard.
 - .3 The fixture shall be equipped with multi-line LCD display for easy-to-read status reports and configuration changes.
 - .4 The fixture shall be equipped with a button user-interface.
 - .5 The fixture shall offer multiple DMX input profile options to include:
 - .1 RGB - control of all individual LED colours via a three-channel profile
 - .2 HSI – control of all individual LED colours via a three-channel profile
 - .3 HSIC – control of all LED colours via a four-channel profile
 - .4 Colour point provides variable colour temperature settings
 - .5 Direct – control of each individual colour channel via an independent channel
 - .6 Studio – Control of the fixture in a white-light 3 channel profile
 - .7 Variable-rate strobe channel shall be provided
- .12 Product shall be ETC Source Four LED Series or Approved Alternative.

2.5 DMX LED Wash Fixture

- .1 The fixture shall be a colour-mixing high-intensity LED illuminator with DMX control of intensity and colour.
- .2 The fixture shall be UL 1573 listed for stage and studio use
- .3 The fixture shall comply with the USITT DMX-512A standard
- .4 Fixture Physical Features:
 - .1 The fixture shall be contained in a rugged all-metal die-cast housing, free of burrs and pits, finished in white.
- .5 Fixture Thermal Features:
 - .1 The fixture shall be cooled with a variable speed fan.
 - .2 The fixture shall utilize thermal management to maintain LED life to an average of 70% intensity after 20,000 hours of use.
 - .3 The fixture shall operate in an ambient temperature range of 0°C minimum, to 40° C maximum ambient temperature.
 - .4 Safety cable mounted to anchor on fixture shall be provided
- .6 Fixture Electrical Features:
 - .1 The fixture shall be equipped with a 120V, 60Hz internal power supply.
 - .2 The fixture shall support power in and thru operation with Neutrik PowerCon connectors.

- .3 Power supply outputs shall have self-resetting current-limiting protection.
- .4 Power supply shall have power factor correction.
- .7 Fixture LED Emitter Features:
 - .1 The fixture shall contain a minimum of four different LED colours.
 - .2 All LEDs used in the fixture shall be high brightness.
 - .3 LED emitters should be rated for nominal 20,000 hour LED life to 70% intensity.
 - .4 All LED fixtures shall undergo a minimum three-hour burn-in test during manufacturing.
- .8 Fixture Colour Features:
 - .1 The fixture shall utilize a minimum of 40 LED emitters.
 - .2 These emitters shall be made up of Red, Green, Blue and Lime.
- .9 Fixture Dimming Features:
 - .1 The LED system shall have high-resolution dimming.
 - .2 The dimming curve shall be optimized for smooth dimming over longer timed fades.
- .10 Fixture Control and User Interface Features:
 - .1 The fixture shall be USITT DMX 512A-compatible via In and Thru 5-pin XLR connectors.
 - .2 The fixture shall be compatible with the ANSI RDM E1.20 standard.
 - .3 The fixture shall be equipped with a 7-segment display for easy-to-read status and control.
 - .4 The fixture shall be equipped with a button user-interface.
- .11 Product shall be ETC ColorSource Par or Approved Alternative.

2.6 Stage Lighting Rig

- .1 The stage lighting rig shall be a complete standalone system that shall allow servicing of stage light fixtures at any time. The contractor shall be responsible for the installation of all aspects of the motorized stage rigging equipment.
- .2 The truss shall have the following features:
 - .1 The truss shall be easily connected together to create a structure to allow light fixtures to be mounted freely at any position.
 - .2 Material: aluminium 6061-T6 extrusions
 - .3 Main chords: 2" outer diameter
 - .4 Attachment: spigot and pin
 - .5 Finish: shall be coordinated with UBC IT Audio Visual
- .3 The electric chain hoist shall have the following features:
 - .1 The chain hoist shall allow hoisting of the rigging equipment.
 - .2 Capacity: 500kg
 - .3 Lift: 35ft
 - .4 Brake: double braking system
 - .5 Speed: up to 8ft/min

- .6 Chain size: 4 x 12mm
 - .7 Control: direct control, external limit switch, positioning encoder
 - .8 Accessories: chain bag
- .4 The cable reel shall have the following features:
- .1 The cable reel shall provide neat and reliable cable management for power and data cabling.
 - .2 The cable reel shall be spring driven without the need to be motorized.
 - .3 Power Reel: 12 AWG multi-conductor cable with 19-pin connector.
 - .4 DMX Reel: 24 AWG multi-conductor cable with DMX connector.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

1.2 Coordination Requirements

- .1 Audio-Video system design shall be coordinated with Architectural, Structural, Interior Design, Electrical and Mechanical to provide a safe and functional operation.

1.3 Description

- .1 General requirements for Sections 27 41 16 to 27 41 52.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General

- .1 With few exceptions, all Audio Visual systems installed on UBC campuses are owned and supported by the UBC IT Audio Visual team (UBC Vancouver) or the IT, Media, and Classroom Services teams (UBC Okanagan).
- .2 Any significant design and implementation decisions relating to AV systems at UBC Campuses requires approval from relevant AV support team.
- .3 Any and all proposed changes to these Guidelines/Specifications shall be subject to approval in writing from UBC IT Audio Visual representative prior to implementation.
- .4 UBC IT Audio Visual will be engaged by the project team to develop the approach to AV system design for all new projects. In many cases, UBC IT Audio Visual will play the role of the AV consultant within the project, and provide the AV designs and coordination directly. In cases where capacity, expertise or other considerations warrant the engagement of external AV design consultants, this decision shall be made in collaboration with UBC IT Audio Visual. Any external AV design consultants engaged by the project shall be a consultant in good standing with a proven history of recent, relevant, and comparable experience in AV design within a higher education context. Avixa CTS and Crestron CTI-CSD shall be considered minimum certifications for potential AV system designers, with other certifications such as Avixa CTS-D and P.Eng considered favorably. UBC IT Audio Visual will be engaged in the selection process for any and all proposed AV system design consultants, and will have the opportunity to formally review and provide feedback on their credentials, experience, and proposed services.
- .5 UBC IT Audio Visual will review and approve AV tender packages inclusive of final specifications provided by any external AV design consultant prior to release to the market. The project team will allow a minimum of two weeks for this review, and will notify UBC IT Audio Visual of the requested review period at least four weeks in advance.
- .6 A copy of any and all AV Tender responses will be provided to UBC IT Audio Visual for review and feedback, with a minimum of 1 week review period. UBC IT Audio Visual should be notified of requested review period no later than the date of tender issue.

- .7 Provide only new equipment and material approved for the installation and suitable for continuous operation. Where the guidelines do not describe a required item, furnish equipment or material consistent with the quality of other specified products, and best suited to the purpose required. Submit these products for review by UBC IT Audio Visual.
- .8 The terms “Approved Products” and “Approved Manufacturers” indicate that products/manufacturers described are the UBC standard, and any alternate products must be reviewed and approved in writing by UBC IT Audio Visual.
- .9 The terms “Typical Products” and “Typical Manufacturers” indicate that the products/manufacturers described are commonly used at UBC, but are not necessarily an enforced standard. Alternate products may be used, provide they are of equal or greater quality and approved by UBC IT Audio Visual.
- .10 User accessible rack mount equipment will be fitted with security covers and tamper proof rack screws to prevent tampering

2.2 Contractor Qualifications

- .1 This section describes minimum and preferred qualifications, experience, and credentials for any AV contractor bidding on and being awarded UBC AV integration opportunities.
- .2 Please note that UBC IT Audio Visual maintains a list of pre-qualified integrators who have already demonstrated their ability to meet the below criteria through a competitive process, and require no further project qualification. The current list of pre-approved AV contractors can be found at the following location: <https://finance.ubc.ca/procure-pay/list-suppliers/categories-and-suppliers/it-hardware-software-and-services/audio-visual>
- .3 Prior to award of any AV systems integration opportunities at UBC to any parties not already on the pre-qualified list, UBC IT Audio Visual will have the opportunity to review documentation and supporting evidence of their ability to satisfy the below qualification criteria.
- .4 CTS certification from Avixa and/or PMP certification from the Project Management Institute is strongly favored for the role of Project Manager.
- .5 Avixa CTS certification is strongly favored for on-site technicians
- .6 Avixa CTS-I or CTS-D is strongly favored for engineer and lead technician roles
- .7 The person(s) in the role of Lead Programmer MUST be Crestron Certified and Crestron Digital Media Certified (DMC-E), Crestron NVX certified and Biamp Tesira certified.
- .8 For AV contractors not on the pre-qualified list, at a minimum the below evidence of qualifications shall be submitted to UBC IT Audio Visual for review and approval prior to award.
 - .1 Submit with proposals resumes/work profiles for at a minimum the positions of Account Manager, Project Manager, Lead Programmer, and Lead Site Technician. Include relevant work history details, past project experience, certifications/education, and any other qualifications relevant to this scope of work.
 - .2 Provide a minimum of three (3) to a maximum of five (5) client references for projects of similar size, scope, and complexity completed within the last 3 years.

- .3 Certificate or letter from control system manufacturer stating official stocking dealer status.
- .4 Certificate or letter from audio processor manufacturer stating official stocking dealer status.
- .5 Comprehensive list of all product brands and lines stocked and available through the dealer, including projectors, flat panel displays, video switching equipment, video conference solutions, technical furniture and racking equipment, and audio reinforcement equipment.
- .6 Provide a comprehensive overview of project quality controls and process.
- .9 Provide examples of AV project documentation, including at least one example of each of the following: Audio system schematic, video system schematic, control system schematic, equipment list, IP log, simplified user manual.

2.3 Energy Efficiency

- .1 The University of British Columbia pursues energy efficiency in audio and video equipment where ever possible. Audio and video products that offer the performance described in these technical guidelines with greater energy efficiency will be of interest, and should be submitted to UBC IT Audio Visual for technical review.
- .2 AV systems should incorporate energy conservation measures so that the display equipment in the systems are not left in an operational state when the rooms are unoccupied. An end of day shutdown shall be implemented in the AV system code to ensure equipment is not unnecessarily running after business hours.
- .3 Provide Energy Star compliant equipment were available, and where the Energy Star power management feature does not compromise the function of the AV systems.
- .4 LEED Gold, when applied to a project, will require the AV systems operation to be included in Whole Building Energy Usage Data gathering.

2.4 Shop Drawings

- .1 Submit prints of the following drawings for review by the Owner, or their designated Consultant before proceeding with the work:
 - .1 Manufacturer's specification cuts and quantity schedule for all items furnished under the contract.
 - .2 Detailed schematic diagram showing all specified components including manufacturers, model numbers, signal types, wiring types, rack elevations, and connector panel drawings.
 - .3 Cable logs showing destinations at both ends and cable identifiers.
 - .4 IP Network design and list of equipment requiring IP address on UBC LAN.
 - .5 Drawings for all custom fabricated equipment indicating dimensions, hardware, labelling and finish.

- .6 Suspension details for all suspended equipment, with relevant engineering stamps.
 - .7 Details for all mounting and equipment integration that interfaces with base building structures, as requested by the consultant team.
 - .8 Manufacturer's catalogue/specification cut-sheets indicating the part number, accessories and options pertinent to the project.
 - .9 Where UBC IT Audio Visual is not programming, example programming files including GUI samples, verbiage and program flow/function map. All requested programming revisions prior to final approval of the programming example files will be considered the responsibility of the winning bidder, and must be undertaken at no additional cost.
- .2 Coordinate documents of related divisions when joint submissions are required.

2.5 Project Record Drawing Requirements

- .1 Instruct the Contractor to mark in red ink on one set of white prints any changes, additions, and omissions not contained in the original documents, and any other pertinent information affecting future work. Maintain the record set on site at all times.
- .2 Within 30 days of Substantial Performance, the contractor to submit a clean set of marked up As-Built prints. Instruct them to certify with signature and turn them over to the Owner, or their designated Consultant, one (1) set of white prints so revised. Instruct the contractor to include in each operating and maintenance manual one set of white prints so revised.

2.6 AV Operation and Maintenance Manuals

- .1 Provide an electronic copy of the manual, formatted as follows:
 - .1 List of equipment provided in each room, with recorded serial numbers (including any AV equipment supplied by UBC or other trades. UBC IT Audio Visual will provide an itemized inventory to the Audio-Visual Contractor).
 - .2 Simplified Operating Instructions
 - .3 As-Built and Reviewed Shop Drawings
 - .4 Performance Measurements
 - .5 Service and Adjustment Instructions
 - .6 Provide list of Rooms, IP addresses used, and CCT port connection numbers and locations for equipment connected to any VLAN.
 - .7 Identify power source locations of any devices powered via remote power supplies.
 - .8 Return all product remote controls, rack keys, cables, and any other miscellaneous accessories not permanently installed on site to UBC IT Audio Visual. Loose items left on site will be considered lost, and subject to replacement at integrator's expense.
 - .9 Digital copies of all product configuration software, and configuration files, along with compiled and uncompiled Crestron code and VTP files.

- .10 Provide a schedule of terminations, cross-referenced to test results.

2.7 Audio Visual Cabling and Connectors

.1 Duplex Multimode Fiber Optic 50/125 Cables

- .1 For all 8 Gbps duplex multimode fiber optics connections, provide 50 micron core, 125 micron cladding multimode duplex fiber optics cable with an overall diameter of 3mm. the cable jacket shall be PVC in orange colour. Insertion loss shall be smaller than 0.5dB and have a ferrule end face radius of less than 30mm. operating temperature shall be 02 to plus 70 degrees.
- .2 Typical products are:
 - .1 Corning Premium
 - .2 Crestron DM fiber
 - .3 Extron OM4 MM P

.2 Duplex Multimode duplex Fiber Optics Patch Cables

- .1 For all 8 Gbps duplex multimode fiber optics connections provide 50 micron core, 125 micron cladding multimode duplex fiber optics cable with an overall diameter of 3mm. Insertion loss shall be smaller than 0.5dB and have a ferrule end face radius of less than 30mm. operating temperature shall be 02 to plus 70 degrees. The patch cable shall be equipped with 2 multimode LC connectors at each end. The patch cables shall be in the following overall length: 1m, 2m, 3m, 5m or 10m.
- .2 Typical products are:
 - .1 Corning Premium
 - .2 Crestron DM fiber
 - .3 Extron 2LC OM4 MM P

.3 Fiber Optics Connector Modules

- .1 Systems using fiber optic cables must have the fiber trunks be terminated in fiber optic patch bays or modular connector termination boxes in the AV racks and in the lectern.
- .2 Extenders, transmitters, receivers and switchers will be connected to the patch bays or termination boxes using pre-fabricated fiber-optic patch cables.
- .3 Typical: Corning Pretium Plug & Play Classic CCH-CP24-D3 series.

.4 CAT6 Shielded Twisted Pair Video Cable

- .1 Must be certified to minimum CAT6 specifications, 250 MHz bandwidth
- .2 Must include end to end foil shield with 100% coverage
- .3 Must include 4 pairs of 23 or 24 AWG solid copper conductors
- .4 Maximum overall cable diameter is 0.260"
- .5 Jacket colour:
 - .1 White for HDBaseT link;
 - .2 Purple for Video-over-IP network.

- .6 Must be available in both plenum and non-plenum rated versions
- .7 Typical manufacturers are:
 - .1 Belden
 - .2 Crestron
- .5 Video RJ45 Connector
 - .1 The data connector shall meet or exceed all requirements of TIA/EIA-568-B.1 & B.2 & B.2-1 for Category 6 shielded.
 - .2 The connector shall have the following features:
 - .1 8P/8W modular female connectors at both ends of video cabling.
 - .2 T568A wiring.
 - .3 Snap-in type at both ends.
 - .4 Connector colour:
 - .1 White for HDBaseT link;
 - .2 Purple for Video-over-IP network.
 - .3 Product manufacturer shall be Leviton, Belden or Approved Alternative.
- .6 Video RJ45 Patch Panel
 - .1 The patch panel shall be rack mounted with standard 19" rack compatibility. Placement of the patch panels to be approved from Drawings submitted to the Consultant by the Contractor. Layout will be expected to optimize rack space and proximity to active components.
 - .2 The patch panel port quantity shall match corresponding network switch port count.
 - .3 The patch panel shall have the following features:
 - .1 Category 6, shielded twisted pair, STP
 - .2 Colour: black
 - .3 T568A wiring
 - .4 14-gauge steel
 - .5 Terminates 26-22 gauge solid conductors
 - .4 Product manufacturer shall be Leviton, Belden or Approved Alternative.
- .7 HDMI Cables
 - .1 Must be minimum HDMI 2.0 certified
 - .2 Must support minimum data transfer rate of 10.2 Gbps, and minimum 48 bit colour depth
 - .3 Cables shorter than 15' in length must support a minimum resolution of 2160p/4K UHD at 30hz
 - .4 Cables greater in length than 15' must support a minimum resolution of 1080p/Full HD at 60 hz

- .5 Must support a minimum of 8 high bandwidth, uncompressed multichannel audio streams
- .6 Must include high quality, gold plated connectors
- .7 Must be highly flexible. Overly rigid, thick, or otherwise difficult to manage cable types will be rejected.
- .8 Where cable runs are longer than those attainable with standard HDMI cabling, appropriate transmitter/receiver extender sets, HD-BaseT extenders, or signal boosters should be specified.
- .9 Cables should include factory manufactured ends. Modular cables (Rapid Run, etc.) will be rejected.
- .10 Typical manufacturers:
 - .1 Kramer
 - .2 Crestron
 - .3 Extron
- .8 Data Cabling
 - .1 The data cabling shall meet or exceed all requirements of TIA/EIA-568-B.2 for Category 5e cabling and components.
 - .2 The cabling shall have the following features:
 - .1 Category 5e unshielded twisted pair, UTP
 - .2 Four pair, 22 AWG to 24 AWG, 100 ohm, solid copper.
 - .3 FT6 rated
 - .4 Jacket colour:
 - .1 Green for AVB network;
 - .2 Green for Dante network;
 - .3 Black for Control network;
 - .4 Red for UBC IT AV trunk;
 - .3 Product manufacturer shall be Leviton, Belden or Approved Alternative.
- .9 Data Connector
 - .1 The data connector shall meet or exceed all requirements of TIA/EIA-568-B.1 & B.2 & B.2-1 for Category 5e.
 - .2 The connector shall have the following features:
 - .1 8P/8W modular female connectors at both ends of data cabling.
 - .2 T568A wiring.
 - .3 Snap-in type at both ends.
 - .4 Connector colour:
 - .1 Green for AVB network;
 - .2 Green for Dante network;
 - .3 Black for Control network;
 - .4 Red for UBC IT AV trunk;
 - .3 Product manufacturer shall be Leviton, Belden or Approved Alternative.

.10 Data Patch Panel

- .1 The patch panel shall be rack mounted with standard 19" rack compatibility. Placement of the patch panels to be approved from Drawings submitted to the Consultant by the Contractor. Layout will be expected to optimize rack space and proximity to active components.
- .2 The patch panel port quantity shall match corresponding network switch port count.
- .3 The patch panel shall have the following features:
 - .1 Category 5e, unshielded twisted pair, UTP
 - .2 Colour: black
 - .3 T568A wiring
 - .4 14-gauge steel
 - .5 Terminates 26-22 gauge solid conductors
 - .6 Product manufacturer shall be Leviton, Belden or Approved Alternative.

3.0 **EXECUTION**

3.1 **Installation**

- .1 Secure all equipment, except portable equipment, in place with a safety factor of at least five (calculate mounting based on object weight x 5). Adequately ventilate all equipment for worst case power dissipation. No item of equipment shall produce residual noise in excess of NC-30 when measured from the centre of the enclosing room.
- .2 Install all equipment in such a manner as to present no safety hazard to operating personnel.

3.2 **Mounting, Rigging and Seismic Restraint**

- .1 All overhead mounting or rigging installations of video projectors and flat panel display equipment must have received the approval of a Professional Engineer registered in British Columbia, at the shop drawing stage prior to installation.
- .2 Rigid and fixed mounting systems (brackets, tube and clamp, frames etc.) used for any piece of suspended equipment must have a safety cable attached between the suspended device and the superstructure used to support the mounting system. The size and construction of the safety cable, and attachment points must be suitable to support the weight of the equipment being restrained.
- .3 Flexible rigging systems (chain and aircraft cable) must be installed by a Certified Rigger. Flexible mounting systems must have suitable seismic restraint sway bracing provided. Seismic restraint systems must be approved by a Professional Engineer registered in British Columbia.
- .4 All free standing equipment racks, trolley or caster equipped racks intended for permanent locations, free standing or platform mounted loudspeakers, video projectors, and other equipment with significant mass and freedom of movement must be equipped with a seismic restraint system that can be disconnected for servicing the equipment.

3.3 Wiring

- .1 Neatly arrange cables with Velcro cable wraps. Avoid tight bundling, and twist cable bundles into a spiral configuration before installing cable ties. Allow a minimum of a 1 metre spiral bound slack service loop when entering racks or panels. Exercise care to avoid damage to wiring or equipment.
- .2 Make all signal connections within systems with rosin-core solder or approved mechanical connectors. Untidy or cold solder joints will be rejected. Use proper crimping tools for mechanical connectors.
- .3 Do not splice cables except with permission of the Owner, or their designated Consultant
- .4 All RJ-45 connections shall be terminated in accordance with this TIA/EIA-568B standard.
- .5 Refer to AVSK-05, AVSK-06 and AVSK-07 for AV wiring details.
- .6 For AV equipment racks with more than three (3) wall wart power supplies of the same voltage, provide DC power distribution system. Distribution system shall include a DIN rail power supply and DIN rail termination block. Refer to AVSK-04 for DC power distribution detail. DC power supply shall have the following features:
 - .1 DIN rail mountable
 - .2 Isolation class II
 - .3 Input voltage: 120 VAC
 - .4 Output voltage: as required by AV equipment
 - .5 Protections: short circuit, overload, over voltage and over temperature
 - .6 Cooling: free-air convection

3.4 Grounding and Shielding

- .1 Isolate all racks containing sound system equipment from the building and electrical grounds. Bond adjacent equipment racks with #6 AWG insulated ground cable.
- .2 Conduit and tray systems containing audio, video and control wiring will be permanently connected to the electrical ground.
- .3 Do the utmost to prevent ground loops of any type, including use of ground isolators when necessary.
- .4 Isolate the shields of all shielded cables from both the conduit system and any other shielded cables.
- .5 Provide continuous shield from source to input point, with shields lifted at the source and grounded at the input point.

3.5 Marking

- .1 Mark all wiring with PVC or neoprene slip-on sleeves, or with tape type markers with a clear heat shrink boot, indicating approved circuit number. All labels must be machine printed. Hand written labels will be rejected.
- .2 Mark all remote or outboard power supplies with permanent labels to indicate which devices they power, and mark all power cables at the U-GND connector where plugged in to the

power outlets to indicate which devices they power.

- .3 Log IP address and other relevant network info of all network enabled devices, and include IP table of all system IP info with as-built documentation.
- .4 Record circuit numbers and wire destinations on as-built drawings and schedules. List spare circuits.

3.6 Nameplates

- .1 Dymo labels are not acceptable. Decal type labels (Brother P-touch) are not acceptable in high traffic or high wear applications. All nameplates shall be printed on a black background, with white text.
- .2 Identify all racks and panels as specifically noted on the drawings.
- .3 Submit all nomenclature to the Owner, or their designated Consultant for approval prior to installation.
- .4 All blank rack panels shall be solid black, and include no logos or company advertising. Integrator(s) may not install custom logos, decals, stickers, or electronic images on any equipment, and will remove any such items at their own expense

3.7 Finishes

- .1 Finish all components exposed to the public with colours and finishes approved by the Owner, or their designated Consultant.

3.8 Lamacoid Labelling

- .1 Engraved lamacoid labels shall be used to identify audio visual equipment accessible to end-users for the purpose of training and supporting.
- .2 Numbering scheme shall start with '1' at stage left (from the point of view of the presenter facing the audience) and ascend in order by increments of one until stage right is reached.
- .3 Each lamacoid number shall correspond to its respective control tab on the touch panel GUI.
- .4 In spaces where there is a single, central projector in addition to dual content projectors, the central projector shall be assigned the last number in the sequence.

3.9 Testing Copper Category Cable Installation

- .1 All copper Category cables shall be tested in conformance with the current ANSI/TIA/EIA-568-C Standard. Testing shall be accomplished [certified tester](#) with appropriate permanent link adapters. Testing shall be performed for at least the minimum copper Category type including, but not limited to the following:
 - .1 HDBaseT, F/UTP Category 6
 - .2 AVoIP, UTP Category 5e
 - .3 Control, UTP Category 5e
 - .4 Dante, UTP Category 5e
- .2 All links must attain a "PASS" certification as required by the standards defined above,

- unless otherwise released from this requirement by the UBC IT Audio Visual representative.
- .3 All copper Category cable links shall be tested for permanent link performance and the following parameters:
 - .1 Length;
 - .2 Wire Map;
 - .3 Insertion Loss;
 - .4 Near-End Crosstalk (NEXT) Loss;
 - .5 Attenuation to Crosstalk Ratio, Far-end (ACR-F);
 - .6 Propagation delay and delay skew;
 - .7 Return Loss;
 - .8 Power Sum Near-End Crosstalk (PSNEXT);
 - .9 Power Sum Attenuation to Crosstalk Ratio, Far-end (PSACR-F).
 - .4 Trained technicians who have successfully attended an appropriate training program and have obtained a certificate, as proof thereof shall execute the tests.
 - .5 The testing equipment shall be within the calibration period recommended by the equipment manufacturer in order to achieve the vendor-specified measurement accuracy.
 - .6 All shielded Category cable test results must show continuity of shield from end-to-end.
 - .7 Random testing of copper Category cables shall be done by UBC IT Audio Visual representative. Where any portion of the end-to-end system does not meet the specifications, the Contractor shall correct the deviation and repeat all applicable testing at no additional cost.
 - .8 Supply a complete set of electronic test results for all copper Category cable tests performed in PDF format with the Operation and Maintenance Manuals.
 - .9 Supply test results for all copper Category cable tests performed for each space as it is handover to the AV Programmer.

3.10 Testing Fibre Optic Cabling Installation

- .1 Measure, verify, and document proper operation of the fibre optic based video system performance in accordance to the TIA/EIA-568-B.3 standards:
 - .1 Test and document end-to-end attenuation for each simplex and duplex multimode fibre optics link to determine optical power loss between each cable termination point.
 - .2 Measure and document fibre optics cable systems insertion loss for each connectorized cable link, using a stabilized optical source and an optical power meter to compare the difference in optical power levels in dBm, by measuring how much light is put into the near end and how much light is exiting the far end. Use factory approved 50/125 core test jumpers only. Perform this procedure in accordance to the TIA/EIA OFSTP-14A multi-mode fibre testing specifications.
 - .3 To prevent high order modes from invalidating the power loss testing they must be attenuated during the referencing step to obtain a valid measure of the optical power travelling along the fibre core using the mandrel wrapping method. Use a mandrel diameter of 22mm for the multimode 3.0mm jacketed 50/125 core fibre optics cabling system.

- .4 For all fibre optics cable runs longer than 100m (300feet) conduct and document a signature trace using an optical time domain reflectometer (OTDR) to locate fibre events and measure losses attributable to cable, connectors & splicing.
- .5 For all Crestron Digital Media systems, provide a complete Digital Media test report
- .2 Forward to the Owner, or their designated Consultant a complete report detailing test results obtained above, accompanied by a letter certifying that all video components meet manufacturer's specifications and that the system is complete and ready for inspection.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

1.2 Co-ordination Requirements

- .1 UBC IT Audio Visual

1.3 Description

- .1 UBC offers two (2) solutions for media capture:
 - .1 PC with video capture card or USB device, or
 - .2 Video/web conferencing record feature.
- .2 The media capture solution shall be compatible with Kaltura and Panopto.
- .3 UBC IT Audio Visual will provide the room PC c/w video capture device to be integrated into the AV systems.
- .4 Installation and testing of the PC will be included in the AV system installation scope. Installation and testing execution is described in the applicable sections of the technical guidelines
- .5 The media capture solution shall be able to broadcast a minimum of two (2) sources such as camera and content feeds outside the UBC network.
- .6 The programming and configuration instructions for the media capture recorder functions are described in the UBC IT Audio Visual Graphical User Interface Standards Document.
- .7 The recorder shall have one (1) video input for cameras and one (1) video input for each content source being presented. For example, a dual content system shall have at minimum three (3) video inputs.
- .8 The recorder shall have an LED recording status light visible to presenter.

2.0 PRODUCTS

2.1 PC Video Capture Card

- .1 The capture card shall have a minimum of two (2) HDMI inputs.
- .2 The capture card shall have embedded HDMI audio inputs.
- .3 The capture card shall support a resolution up to 1080p.
- .4 The capture card shall support Windows 10 operating system
- .5 The capture card shall be a PCIe format card.

2.2 PC Video Capture USB Device

- .1 The capture card shall have one (1) HDMI input.
- .2 The capture card shall have embedded HDMI audio inputs.
- .3 The capture card shall support a resolution up to 1080p.
- .4 The capture card shall support Windows 10 operating system or later.
- .5 The capture card shall be a PCIe format card.

3.0 EXECUTION

3.1 Data Infrastructure

- .1 Provide one (1) data drop for each media capture appliance and configure to media capture VLAN.
- .2 Where AV system has managed network switch, media capture recorder may be connected to managed network switch if media capture VLAN is configurable.

3.2 AV Connectivity

- .1 Where a media capture appliance or PC w/ video capture device is not installed in an AV space with 80 seats or more, provide one (1) content HDMI output, one (1) camera HDMI output, and one (1) balanced stereo audio XLRM output on a rack plate in the AV rack where a future media capture appliance would be installed.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Design Criteria

- .1 A listen assist system shall be installed in teaching spaces of 100 net square meters (NSM) or greater or as required by the BC Building Code, whichever has the more stringent requirements. The coverage shall achieve 100% of the seating area. Where 100% coverage cannot be achieved, UBC IT Audio Visual shall be consulted to determine an approved solution.
- .2 LAN or Radio Frequency (RF) listen assist solutions are acceptable options with preference for LAN.
- .3 Where multiple classrooms are served by one set of receivers, the minimum receiver count should be based on 5% of the largest classroom seat count.

2.2 Listening Assistance Equipment and Materials

.1 RF-Based Listen Assist Systems

- .1 UBC utilizes two types of RF-based listen assist systems: 72 MHz and 2.4 GHz.

.2 72 MHz Listen Assist Systems

.1 72 MHz FM Transmitter

- .1 The FM transmitters will operate in the designated FM listening assistance band of 72 MHz.
- .2 The transmitters will have selectable broadcast frequencies in the 72 MHz band allowing 16 operating channels to be selected. These frequencies will be on industry standard centres so that any brand of FM listening assistance receiver could be used on any system.
- .3 The transmitters should have both line and microphone levels inputs, and the input should have an integral audio compressor with peak stop limiter to prevent high peak levels.
- .4 The transmitters should be rack mounted with the AV equipment and the antenna should be mounted outside the rack, extended using 50 Ohm coaxial cable.
- .5 Where multiple classrooms are grouped in a single building, each room should have a dedicated transmitter with a visually conspicuous decal indicating the transmitting channel.
- .6 Approved manufacturer is Listen Technologies.

.2 72 MHz FM Receiver

- .1 The FM receiver will operate in the 72 MHz FM band.
- .2 The receiver will have selectable channels amongst the 16 available, with a visual display to indicate channel selected.
- .3 The receiver will have an easily accessible volume control and a 3.5mm headphone connector.
- .4 The receiver will be equipped with rechargeable batteries.
- .5 Each receiver should be supplied with a walkman type circumaural headphone, with 10 extra ear cushion sets for each receiver.
- .6 Each receiver should be supplied with an induction neck loop.
- .7 Where there are multiple classrooms equipped with listening assist systems in a single building, one set of receivers may be used for the group of classrooms.
- .8 Approved manufacturer is Listen Technologies

.3 FM Receiver Battery Charger /Case

- .1 Each listening assistance system FM receiver set should have a combination carrying/storage case and battery charger.
- .2 Each charger should be able to charge all the available receivers simultaneously.
- .3 Approved manufacturer is Listen Technologies

.3 **2.4 GHz Listen Assist Systems**

.1 2.4 GHz FM Transmitter

- .1 The transmitter shall operate in the band of 2.402 – 2.480 GHz.
- .2 The transmitter shall support an audio bandwidth of 100 Hz – 7200 Hz.
- .3 The transmitter shall be mounted near the entry door to allow users to pair their receiver to the transmitter upon entering the space.
- .4 The transmitter shall have a balanced line level XLR input as its primary signal input.
- .5 The transmitter shall have minimum of two (2) year warranty.
- .6 Laminated pairing instruction sheet shall be placed on the wall near the transmitter.
- .7 Approved manufacturer is Phonak Roger Base Station.

.2 2.4 GHz Receiver

- .1 The receiver shall operate in the band of 2.402 – 2.480 GHz.
- .2 The receiver shall provide USB port for connection to third party devices and charging.
- .3 The receiver shall include lanyards that can provide t-coil induction loop.
- .4 The receiver shall pair transmitter upon button press at transmitter.
- .5 Approved manufacturer is Phonak Roger Neck Loop.

.4 LAN Based Listen Assist Systems

.1 LAN Transmitter

- .1 The transmitter shall have latency no greater than 60 ms.
- .2 The transmitter shall have an audio frequency response of 40Hz – 20KHz.
- .3 The transmitter shall have a balanced XLR input.
- .4 The transmitter shall have a Dante input.
- .5 The transmitter shall support PoE power or 110V wall power.
- .6 The transmitter shall be able to broadcast audio signal over building network and Wi-Fi infrastructure.
- .7 The transmitter shall be able to support up to 100 client per devices.
- .8 Approved manufacturer is Sennheiser MobileConnect Station.

.2 LAN Receiver

- .1 The receiver is a mobile device such as Android or iPhone phones.
- .2 The receiver application shall be compatible on Android and iOS.
- .3 The receiver shall be able to pair with the transmitter by pin code or QR code.

3.0 **EXECUTION**

3.1 **Induction Loop Listen Assist Systems**

.1 Wiring

- .1 All audio circuits, unless otherwise specified, shall be balanced, floating and shielded two wire circuits with the red or white wire hot (connected to pin 2 of XLR3 connectors and to the Tip of phone connectors) and the black wire cold (connected to pin 3 of XLR3 connectors and to the Ring of phone connectors).
- .2 Install ribbon cables (if used) flat on floor and tape with floor tape. Turns will be facilitated by folding the ribbon cable once at the angle required to achieve the turn (eg: 90 degree turn is a single fold of 45 degrees).
- .3 Loop wire must be twisted together for at least 1' prior to being connected to the induction loop amp. Twisted portion of loop wire will be soldered to ribbon cables as required for floor installs. Twisted portion of induction loop wire shall not exceed 30'.

.2 Grounding and Shielding

- .1 Isolate the shields of all shielded cables from both the conduit system and any other shielded cables. Provide continuous shield from source to input point, with shields lifted at the source and grounded at the input point. Properly serve all unconnected shielding. Pin 1 on XLR type connectors must not be connected to the connector barrel or shell.

.3 Testing

- .1 System testing will be conducted with a Fosmeter Pro (FPRO):
 - .1 If the integrator does not own a Fosmeter Pro, one will be purchased by the integrator at no cost to the owner.
 - .2 Results will be recorded in the BS EN 60118-4 compliance checklist.
 - .3 Results will be within required parameters to meet BS EN 60118-4 compliance.
 - .4 An inductive loop receiver will also be used to validate acoustical performance of induction loop system
 - .5 Limiters and or compressors will be tuned during commissioning to prevent amp cutoff triggering when audio signals fluctuate from normal levels.

3.2 **RF-Based Listen Assist Systems**

.1 Wiring

- .1 All audio circuits, unless otherwise specified, shall be balanced, floating and shielded two wire circuits with the red or white wire hot (connected to pin 2 of XLR3 connectors

and to the Tip of phone connectors) and the black wire cold (connected to pin 3 of XLR3 connectors and to the Ring of phone connectors).

- .2 Install coax cable in a manner that will prevent sharp bends or kinks. Use right angle coax connectors where necessary to prevent cable kinking in shallow electrical boxes.

.2 Grounding and Shielding

- .1 Isolate the shields of all shielded cables from both the conduit system and any other shielded cables. Provide continuous shield from source to input point, with shields lifted at the source and grounded at the input point. Properly serve all unconnected shielding. Pin 1 on XLR type connectors must not be connected to the connector barrel or shell.

.3 Testing

- .1 Conduct tests to demonstrate that the Listening Assistance system is properly functional:
 - .1 With speech program at nominal levels in the room, verify that the transmitter is able to function without clipping or overload.
 - .2 Ensure that the receivers are able to receive the signal at all seats in the room. Adjust the transmitter antenna if necessary to ensure complete coverage.
 - .3 Ensure that the receiver signal in the headphones is free of audible distortion with the speech test signal.

Appendix A

Test Certificate for AFILS in accordance with BS EN 60118-4		
This test certificate is used to log the results detailed in the Fosmeter Pro (FPRO) Instruction (Doc. No. DCM0004006).		
Tested to BS EN 60118-4 at any point within the useable volume.		
1	Background Noise Acceptable: <-42 to <-22 dB L	Is background noise acceptable? Yes <input type="checkbox"/> No <input type="checkbox"/> If No _____ dB L
1	System Noise Acceptable: <-42 to <-22 dB L	Is system noise acceptable? Yes <input type="checkbox"/> No <input type="checkbox"/> If No _____ dB L
2	Magnetic Field Strength using a pulsed 1 kHz signal Acceptable: 400 mA/m (0 dB L)	Is field strength acceptable? Yes <input type="checkbox"/> No <input type="checkbox"/> If No _____ dB L
3	Frequency Response Acceptable: signal @ 1 kHz +/-3 dB L, 100 Hz to 5 kHz	Is frequency response acceptable? Yes <input type="checkbox"/> No <input type="checkbox"/> If No _____ dB L
Was a metal compensation test performed? Yes <input type="checkbox"/> No <input type="checkbox"/>		
Was an overspill test performed? Yes <input type="checkbox"/> No <input type="checkbox"/>		
Was a subjective audio test performed? Yes <input type="checkbox"/> No <input type="checkbox"/>		
Please note, a plan showing the loop location is required by BS EN 60118-4. Attach a plan to this document (this can be a building drawing or a simple sketch).		
Customer: _____ Site/Location: _____		
Install Company: _____ Installer: _____		
Equipment Used: _____ Serial Nos.: _____		
Installer Comments:		
The system has been tested in accordance with BS EN 60118-4.		
Signed: _____ Date: _____		

END OF SECTION