DESIGN STANDARD

N. Audio Visual

Contents

Revision log

Current issue

N. Audio Visual - UoA Design Standards. FINAL Version 5. May 2023

Previous issues

Version	Authors	Description	Revision	Date
1.0	Noel Threapleton, Technology Services, UoA	N. Audio Visual - UoA Design Standards	DRAFT Version 1	December 2017
2.0	Noel Threapleton, Technology Services, UoA	N. Audio Visual - UoA Design Standards.	DRAFT Version 2	December 2017
3.0	GHD	N. Audio Visual - UoA Design Standards.	DRAFT Version 3	March 2018
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5.0	Vicki Jacobs, Capital Project Delivery, UoA, GHD	N. Audio Visual - UoA Design Standards.	FINAL Version 5	

List of revised items

Version	Authors	Revised items	Date
5.0	Infrastructure, UoA	Abbreviations, 1.Introduction, 2.General Requirements removed and reference in Vol.A Project Process Checklist	May 2023

Revision management

It is envisaged that revisions to this document will be undertaken at intervals of not more than two (2) years.

Endorsement body

Director of Infrastructure

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Authors and acknowledgements

The standards have been developed by Capital Projects with the assistance of UoA staff, external consultants, contractors, and colleagues from other education institutions. The University conveys its thanks.

Abbreviations

(refer –Standard Volume A. Project Process Checklist)

1. Introduction

(refer –Standard Volume A. Project Process Checklist)

2. General requirements

(refer –Standard Volume A. Project Process Checklist)

3. Technical requirements

This section outlines the specific technical requirements for M. Audio Visual Design Standard.

3.1 Control system programming

The University will conduct their own programming of control systems, unless otherwise requested. In the case where the University engages a contractor, all source code, modules, touch panel files and associated files must be provided at the completion of the project. The contractor will be required to work with The University (in cases of contractor supplied programming) to ensure control systems report to AMX RMS, source code and user interface functions similar to other spaces. This will be delivered by meeting the following milestones:

- Return brief and scope confirmation (UoA/AV Contractor)
- Draft layouts of code, user interfaces, DSP configurations and any other relevant files (AV Contractor)
- Draft review and approval (UoA)
- Final review prior to go-live (UoA/AV Contractor)
- Final implementation and handover (AV Contractor)

The University will not provide any security credentials (username or passwords) for devices, these will be set post hand-over and any additional access required after must be arranged with AV Services.

3.2 Project commissioning and completion

UoA AV Services will advise during the planning stage the amount of time required to complete any system configuration or programming. This must be accounted for in the project timeframe to ensure a working space is delivered within the deadline. All audio visual works must be included in the targeted Practical Completion date. Audio Visual works will be deemed practically complete once AV Services have carried out a defect inspection, performed a full room commission and as-built drawings are received. All defects must be resolved within 24 hours of notice unless otherwise agreed with AV Services.

3.3 Screen size and sightline specification

3.3.1 Introduction

The University of Adelaide abides by the ANSI/INFOCOMM V202.01:2016 'Display Image Size for 2D Content in Audiovisual Systems' standard. The specified screen should be sized in proportion to cover distance to the farthest viewer and to not overwhelm the closest viewers. Angles of view must also be taken into consideration as well as overall ceiling heights. Multiple screens may be used to overcome challenges in irregular spaces.

3.3.2 Guidelines for screen size and sightlines

To calculate suitable screen sizing, the designer must follow the steps detailed in the INFOCOMM standard. UoA has deemed the element height % to be 3% in spaces with an aspect ratio of 16:9 unless otherwise approved.

Both plan and elevation views are to be provided for all screens proving conformance to the standard. The views will demonstrate the closest viewer, the farthest viewer and area of conformance as well as horizontal and vertical viewing angles.

3.3.3 Projector placement

The projector mustbe installed in a location to allow clear projection onto the screen surface and allow the presenter to freely move about the presentation area without casting any shadows. The projector location needs to be in accessible safely with a 6ft Platform Ladder for servicing and maintenance. If this cannot be achieved then a plan detailing how this can be achieved must be submitted, for example, a section of easily removed seats or utilising a projector mount that lowers to a serviceable height.

3.3.4 Dual screen projection

In venues that require dual projection to conform to the viewing standard, the projectors must be configured to show the same image. Venues that require to show two different sources of content should be designed to meet the standard, otherwise reinforcement screens may be implemented to ensure coverage.

3.3.5 Examples of plan and elevation views

Figure 1 - Plan view showing conforming viewing area

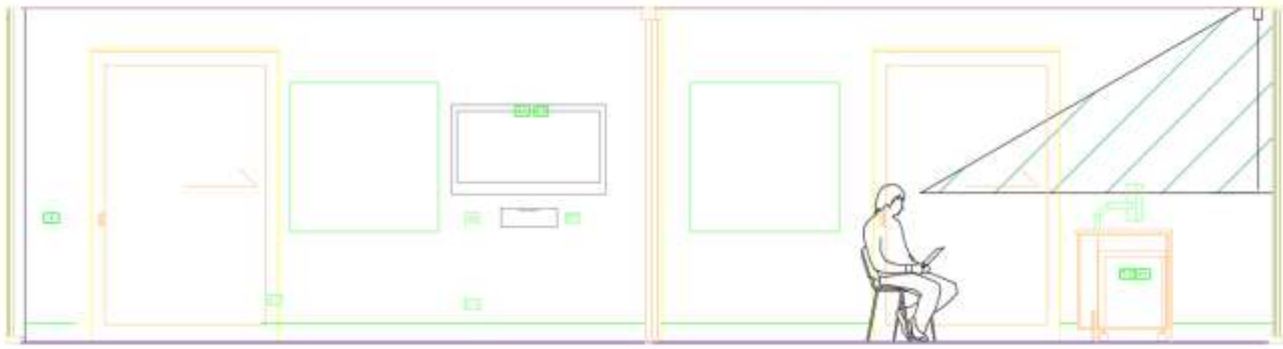

Figure 2 - Elevation view showing closest viewer and viewing angle.

3.4 Image quality and lighting

3.4.1 Standard compliance

Projected images must be legible and contrast ratio must meet the defined limits of the ANSI/INFOCOMM 3M-2011: 'Projected Image System Contrast Ratio' standard. All lighting sources (installed lighting, windows etc.) in a venue should be controllable so that minimum contrast ratio levels can be achieved at any point on the image area. Measurements of contrast ration must be carried out as defined in the standard. The table below demonstrates acceptable minimum contrast ratio.

Table 1 - Minimum projected contrast ratios

Projected Image	Examples	Minimum Contrast Ratio
Text and Numerals	Documents, spread sheets, bullet point text, charts and graphs	7:1
Pictures	Photographs, artwork and illustrations	15:1
Movies	Videos, film, recordings	50:1 (minimum) 80:1 (best practice)

3.4.2 Projection surfaces

Projected images should be onto matt white motorised screens with a gain of 1.0. Where high gain or rear projection is in use, the manufacturers specification on viewing angle must be observed. Walls are acceptable projection surfaces as long as they are painted flat white, uniformity flat and perpendicular to the projector. Where whiteboards are to be used as projection surface, ultra-short through projects mustbe used to minimise reflections on the audience.

3.4.3 Flat panel displays

Flat panel displays must adhere to the same standards as projected images (ANSI/INFOCOMM V202.01:2016 "Display Image Size for 2D Content in Audiovisual Systems" and ANSI/INFOCOMM 3M-2011: "Projected Image System Contrast Ratio"). LCD panels mustbe mounted with their bottom edge at 1200mm above finished floor level unless otherwise approved. Power and Data points must be coordinated to conceal the points. The elevation on the following page demonstrates power and data locations with display panels.

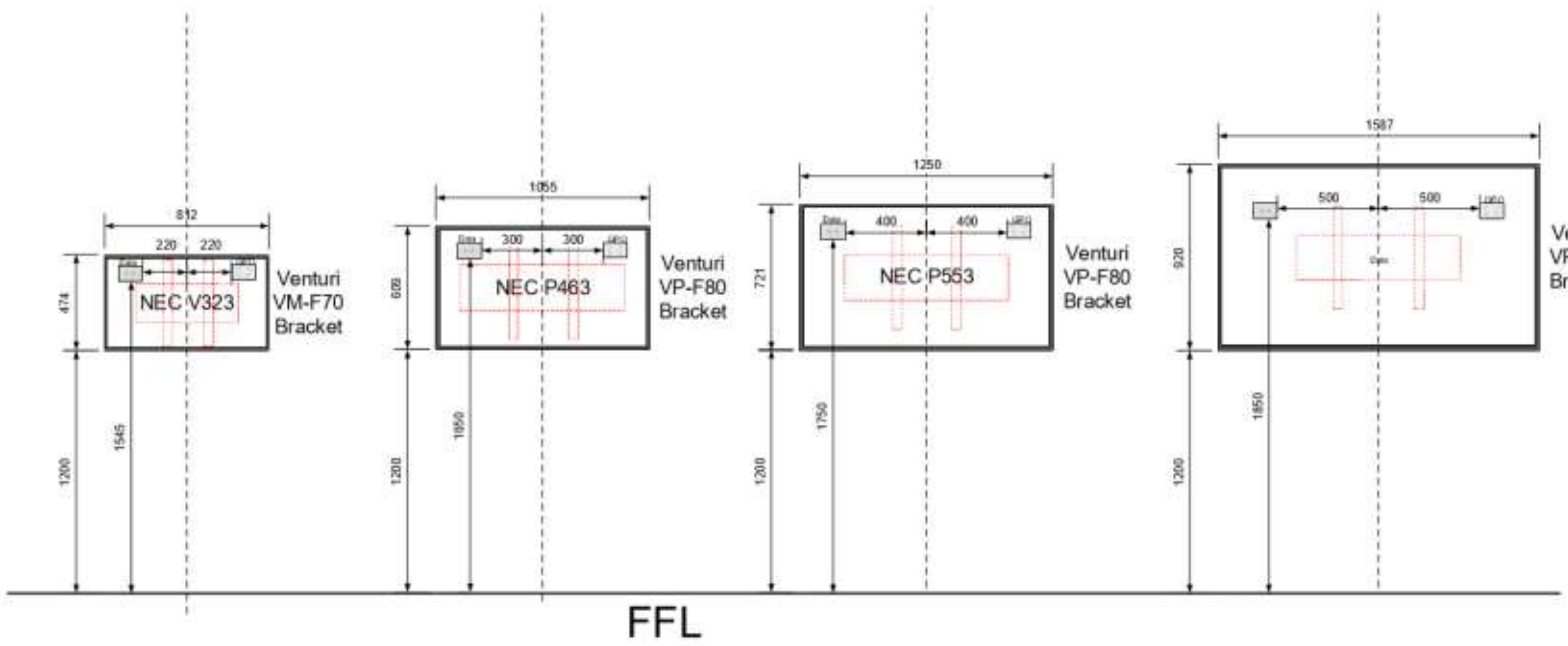

Figure 3 Flat panel display mounting arrangement details

3.5 Acoustic design

3.5.1 Introduction

This section addresses acoustic design requirements pertinent to the suitability of spaces for teaching activities.

3.5.2 Summary of criteria

Two acoustic criteria are considered: internal noise level and reverberation time (RT). These quantities are both properties of the acoustics of a space, and should be assessed independently of any installed sound system.

If uncontrolled, both quantities can have a detrimental effect on speech intelligibility, making it difficult for listeners in a learning environment to concentrate, leading to poor learning outcomes.

A distinction is made between criteria for general spaces, and those employing video conference systems, which need to be more stringent.

Table 2 - Criteria for general spaces

Quantity	Desirable	Acceptable	Unacceptable
Internal Noise LAeq, dB(A)	< 40	40-50	> 50
RT (s) (500Hz, 1kHz, 2kHz avg.)	< 0.5	0.5-1.0	> 1.0

Table 3 - Criteria for spaces with video conference equipment

Quantity	Desirable	Acceptable	Unacceptable
Internal Noise LAeq, dB(A)	< 35	35-45	> 45
RT (s) (500Hz, 1kHz, 2kHz avg.)	0.3-0.5	0.6-0.7	> 0.7

3.5.3 Measurement guidelines

Detailed guidance regarding internal noise level and reverberation time is provided in Australian Standard 2107:2000, Acoustics - Recommended design sound levels and reverberation times for building interiors. Refer to AS2107:2000 and its references for complete descriptions of internal noise level, reverberation time and their measurement and application.

Measurement methods should comply with the AS2107:2000 Clause 6, which references other relevant Australian Standards regarding suitable methodology and instrumentation etc. General guidance regarding the intent of internal noise and reverberation time measurements is provided in the following sections.

3.5.4 Internal noise level

The internal noise level of a space describes the ambient noise that remains when all wanted sounds are absent, typically including contributions from:

- Building services e.g. Heating, Ventilation and Air-Conditioning (HVAC) systems, water and waste pipes, lifts etc.
- External noise sources e.g. road traffic
- Internal noise sources e.g. building occupants in adjacent spaces, printers, copiers etc.

Spaces for learning should aim to reduce internal noise levels such that wanted sounds are clearly audible above the ambient noise. If the internal noise levels are too high, listeners will have difficulty discerning speech sounds from unwanted noise.

3.5.5 Measurement locations

Noise measurements should be taken at the expected occupancy positions throughout the space, at approximate ear height for either seated or standing persons as appropriate for the space – i.e. 1200 or 1600mm AFFL respectively.

An indicative sample position can be chosen where there is little spatial variation in noise level. Where significant spatial variation exists (e.g. due to the operation of a particularly noisy piece of localised plant) the location should be chosen to reflect the maximum recorded level.

3.5.6 Reported noise level

The reported noise level should be the maximum found across the expected occupancy positions in the space.

3.5.7 Measurement conditions - inclusion of noise sources

Measurements should be made under the typically expected operating conditions of the space, i.e. with all heating, ventilation and air conditioning (HVAC) equipment operating, road traffic and building occupancy noise present.

Where a noise source is known to be out of the ordinary, (e.g. building construction works) it is acceptable to schedule the measurement for a time when it is not present.

3.5.8 Character of noise

Internal noise should not contain any distinctive characteristics such as prominent tones or significant temporal fluctuations. If such acoustic artefacts are present in any measured noise level, they should be assessed in accordance with Section 6.1.7 of AS 2107:2000, with a correction applied to the sound level as necessary.

3.5.9 Sound level measurements

Noise levels must be measured with an integrating sound level meter, capable of measuring the Equivalent Continuous A-weighted sound pressure level (LAeq), over a period that is appropriate for the dominant type of noise source being measured.

The measurement period used should be long enough to fully characterise any natural variation in the noise level, and as such, will vary depending on the nature of the dominant noise source. As a guide, the following is recommended at a minimum:

Table 4 - Minimum recommended noise source measurement

Dominant Noise Source	Minimum LAeq Period
HVAC	30s
Road Traffic	2m
Building Occupancy	5m

3.6 Reverberation time

When a sound source is placed inside a space, multiple reflections of sound from the internal surfaces combine, creating the acoustic ‘character’ of the space. This ‘character’ is often represented by the space’s reverberation time, which is a measure of how long it takes for sound within the space to die away (i.e. decrease in level by 60 dB) after the initial sound has ceased.

Spaces for learning should aim to control (i.e. shorten) the reverberation time, so that listeners primarily hear the sound directly from the source, and hear little of the persistent sound caused by reflections from the room’s surfaces.

3.6.1 Measurement locations

Reverberation time measurements involve the placement of a stimulus source (e.g. loudspeaker or balloon) and a receiver (microphone). It is recommended that multiple combinations of source and receiver are used across several measurements, to calculate a spatial average.

A minimum of three distinct measurement positions is recommended, with the final reported result being the spatial average across all positions.

3.6.2 Frequency dependence

Reverberation time varies with frequency. The reverberation criteria presented is for an average of the 500Hz, 1kHz and 2kHz octave bands, with each octave band value being the spatial average across all measurement positions.

3.6.3 Measurement method

There are numerous available methods to measure reverberation time. The method employed is not critical, as the accuracy of results with most methods is sufficient for The University’s purposes. Example methods include:

- Impulsive noise (e.g. balloon burst)
- Interrupted noise (using a suitable loudspeaker and broadband noise source)
- Schroeder integration of Room Impulse Response (RIR)

3.7 Audio performance

3.7.1 Introduction

This section addresses the audio performance of finished spaces complete with installed sound systems.

Detailed guidelines for the measurement and reporting of audio criteria is provided below for the audio visual contractors who will be expected to assess them.

3.7.2 Summary of criteria

Multiple criteria are considered, covering both sound systems for program audio playback and speech reinforcement. The criteria provides The University with baseline performance levels that can be assessed at handover, providing consistency across all learning spaces.

Note, unlike the other criteria, STI is heavily influenced by the room acoustic environment; particularly reverberation time, but also internal noise level. As such, poor performance in this criterion is more an indicator of room acoustic issues than of poor sound system installation.

Table 5 - Baseline performance levels

Quantity	Desirable	Acceptable	Unacceptable
System Noise – Above Ambient, LAeq dB(A)	< 0	0 – 5	> 5
Program System SPL, dB(A)Slow	85	75 – 85	< 75
Program Frequency Response (100Hz – 10kHz)	± 3dB	+3/-6dB	> +3/-6dB
Speech System SPL, LAeq dB(A)	65 – 70	60 – 65	< 60
Speech Frequency Response (100Hz – 10kHz)	± 3dB	+3/-10dB	> +3/-10dB
Speech Transmission Index (STI)	> 0.68	0.68 – 0.56	< 0.56

3.7.3 Measurement guidelines

Measurement equipment and methods need not comply with any Australian or International Standards; however, it is expected that equipment designed and built for professional sound system measurement is used.

General guidance regarding the intent of each criteria and their appropriate measurement is provided in the following sections.

3.7.4 System noise

When powered, but not operating, the installed sound system should not produce any unwanted noise e.g. hiss, hum, buzz or tones, which can be distracting to listeners. Ideally, when the system is powered on it should be inaudible above the room's internal ambient noise level.

Where system noise exists, it is usually caused by an installation issue, such as:

- Improper system gain structure
- Incorrect termination of cables
- Ground loop hum – (various causes)

Where possible, the audio visual contractor should first investigate the source of the system noise and try to eliminate it. Where eliminating the noise can be shown to be impossible, it may be considered acceptable if it meets the criteria outlined.

3.7.5 Measurement locations

System noise measurements should be taken at the expected occupancy positions throughout the space, at approximate ear height for either seated or standing persons as appropriate for the space – i.e. 1200 or 1600mm AFFL respectively.

An indicative sample position can be chosen where there is little spatial variation in system noise level. Where significant spatial variation exists (e.g. close to a buzzing speaker) the location should be chosen to reflect the maximum recorded level.

3.7.6 Measured internal ambient noise

The internal ambient noise level must first be measured to assess the system noise level. Internal ambient noise measurements should be taken at the same location as the corresponding system noise measurement.

3.7.7 Reported noise level

The reported system noise level should be the maximum found across the expected occupancy positions in the space. The system noise level is:

- Acceptable, if it is indistinguishable from the internal ambient noise level
- Unacceptable, if it exceeds the internal ambient by more than 5dB.

3.7.8 Measurement conditions – inclusion of noise sources

Measurements should be made under the typically expected operating conditions of the space, i.e. with all heating, ventilation and air conditioning (HVAC) equipment operating, road traffic and building occupancy noise present.

Where an ambient noise source is known to be out of the ordinary, (e.g. building construction works) the measurement should be scheduled for a time when it is not present.

3.7.9 Sound level measurements

Both internal ambient and system noise levels must be measured with an integrating sound level meter, capable of measuring the Equivalent Continuous A-weighted sound pressure level (LAeq), over a 30s period.

3.8 System sound pressure levels–program and speech

System sound pressure levels (SPLs) should be consistent from space to space, regardless of their size. i.e. a lecture theatre's sound system should not necessarily be louder than a classroom just because it is a larger space. Larger spaces require attention to evenness of coverage, but not necessarily more SPL.

For this reason, the system SPL criteria apply to all spaces equipped with program playback and / or speech reinforcement systems.

For program audio playback in learning environments, sound systems should be capable of maximum SPLs commensurate with a foreground music reproduction system. i.e. the loudest one might comfortably operate a home Hi-Fi system.

For speech reproduction in learning environments, sound systems should be capable of average levels similar to unaided conversational speech at 1m. The system does not need to increase speech SPLs significantly above human levels, but should aim to deliver a similar level to all listeners.

3.8.1 Measurement locations – program SPL

Program SPL measurements should be taken at the nearest on-axis listener position for each loudspeaker system within a space (i.e. best-case listener position).

For point source loudspeaker systems:

- Outside the 'near-field' of the loudspeaker (at least 3x the height of the loudspeaker away)
- On-axis of the high frequency device in the loudspeaker
- Where multiple loudspeakers are part of a system (e.g. stereo), on axis of one chosen unit
- At ear height of either seated or standing listeners as appropriate

For distributed ceiling loudspeaker systems:

- Directly beneath one of the loudspeakers (i.e. on-axis of one chosen unit)
- At ear height of either seated or standing listeners as appropriate

3.8.2 Measurement locations – speech SPL

Speech SPL measurements should be taken at the furthest listener position from the presenter and furthest from the closest sound reinforcement loudspeaker (i.e. worst-case listener position), at ear height of either seated or standing listeners as appropriate.

3.8.3 Multiple loudspeaker systems

For systems consisting multiple loudspeaker systems, program and speech reinforcement SPL measurements should be taken with all channels driven, as per normal operation.

Where independent loudspeaker systems combine to form a complete system, separate SPL measurements should be taken at appropriate locations for each independent system, e.g.

- For main and fill loudspeakers in point source systems

- For each independent circuit (i.e. amp channel) in distributed ceiling systems

Recorded SPLs for separate loudspeaker systems should match to within a tolerance of 3dB.

3.8.4 Reported SPLs

The reported program SPL should be the maximum achieved by the system at the nearest listener position.

User volume controls should be at maximum during the measurement.

The reported speech SPL should be the average level achieved by the system at the furthest listener position, over a 30s period of continuous speech.

If user control of speech SPL is provided, it should be at its maximum level – before feedback – during the measurement.

3.8.5 Input signal

Program SPLs should be measured with a broadband pink noise signal input.

Speech SPLs should be measured with a live talker, using the microphone(s) provided for the presenter. The live talker should provide a slightly raised vocal effort, typical of a talker presenting to a group of listeners.

Where multiple microphones are provided, the speech SPL should be measured and reported for each.

3.8.6 Sound level measurements

Program SPLs must be measured with an integrating sound level meter, capable of measuring the overall A-weighted sound pressure level using a slow integration time (dB(A)Slow).

Speech SPLs must be measured with an integrating sound level meter, capable of measuring the Equivalent Continuous A-weighted sound pressure level (LAeq), over a 30s period of continuous speech.

3.9 Frequency response – program and speech

The response of installed sound systems should be adjusted to provide an even balance between frequencies across the audible spectrum. For both program and speech systems, the ideal target is a flat frequency response from 100Hz to 10kHz.

3.9.1 Measurement locations

Program frequency response measurements should be taken at the same position used to measure the program SPL from each loudspeaker system.

Speech frequency response measurements should be taken at the same position used to measure speech SPL. The same 'worst case' listener position should be used.

3.9.2 Reported frequency response

The reported program frequency response should be that achieved by the system at 75% volume, at the measurement position. i.e. the user volume control should be at 75% during the measurement.

The program frequency response is:

- Desirable, when all deviations fall within ±3dB;
- Acceptable, when all deviations fall within +3/-6dB;
- Unacceptable, when any deviations fall outside +3/-6dB; over the range 100Hz to 10kHz.

The reported speech frequency response should be that achieved by the system at nominal volume at the 'worst case' listener position.

The speech frequency response is:

- Desirable, when all deviations fall within ±3dB;
- Acceptable, when all deviations fall within +3/-10dB;
- Unacceptable, when any deviations fall outside +3/-10dB; over the range 100Hz to 10kHz.

Note: the speech frequency response criteria allows for greater negative deviations to account for the expected roll-off in high frequency from ceiling speaker systems when measuring at the 'worst case' position, off-axis.

Care should be taken to ensure dips in measured frequency response due to measurement conditions – e.g. floor bounce, side wall reflection, loudspeaker crossover etc. – are excluded from the assessment of frequency response.

3.9.3 Multiple loudspeaker systems

For systems consisting multiple loudspeaker systems, program and speech reinforcement frequency response measurements should be taken with all channels driven, as per normal operation.

Where independent loudspeaker systems combine to form a complete system, separate frequency response measurements should be taken for each independent system, e.g.

- For main and fill loudspeakers in point source systems
- For each independent circuit (i.e. amp channel) in distributed ceiling systems

3.9.4 Input signals

Program and speech frequency response measurements can be made with any signal suitable for 2-channel Transfer Function (TF) measurements as an input. E.g.:

- Broadband pink noise
- Swept sine signal (chirp)
- Minimum length sequence (MLS)

The input signal can be electrically connected to the speech reinforcement system directly, e.g. using a line input connection. It is not necessary to use a simulated talker loudspeaker with the system’s microphone(s).

3.9.5 Measurement type

Program and speech frequency response measurements should be made as 2-channel, Transfer Function (TF) measurements, using a Fast-Fourier-Transform (FFT) based analyser.

3.10 Speech Transmission Index

Detailed guidance regarding Speech Transmission Index (STI) is provided in IEC Standard 60268-16:2011, Sound system equipment - Part 16: Objective rating of speech intelligibility by speech transmission index. Refer to IEC 60268-16:2011 and its references for a complete description of STI, its measurement and application.

Sound systems for both program playback and sound reinforcement should be adjusted to yield acceptable speech intelligibility, as accurate reproduction of speech is the primary use of sound systems in learning environments.

With the exception of RASTI, any of the methods outlined in IEC 60268-16:2011 is suitable for measuring STI. The STI-PA method is recommended for its convenience, as it is fast, and can be implemented using a hand-held device. Full STI calculated from analysis of a system impulse response is also possible, but typically requires more time on-site and in post-processing.

3.10.1 Measurement locations

STI measurements should be taken at a minimum of 4 measurement locations, including:

- The nearest on axis listener position (i.e. best-case listener) for each independent loudspeaker system
- The furthest listener position (i.e. worst-case listener) for each independent loudspeaker system
- Any locations where STI may be degraded, e.g. close to a noise source

3.10.2 Reported STI

The reported STI values for program systems should be that achieved by the system at 75% volume, at each measurement location. i.e. the user volume control should be at 75% during the measurement.

The reported STI values for speech reinforcement should be that achieved by the system at nominal volume.

As per IEC 60268-16:2001, at least three STI measurements should be taken at each measurement location. If the variance between the first three measurements is greater than 0.03, another three (for a total of six) should be taken. The reported STI for each location should be the average of the three (or six) measurements.

3.10.3 Input signals

As STI can be measured by several methods as defined in IEC 60268-16:2001, there are numerous appropriate input signals. Signals for the two recommended methods are discussed below.

If using the STI-PA method, use the specific STI-PA test tone supplied with your measurement device.

If calculating STI from a system impulse response, use any signal suitable for 2-channel Transfer Function (TF) measurements as an input. E.g.:

- Broadband pink noise
- Swept sine signals
- Minimum length sequence (MLS)

The input signal can be electrically connected to the speech reinforcement system directly, e.g. using a line input connection. It is not necessary to use a simulated talker loudspeaker with the system’s microphone(s).

3.10.4 Multiple loudspeaker systems

For systems consisting multiple loudspeaker systems, program and speech reinforcement STI measurements should be taken with all channels driven, as per normal operation.

3.10.5 Separate program and speech systems

Where both program playback and speech reinforcement systems are present in a space, separate STI measurements should be made for each. A different set of measurement locations may be required for measurement of each system.

3.11 Venue lighting

3.11.1 Standards compliance

All lighting must meet the requirements of the Australian and New Zealand Standards – AS/NZS 1680 for Lighting (as amended) and relevant building codes. The particular sections that venue lighting must adhere to are:

- AS/NZS 1680.2.1:2008 (as amended) Interior and workplace lighting – Specific applications – Circulation spaces and other general areas
- AS/NZS 1680.2.2:2008 (as amended) Interior and workplace lighting – Specific applications – Office and screen-based tasks
- AS/NZS 1680.2.3:2008 (as amended) Interior and workplace lighting – Specific applications – Educational and training facilities

3.11.2 Lighting arrangement in venues

AV Services must be engaged to assist with the design of lighting in venues. The aim is to control all ambient (venue lighting, sunlight etc.) light to meet the required contrast ratio of the projected image, provide suitable note taking light, illuminate the presenter and any demonstration or presenter workspaces. All lighting and environment is to be controlled through the venue audio visual control system, the electrical contractor must provide an interface at the audio visual equipment rack location. AV Services are to be provided with a draft copy of CBUS/Lighting System programming configuration prior to hand over, to review and approve groups and channels. All lighting control systems are to be configured to the specified lighting VLAN.

Examples are shown overleaf of typical lighting arrangements in reaching venues.

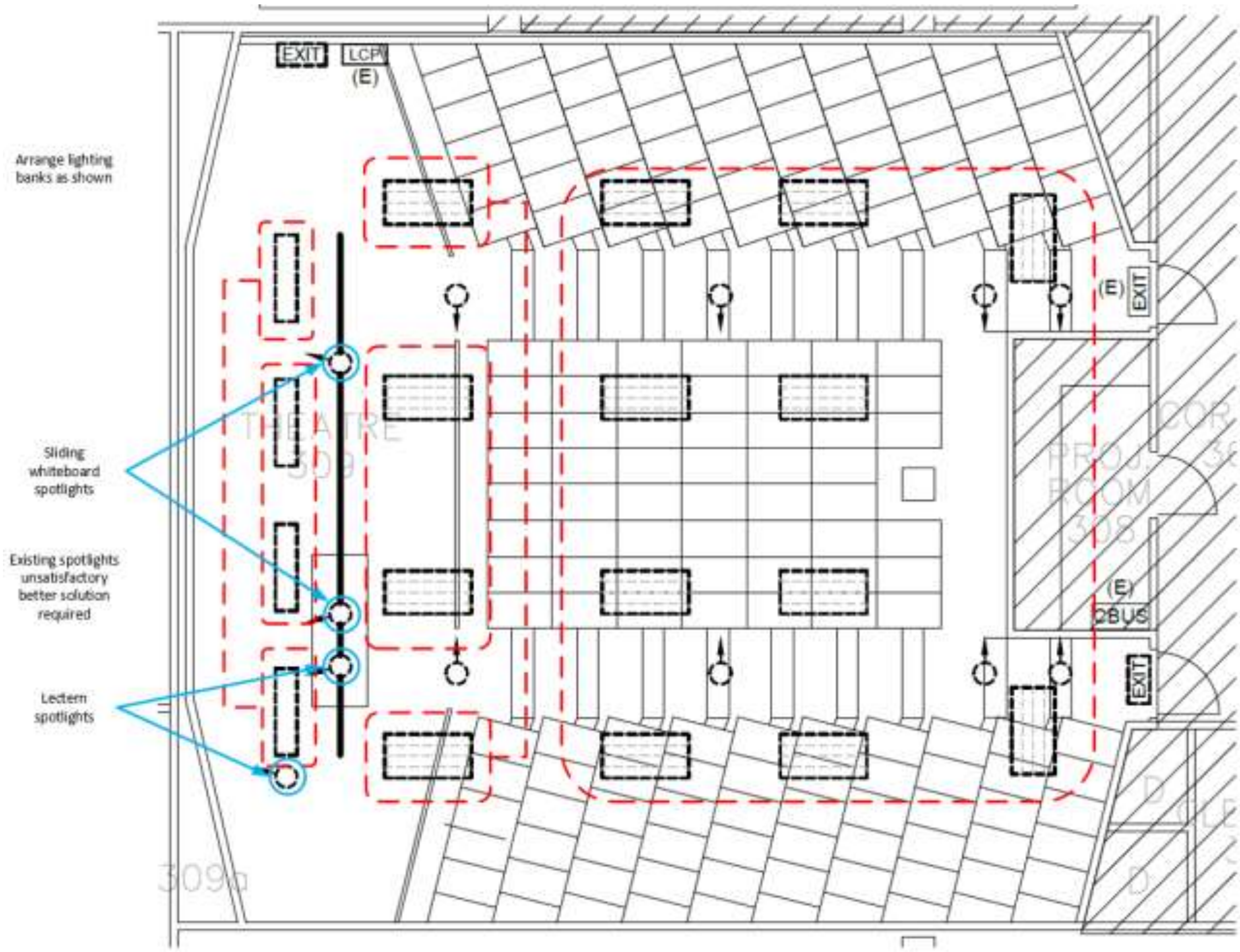

Figure 3 - Lecture theatre

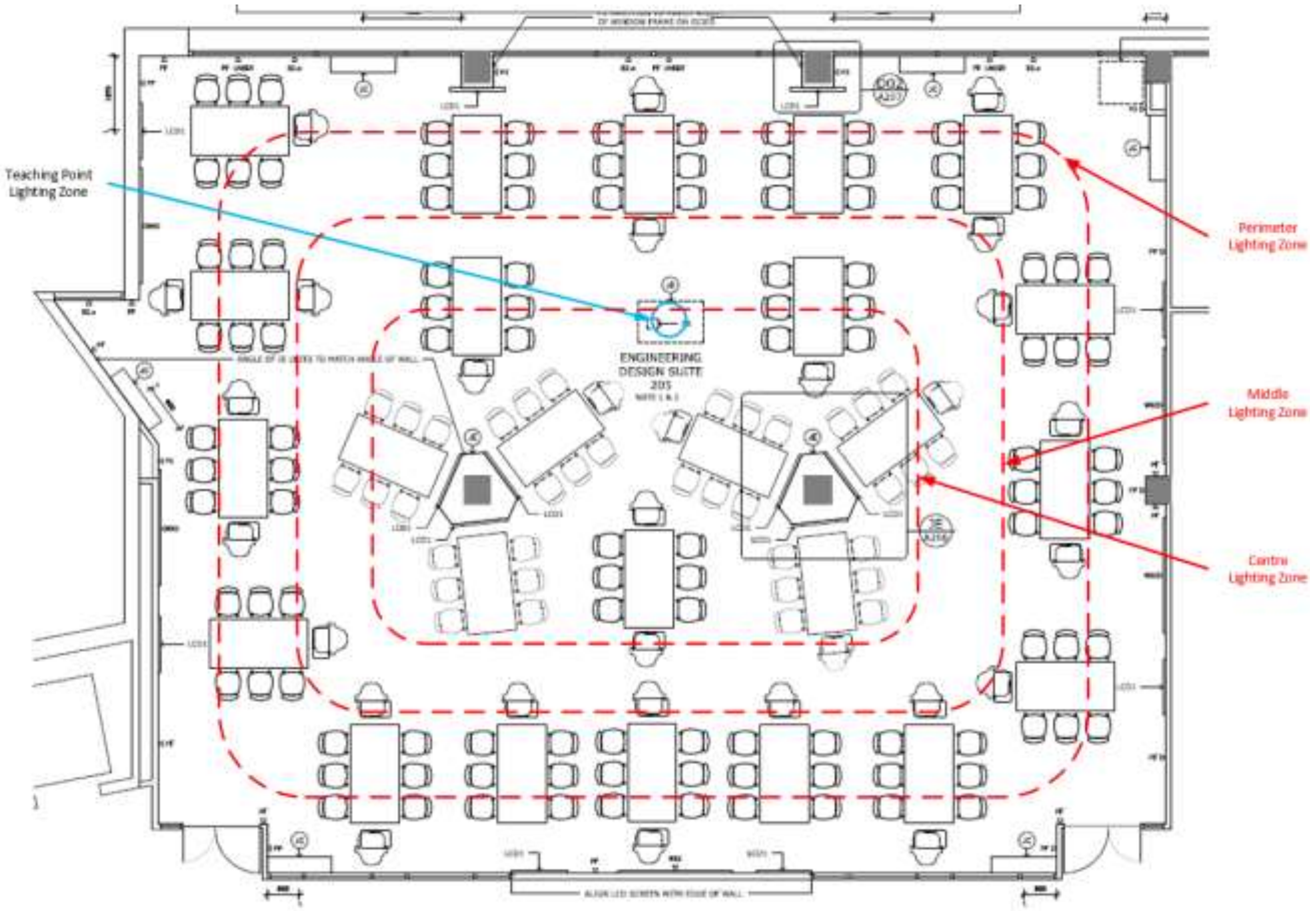

Figure 4 - Flat floor small group space

3.12 Audio visual equipment housing and cabling

3.12.1 Joinery provisions for equipment racks and equipment

In spaces that Audio Visual equipment is present, there must be lockable, ventilated and AV Services approved joinery. Provisions for power, data and audio visual connection cables must be made within the joinery. Suitable clearance between the equipment rack and services connections must be maintained.

Lectern and workbench areas will be coordinated to allow for devices to be permanently fixed (where applicable) whilst maintaining a sizeable work area for teaching materials.

All joinery or housing containing audio visual equipment must be keyed to The University's Audio visual key set (Abloy key – ITN-12).

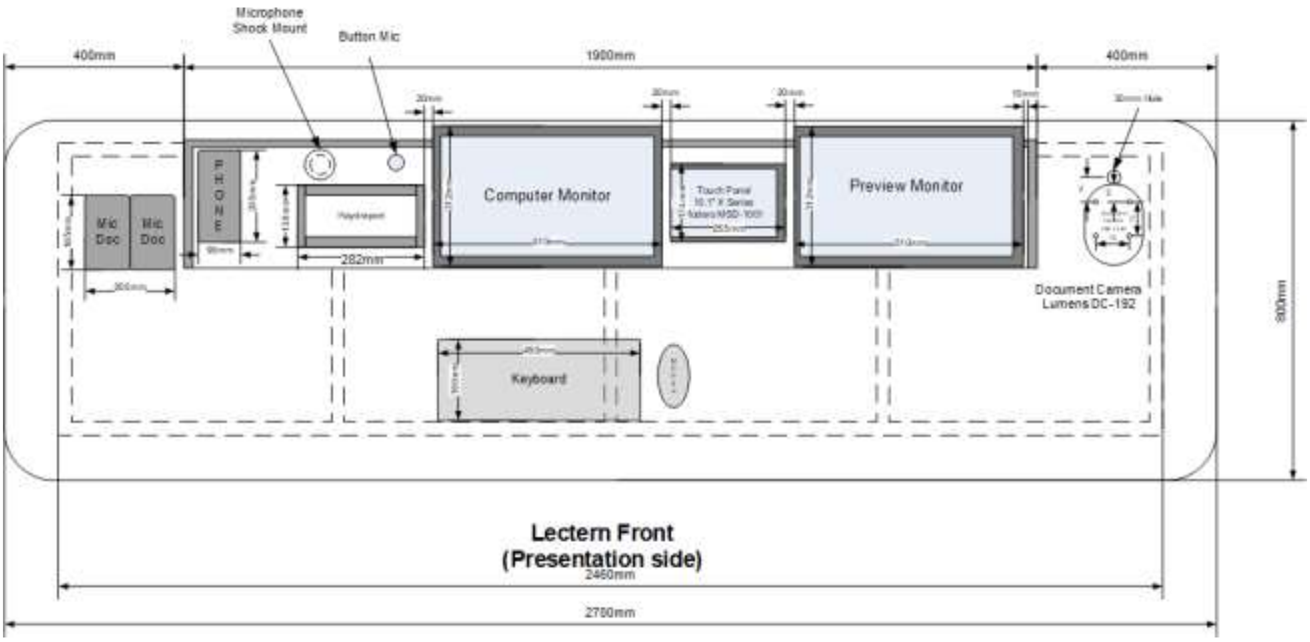

Figure 5 - Typical lecture theatre lectern layout

AV Services have a standard design lectern for venues outside of lecture theatres. AV Services preferred joiner is MigDesign. Shop drawings can be provided at request for manufacturing. Any deviation for the design mus tbe submitted for approval by the AV Services Manager.

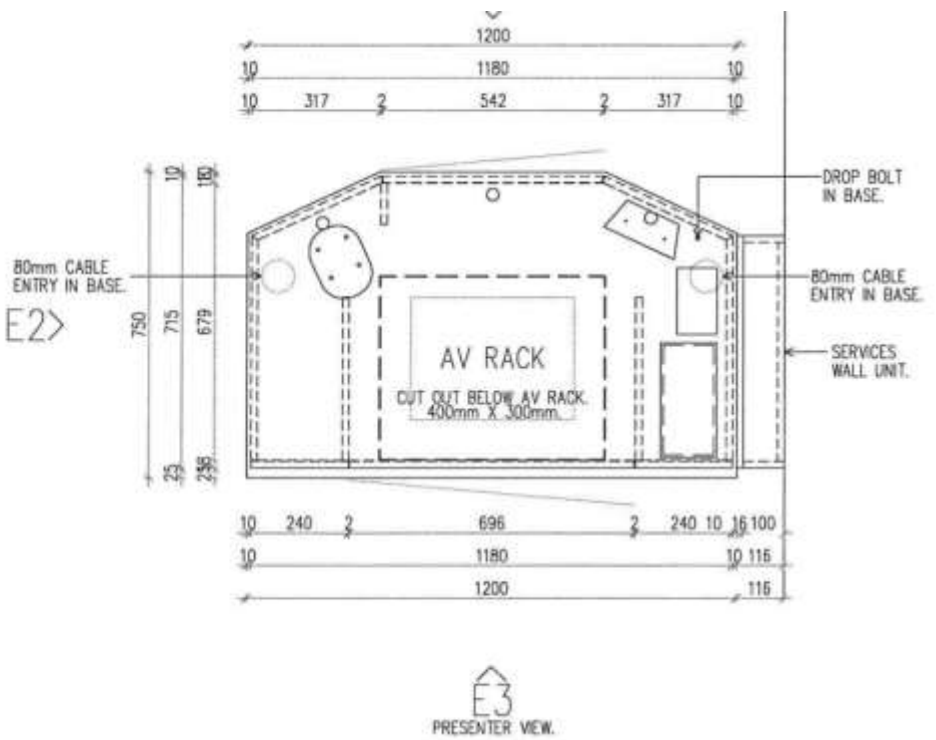

Figure 6 - Standard lectern design

3.12.2 Maintenance access

Front and rear access for audio visual equipment racks or suitable cable length (as to allow an equipment rack on casters to be removed from joinery and maneuverered to allow front or rear access) is required for all spaces. Enclosed equipment rack areas should have enough clearance for technicians to freely be able to remove equipment with the need of dismantling joinery, equipment rack or equipment.

There must be a clearance of any equipment rack access of at least 800mm.

3.12.3 Ventilation

All joinery containing audio visual equipment needs ventilation, there must be vents at the bottom of the joinery to bring cool air in and vents towards the top of the joinery to allow warm air to be exhausted. Vent covers should be selected or manufactured to reduce intrusion of rodents.

The temperature of the equipment rack should not exceed 40 degrees, this can be managed by utilising active cooling equipment. Cooling equipment can be in either the form of low voltage fans or rack mounted fan arrays.

3.12.4 Standard rack assembly

All equipment racks are to be Elgee 19" Reinforced Rack Frames, with additional structural reinforcement. Devices that are not able to be rack mounted will reside on an equipment shelf and held in place with Velcro, in a way that is easy for removal. Rack shelves and equipment allocation will be documented in provided audio visual schematics for each project.

8-way rack mounted PDUs and Network Services approved switches are to me mounted at the rear of the rack, with the network cabling facing outwards.

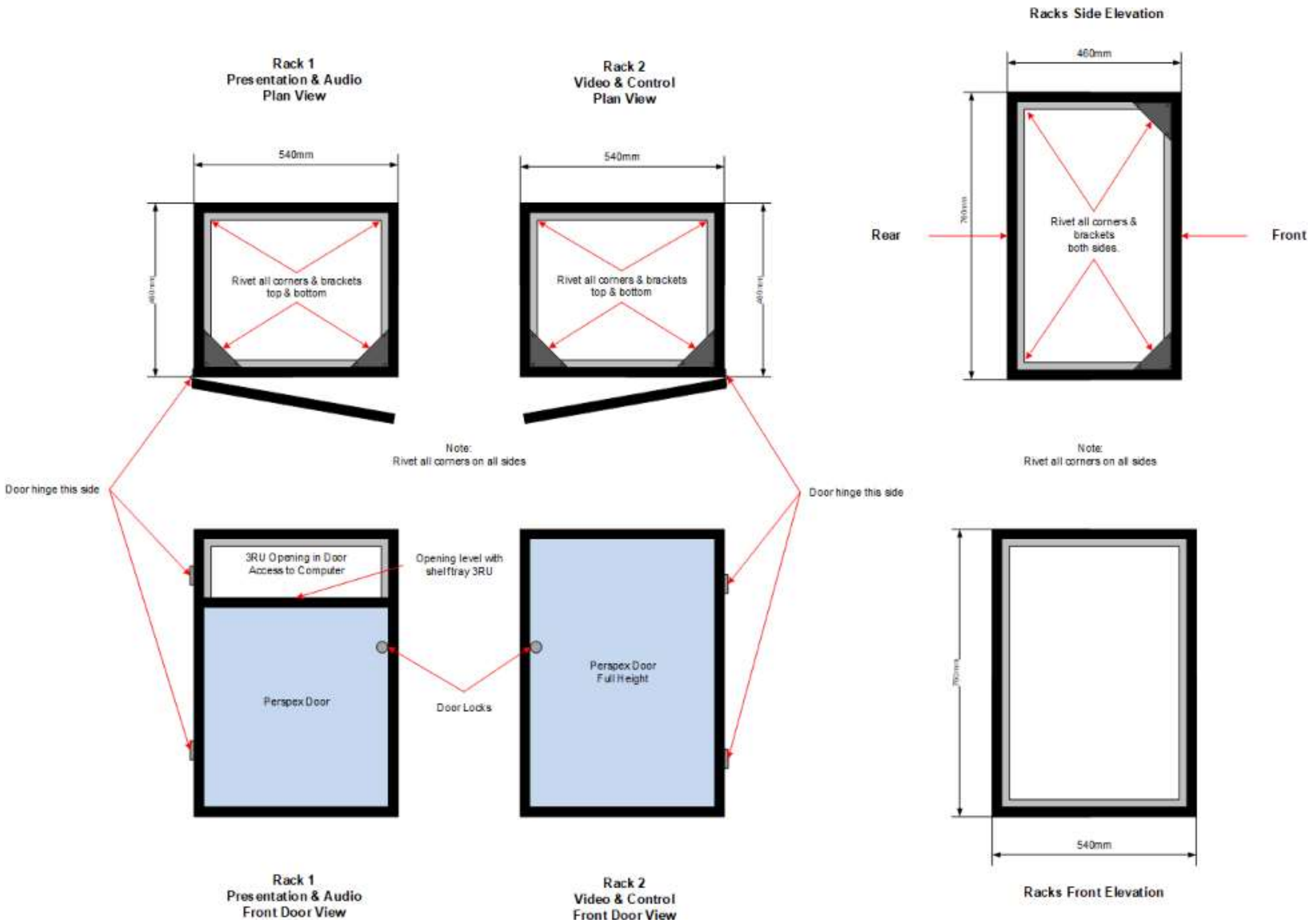

Figure 7 - Typical equipment rack build

3.13 Equipment rack cabling management

3.13.1 Standard of works

Wiring and workmanship must comply with the relevant standards provided by Standards Australia and the International Organisation for Standardisation, including all future amendments. Subsequent cabling works must comply with requirements of the Electric Supply Authority Regulations, Australian Communications and Media Authority, the Building Code of Australia and the Insurance Council of Australia.

All audio visual devices must reside on the same power circuit, as to not introduce electrical interference between equipment.

All cabling contained within the equipment rack must be supported by lacing bars and held in place by Velcro straps. Any cabling feeding into the rack externally will be bundled together and contained within a nylon cable jacket.

When cabling is broken out from the nylon cable jacket, low level audio, video, control and any other low voltage cables will be run on the left-hand side of the rack (when viewed from the rear). Power and amplified audio cables will reside on the right-hand side of the rack. In the case of multiple racks, cable runs will alternate between sides as to lower the risk of interference.

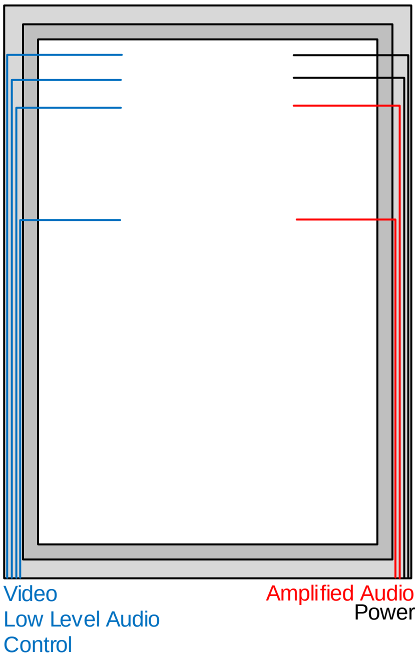

Figure 8 - Cable pathways for equipment racks

3.13.2 Cable termination

All internal cabling must be cut to suitable length to ensure excessive cabling is not left in the rack. Terminal blocks, connectors or plugs will be provided by the contractor for all cables that interface with audio visual equipment.

Cables and any specific connectors will be specified by The University on the Bill of Materials.

Exposed wiring at the equipment end must have the wire strands twisted back and be covered with heat shrink tubing.

3.13.3 Cable labelling

All equipment rack labelling must be labelled with adhesive labels and clearly display cable number from The University's provided cable schedule. Labels will be affixed to both ends of the cable and must have printed text (handwritten will not be accepted). Fixed labels (affixed to other devices such as touch panels etc.) are to be engraved metal or plastic laminate.

3.13.4 Network cabling

All rack network cabling and visible network cabling can be performed by the AV Contractor. Any concealed cabling (cable that is run not viewable such as to IP Cameras mounted in the ceiling, floor track or down door frames to Room Booking panels) must be completed by a licenced communications cabling system installer.

All network cabling must be TE Commscope CAT6/CAT6A, which will be specified on the Bill of Materials.

Network cabling utilised for transferring Audio and Video (HDBaseT/Extron DTP etc.) mustbe TE Commscope CAT7 F/FTP Orange (171163-2). This cable must have its own pathway created and not run along the current UofA Communications paths (e.g. cabling must have its own separate catenary run in the ceiling space).

3.14 Whiteboards and writing surfaces

3.14.1 Standard type

All writing surfaces in teaching spaces must be dust free, this will be achieved by using whiteboards and dry erase pens. Dust from chalkboards are damaging to audio visual equipment and have negative health impacts. The standard surface for whiteboards is enamel on steel. Trays must be provided to store pens and erasers, the tray needs to be installed in a location as to not obstruct any users.

Fixing height

All white boards will be mounted where the edge of the writing area must not exceed 900mm, or be lower than 850mm from the finished floor level.

3.15 Digital signage

3.15.1 Standard digital signage

Digital signage screens will be specified on a per location basis taking into consideration content size and reach as well as the environment. Digital signage systems will consist of an LCD Display and signage player. Each digital signage location will require dual power and data unless otherwise specified.

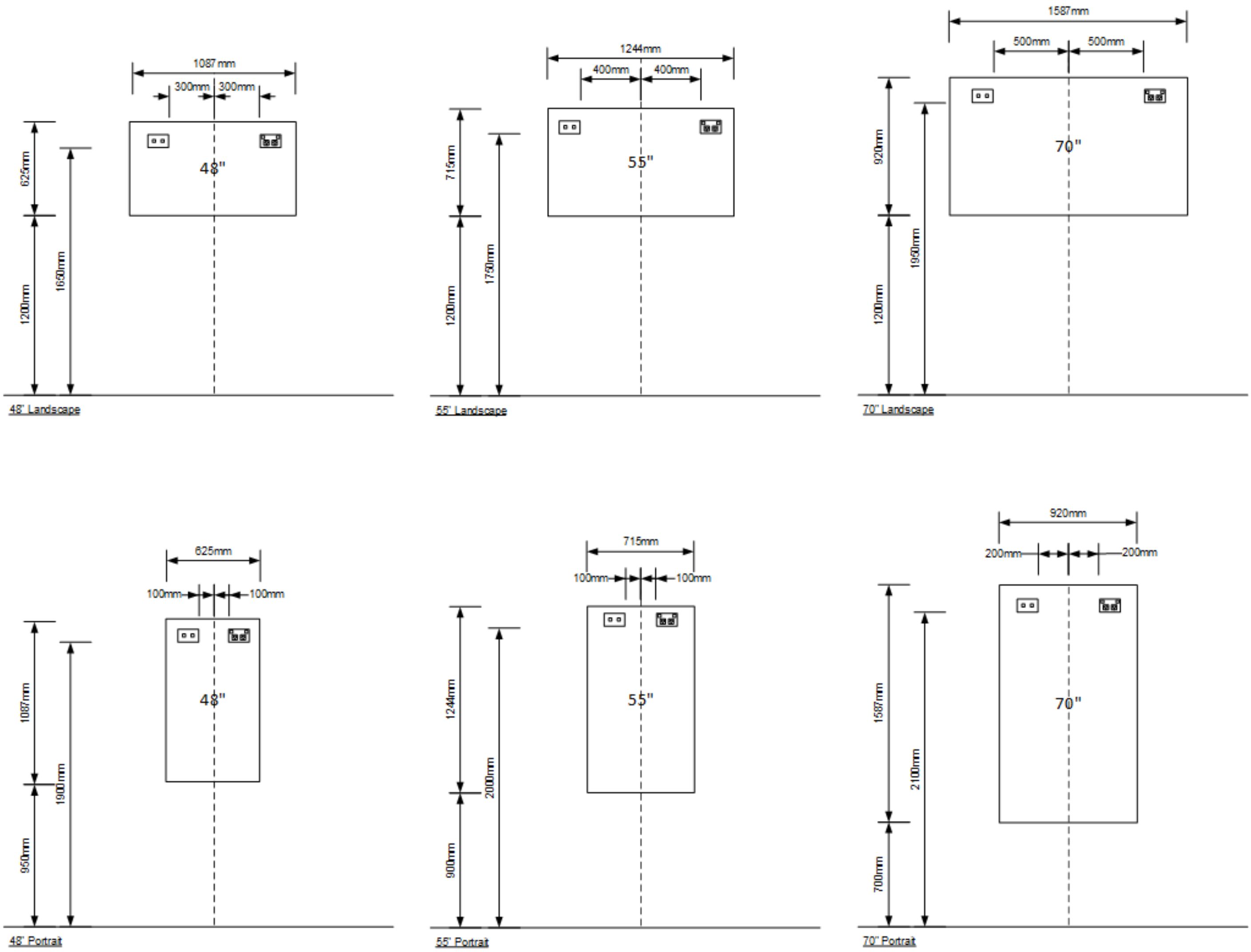

Figure 9 – Typical mounting heights for digital signage

3.15.2 Digital wayfinding

Digital wayfinding screens will be specified on a per location basis taking into consideration content size and reach as well as the environment. Digital Wayfinding systems will consist of an Interactive LCD Display/Kiosk and signage player. Each digital signage location will require dual power and data unless otherwise specified.

3.16 Room booking panels

All Room Booking panels must be capable of displaying both Microsoft Exchange calendar bookings as well as bookings from Scienta Syllabus +. Room Booking panels will have LED indicators to show room availability, touch enabled and be either wall mountable or mountable to door frames. Room Booking panels must be mounted in landscape orientation and mounted between 900mm and 1200mm AF L to allow user interaction where required. In the case where the Room Booking Panel is installed to a doorframe, the data contractor must install network cabling to the room booking panel position for connection.

3.17 Video conferencing

Video conferencing will be carried out via a software and any associated hardware (Microphones/Speakers etc.) must be compatible with the software. All spaces mustbe designed in consultation with AV Services to ensure all acoustics, lighting and equipment requirements are addressed.