SECTION 27

AV STANDARDS FOR JCU CLASSROOMS AND LECTURE THEATRES

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2.01	3/6/2014	Derek Powell	Draft for VAVS approval
2.02	3/6/2014	Derek Powell	With VAVS Comments
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27.0 AV STANDARDS FOR JCU CLASSROOMS AND LECTURE THEATRES

This document is a section of the James Cook University (JCU) Design Guidelines and is not to be read in isolation. Consultants and Contractors are required to comply with all sections of the JCU Design Guidelines.

27.1 Design Approvals

The consultant shall be held responsible / liable for ensuring that all works necessary for the complete installation and successful operation are included in the design and specifications.

Any non-conformances to these guidelines shall be approved in writing by the JCU Estate Directorate, Deputy Director, Planning and Development.

27.2 General

Audio-visual fit-out within JCU facilities is generally within two distinct areas – Common Spaces and Faculties/Schools.

27.2.1 Common Spaces

Common space areas are used for teaching across all faculties of the University and have standard minimum requirements which must be met. Common spaces are generally specified under nine categories:

- Large Theatre
- Seminar Room
- Teaching Room
- Boardroom
- Meeting Room
- Tutorial room
- Collaborative space
- Specialty Lab
- Computer Lab

Video-Conferencing and Audio Visual Services (VAVS) are responsible for the common area audio-visual requirements for James Cook University and the responsible University Audio-Visual Officer can be contacted on 07 4781 3273.

The Project Manager and the Principal or Lead Consultant must be guided by Video-Conferencing and Audio-Visual Services when preparing tailored audio-visual specifications, during all design phases, on a room-by-room basis.

All common spaces must be designed for equitable access and to enable mobility, including:

assistance to hearing-impaired people using the JCU standard Williams Sound Infra-Red hearing assist systems where appropriate .

27.2.2 Divisions/Colleges

Within the Division/College facilities there are varying arrangements on the provision of audiovisual services which may be augmented according to special requirements of the Division. The Project Manager and Principal or Lead Consultant shall liaise with the College to establish the most appropriate means of determining the requirements and scope for AV provision in Division or College based spaces. Equity and access must still be considered however.

In many instances there is now a need to record teaching activities or to incorporate the ability for students to access College facilities from remote locations. This will require close linking of the audio-visual systems with the computer networking systems operating within Colleges and an investigation of these requirements should be undertaken by the project team early in the project's development and approved by the User Groups and JCU Project Manager in SD.

27.2.3 Specialist Designers and Contractors

The engagement of specialist audio-visual consultants must be considered in all new construction projects involving audio-visual requirements in JCU teaching Spaces.

Any contractor, involved in the installation of Audio Visual equipment in JCU Common teaching spaces must be an AV systems contractor, normally engaged in the business of AV system installation. The AV Contractor shall not be a general electrical contractor only. The AV Contractor shall be able to demonstrate that the company has been engaged in AV system installation for a substantial period and has completed projects of a similar size and scope.

It is a mandatory requirement that the contractor shall be an authorised dealer for the major lines of equipment to be supplied.

The contractor must provide evidence that their staff:

- hold a current ACMA licence for the installation of communication cabling
- hold suitable and approved industry qualifications (such as the CTS issued by AVIXA)
- employ programmers and commissioning staff who hold specific manufacturer-issued certifications for the control and DSP equipment to be installed

27.2.4 Purchasing

The University maintains a number of purchasing arrangements such as the University Procurement Hub (UPH) covering AV equipment and installation services. JCU business units should investigate existing arrangements before committing to purchasing AV equipment and services to be sure maximum advantage is taken of these arrangements.

27.2.5 Departures from Standards

Any departures from these standards must be approved in writing by JCU Video-conference and Audio Visual Services (VAVS) through the JCU Project Manager prior to contracts being entered into.

27.3 Responsibilities and Process

Since all AV equipment and systems will have to fit within JCU's existing AV infrastructure and support mechanisms, VAVS staff shall be involved in the process from the Concept Design phase. JCU VAVS staff maintain installed equipment, so they are in every sense a stakeholder.

- ***Audiovisual equipment in general teaching spaces must be as specified by VAVS***.
- ***For projects involving the installation of AV equipment a specialist must be appointed to act as consultant in conjunction with the architect. This may be a specialist audiovisual consultant or (on smaller projects) a nominated audiovisual contractor or VAVS may act as the audiovisual consultant.***
- ***On some projects, VAVS may act as the installation contractor (where appropriate) or may nominate an approved audio visual contractor.***

27.3.1 Process

JCU endorses the process outlined in the *AETM Audio Visual Design Guidelines* (www.aetm.org) for involving JCU staff at key points in the design process. The guidelines set out processes based on ANSI/Infocomm Standard 2M-2010 (*Standard Guide for Audio Visual Systems Design and Coordination Processes*) for the engagement of the JCU AV staff that include the following stages:

Project Initiation

In addition to the AV designer, the institution's AV Services staff should be involved in briefings during the project DD phase. VAVS should be advised in writing of the proposed:

- Critical dates and milestones
- Project Stakeholders
- External Consultants

Consultation

Consultation with JCU VAVS staff is essential for any project where the proposed functionality of the space requires presentation technology. In particular, VAVS staff must be given adequate notice of the proposed tender issue dates to:

- Allow for the preparation of AV specifications; or (where a consultant is involved)
- Allow for the review of such specifications prior to issue

Communication

JCU VAVS management must be informed of project related site meeting schedules and consultant meetings where appropriate. Specific documentation for each project is to be forwarded to the VAVS management. Note that drawings should be supplied in electronic form for mark-up.

Approvals

Components detailed in AV specifications supplied either by VAVS staff or as part of approved tender documentation provided by consultants cannot be substituted without the express written consent of the institution. For verification of specified components, sub-contractors must produce samples for inspection by a representative of VAVS.

Acceptance Testing

VAVS staff will inspect the installation to confirm that it complies with these specifications.

27.4 Classification System for General Teaching Spaces

The level of AV facilities to be provided in general teaching spaces are classified as follows. Spaces in any category may or may not include videoconferencing facilities. In general the minimum AV specification for these categories are:

Large Theatre	Single or Multiple projectors Desktop PC Laptop interface Visualizer/Document camera PA system with lectern and wireless microphones	Typically a large Tiered Lecture Theatre with high definition wide screen projection capable of displaying two different images simultaneously. May have Videoconference facilities with two cameras (presenter and audience) and separate content transmission channel. May have some group collaboration capabilities.

Seminar Room	Multiple projectors or flat panel displays Desktop PC Laptop interface Visualizer/Document camera	Typically a large flat floor classroom with high definition wide screen projection capable of displaying two different images simultaneously May have Videoconference facilities with two cameras (presenter and audience) and separate content transmission channel
Teaching Room	Single projector or flat panel display Desktop PC Visualizer/document camera Laptop interface	Typically a Medium sized Tiered or flat floor classroom used for local teaching
Boardroom	Single or multiple flat panel displays Desktop PC Laptop interface Visualizer/DocCam	Boardroom table style room usually with videoconferencing facilities.
Meeting Room	Single or multiple flat panel display Laptop interface	Boardroom table style room or smaller. May or may not have videoconferencing capabilities.
Tutorial room	Single flat panel display Desktop PC Laptop interface	Smaller teaching space typically used for tutorials and smaller groups.
Collaborative space	Multiple large flat panel displays May have single or multiple projection system Desktop PC Laptop interface Visualizer/Document Camera	Group displays with or without centralised display. Can be used as a collaborative learning space or individual group learning.
Specialty Lab	Several large flat panel displays Desktop PC Laptop interface Visualizer/Document Camera	AV equipment interfaced with specialist devices or configured for customised requirements
Computer Lab	1x projector or flat panel display Desktop PC Laptop interface	Computer lab equipped with centralised display and student computers.

Further information may be obtained at the VAVS website at http://www.jcu.edu.au/videoconferencing

27.5 Equipment Specifications

Audio visual equipment must adhere to the specifications and brands determined by VAVS. Details of current standards, and approved brands and models will be documented on the VAVS website.

27.5.1 Allowable Equipment

To ensure compatibility with JCU systems and spares holding the following preferred manufacturer's equipment shall be specified. Other brands of equipment should be noted for approval.

Control systems	Extron
Touch Panels	Extron
Audio DSP	BIAMP, QSC
Switchers	Extron
Audio systems	Bose, JBL, Crown, Australian Monitor
Radio Microphones	Shure, AKG
Hearing Augmentation	Williams Sound – IR systems
Data projectors	Panasonic Lamp-less projectors where ever possible
Flat panels	Panasonic, Sony, Samsung or other leading brands
Videoconferencing codecs	Cisco
Presentation Interfaces	Extron
Document cameras	Lumens
Wireless Presenters	Kramer
Lectern furniture	Team Mate
PTZ Video cameras	Sony, PTZ Optics, AVerMedia

27.5.2 Interface with JCU Supplied PCs

Where PCs are specified in designs the interface to the AV system should typically provide for HDMI connection.

Laptop interfaces should support HDMI. Liberty Ring adaptors should be provided for USB-C.

Designers should consult staff from JCU's IT Services and Support with regards to the make and model of computers that will be supplied, currently the latest model Dell and Apple computers.

27.6 Projection Specifications and Sightlines

Projection facilities in teaching rooms must be designed to comply with the size and viewing angle requirements described in the current edition of the AETM *Audiovisual Guidelines for Tertiary Teaching Spaces.* The minimum specifications (rules) from the AETM Guidelines are as set out below. (See also the Section in this document on *Teaching Spaces*). To remain in compliance with the JCU design guidelines, no more than 10% of the seats in any teaching space may fall outside any rule.

The acceptable area for audience placement in front of a screen is determined by:

- the horizontal and vertical angle of view
- the distance to the display for the furthest viewers
- clear sightlines to both the projected image and the presenter for all viewers

27.6.1 Rule 1: Screen Height and Maximum Viewing Distance

In general classrooms, the height of the projection screen or flat panel display shall be no less than the distance from the centre of the screen to furthest audience member divided by 6. In specialist instructional spaces a more stringent standard may be applied and the height of the projection screen or flat panel display shall be no less than the distance from the centre of the screen to the furthest audience member divided by 4. This follows the international Infocomm/ANSI standard.

27.6.2 Rule 2: Maximum Horizontal Viewing Angle

The maximum horizontal viewing angle shall be 45 degrees angle from the centre line of the screen. Where multiple screens are in use, with different information on both, then the horizontal viewing angle shall not exceed 45 degrees to the opposite edge of the furthest projected image. (see below) The legibility of text and images will be too compromised at greater angles. For wide spaces, repeater screens may be an option.

27.6.3 Rule 3: Maximum Vertical Viewing Angle

The maximum vertical viewing angle shall be no more than (plus or minus) 15 degrees to the centre of the image, measured from perpendicular at seated eye height (1270mm AFFL) from the front row centre seat. For tight spaces, this rule may be relaxed to a maximum angle of 35 degrees to the TOP of screen.

27.6.4 Rule 4: Screen Bottom Edge Minimum Distance from the Floor

For flat floor venues with an unobstructed view the screen shall be positioned so that the bottom edge of the viewable area is no less than 1.2m above the floor.

27.6.5 Multiple Screens

Where screens are used for the presentation of different material, the angles of view and viewing distances must be considered for each screen.

27.6.6 Screen Aspect Ratio

The recommended aspect ratio for classroom displays is widescreen format. In circumstances where projection alone is used for display, the 16:10 aspect ratio provides an optimum display for PC based instruction. Where a mixture of large screen monitors and projection is used, a 16:9 aspect ratio is recommended for projection screens to avoid distortion of one format or the other.

These guidelines for viewing are reproduced for convenience only. The applicable standards shall be the latest AETM revision. Refer to the AETM website www.aetm.org for the latest version of these guidelines.

27.7 Services & Environment

Services (including power and network) must be specified and provided to suit the requirements of the AV equipment fitted to the room. The following recommendations are minimum requirements for the various fit-out categories.

27.7.1 Power

Where possible all audio visual equipment should be on the same power circuit. If more than one circuit is required, the circuits should be on the same phase.

Power requirements for Audio Visual equipment should be specified by the Audio Visual Consultant.

Switched and Metered-by-Outlet power distribution units (PDU) by CyberPower must be provided with enough outlets for each AV component residing in the AV rack.

27.7.2 Network

Requirements for Network ports for Audio Visual equipment should be specified by the Audio Visual Consultant. The table below sets out the minimum requirements for network provision in the various categories of AV fit-out. Managed Network Switches can be installed into AV lectern/workbenches to reduce the amount of structured cabling.

All network ports should be connected to the VLAN virtual subnet allocated to lecture theatres on the relevant campus. Integrators must submit a list of serial numbers and MAC addresses to JCU for equipment to be connected to the network and will be provided with IP addresses to suit.

27.7.3 Phone

An internal - only telephone should be provisioned at (or adjacent to) the teaching position in teaching spaces and in the Bio box (where applicable) in lecture theatres.

In videoconference equipped spaces, one data outlet should be provided for the connection of an IP telephone handset, preferably with hands free capability.

27.7.4 Electrical Test and Tag

All mains powered equipment installed by the contractor should be electrically tested prior to installation.

27.7.5 Equipment Housing

The preferred location for audio visual equipment in teaching spaces is in the lectern or at the teaching position. Where the amount of equipment required exceeds the available space, equipment not requiring user operation (such as power amplifiers) should be located in a purpose designed equipment room. Unless specified otherwise by the Architect or JCU Project Manager, where a lectern is to be supplied as part of the installation it shall be a *Team Mate* brand lectern or similar.

Regardless of the location, audio visual equipment should be installed in standard 19" racks. Racks must provide convenient access to the front and rear of the equipment. Where racks must be installed in joinery (e.g. in a meeting room), and where rear access or side access cannot be provided, the joinery must allow the rack to be easily slid out for servicing. If the rack is not mounted on a self-supporting sliding frame, then there must be no plinth, and there must be sufficient width and depth (clear of obstructions such as hinges) for the rack and cables to be removed completely from the joinery and turned through 90 degrees.

Regardless of location, there must be sufficient ventilation (air flow) to prevent unacceptable temperature rise. The specifications for ventilation and air-conditioning for AV equipment shall be the same as applying to JCU Network equipment.

27.8 Special Considerations for Videoconferencing

27.8.1 Design Issues

Many of the design issues for videoconference equipped spaces are similar to those for spaces where audio visual displays are used, but because communication is two-way, involving the use of microphones and cameras, matters of acoustics, space design and lighting are even more important.

27.8.2 Room Layout:

Backgrounds can add to the clutter or distract from the focus of a conference. To ensure a suitable background, consider the following:

- Avoid moving backgrounds such as curtains in a draft or people walking behind

- Locate doors either side or at the back of the room so that people can exit without crossing the camera's field of vision.

- Rectangular-shaped rooms are best for meetings with four or more people - all participants should be within the camera's view. Square rooms are suitable for smaller meetings with less than three people.

- Avoid white or very light colours that will reflect the light and make it difficult to see the participants' faces. Avoid shiny surfaces.

- Wall finishes should be free from patterns that may create difficult working conditions for cameras. Patterns create more detail in the image making it difficult to compress resulting in jerky images.

- The curtains and wall coverings in your room should be as simple as possible. Medium to pastel blue tones provide good skin tones on video cameras. If this is not possible, consider video conference specific backdrop blinds that can be lowered when required.

27.8.3 Furnishing Considerations for Videoconference Spaces

Tables should be equipped with boxes to give access to power and data, as well as inputs from user provided laptops and portable devices. Connectivity should allow for HDMI inputs as a minimum.

Consider placing a logo behind the users as long as it does not reflect light or detract from the participants. This can provide easy identification of the venue to "far-end" participants. Hang additional wall clocks in the room to display alternate time zones, particularly if contact is routinely made to overseas or interstate destinations.

The furniture should have a matt (or at worst satin) surface and should not be lighter than oak or darker than medium teak. Particularly, the furniture should not have any chrome or bright metal finishes which could reflect light into the camera lens.

27.8.4 Acoustics in Videoconference Spaces

Since videoconference spaces are often used for confidential meetings including student interviews and disciplinary hearings, care must be taken to ensure sufficient isolation so that conversations or "far-end" reproduced audio is not audible outside the room.

To this end, an acoustic engineer should be engaged to provide advice regarding the use of acoustic ceiling tiles, the use of suitable floor coverings to absorb and dissipate sound energy, and acoustic treatment to wall space in the room. Particular care needs to be taken if the room contains large windows or glass areas. Videoconference rooms should be designed to have appropriate reverberation times to aid intelligibility.

Further guidance may be found in Section 18 of these Design Guidelines.

In general, wall partitions should have a low sound transmission rating. Under the direction of the acoustic consultant, consideration should be given to whether walls should extend to the slab above and be sealed on both the top and bottom. Doors into the space should have an appropriate STC (Sound Transmission Class) rating and should typically be constructed of solid wood with rubber door sweeps.

27.8.5 Consideration of Noise Sources in Videoconference Spaces

Mechanical devices such as heat exchangers and ventilation units should not be located in the ceiling above the immediate space or the surrounding areas. These devices will transfer mechanical vibrations into the space, adding to the overall noise floor.

HVAC diffusers, returns, and associated ducts should be designed to allow air to flow through them at minimal velocities and with minimal disruption of the airflow.

Microphones should be placed within the critical distance of the intended sound source. (Critical distance is the distance at which the direct and the reflected sound are equal.) This distance varies depending on the acoustic properties of the finished space. Aim for HVAC (NC 25-30 throughout room) SPL 35dbA or better – a lower number, and low sound ingress.

Locate videoconference rooms away from "noise" sources like: exterior walls with windows; elevators; washrooms; cafes; high traffic areas; high speed photocopiers.

27.8.6 Lighting for Videoconferencing

Video conference venues are in effect small television studios and require additional care and consideration in lighting design. It is important to minimise shadows, eliminate glare, avoid reflective surfaces and create an evenly lit environment. Specific advice for videoconference lighting may be found in the AETM Audio Visual Design Guidelines. Some key points are reproduced below.

The best general lighting for videoconferencing is diffuse fluorescent. However even fluorescent lights will cause unattractive shadows around the eyes of participants if placed directly overhead. When carefully placed fluorescent asymmetrical wall washer light fittings can provide an even light at a 45 degree angle that reduces eye shadowing. Small spotlights carefully applied can provide pleasant shaping and highlights to the participant's faces. For consistency of colour and skin tone reproduction by the camera use lights of the same colour temperature (e. g. 4000 Kelvin) and ensure illumination of participants' faces at around 500 lux.

Ideally, the room should not have any exterior windows. If it does, they need to be fully covered with curtains or blinds. Even a small chink of sunlight in the background can cause problems for the camera. Backgrounds and table tops should not be too dark or too light as this can cause difficulty with camera auto-iris control. Mid tones and moderate lighting levels on background walls will give the best results. Avoid patterned or woven fabrics and finishes on walls as these can produce moiré patterns or strobing effects when the camera is moved.

27.8.7 The Videoconference Room Environment

Any artwork, wallpaper, or corporate logo that are to be in the field of view of the camera should not contain busy patterns or multiple closely spaced horizontal, vertical, or diagonal lines. Recreating these patterns requires additional codec processing resources and can sacrifice overall image quality.

Table surfaces can be a source of glare. Specify matte finishes to minimise reflectivity.

Ensure that air-conditioning vents are not located adjacent to fixed microphones. Mechanical noise from fans can be obtrusive and airflow directly on microphone capsules can cause significant "wind" noise.

Camera and projector mounts must be located away from potential sources of vibration which can cause jitter in the image.

27.8.8 Videoconference Monitors and Projected Images

The reproduced image size must conform to AETM guidelines. Monitors and screens should be sized such that the furthest viewer is placed further from the screen than a distance equivalent to 5.3 times the picture height. The horizontal viewing angle to the screen must not exceed 45 degrees and the vertical angle from any viewing position to the centre of the screen should not exceed 15 degrees.

For further guidance refer to the current AETM guidelines at www.AETM.org.

It is recommended that videoconference monitors be capable of reproducing images in High Definition at a resolution of 1920 x 1080.

27.8.9 Dedicated Videoconference Rooms

JCU policy is that meeting rooms must always be multi-purpose. To this end, all videoconference rooms must be capable of displaying content from connected equipment (such as laptops) even when no videoconference connection is active. VAVS staff are available to provide advice on standard design types already in use at JCU.

27.8.10 Specification for Videoconference Meeting Rooms

Meeting rooms that are equipped for videoconference typically have one camera only, mounted immediately adjacent to the monitor as close as possible to the centre of the image area. The camera must have a clear view of all participants, but should not be mounted too high as this provides an unnatural viewing angle at the far end.

The acoustics should be well controlled (see above) so that auto-tracking camera systems that rely on directional microphones to track the current speaker may be deployed. Plain backgrounds will also assist where facial recognition technology is employed in camera systems to provide auto focus.

Where possible, microphones should be positioned as a ceiling array, rather than mounted in (or on) the table.

27.8.11 Specification for Videoconference Equipped Lecture Theatres

In larger teaching spaces two or more cameras are to be installed to cover both the teaching area (where the session originates from the “near-end”) and also the student (or audience) area for situations where the teaching is undertaken from the “far end”.

The lecturer’s camera must be capable of covering both the lectern area and the general teaching “stage” including the area of any whiteboards. Care should be taken so that the cameras are out of the reach of students, but not so high as to provide an unacceptably steep angle on the lecturer. Audience cameras must be situated such that a clear view can be obtained of every section of the audience.

One or more monitors should be provided for the lecturer to be able to view the far-end audience without turning away from the local audience.
These spaces must be fitted with sufficient ceiling mounted microphones to enable questions to be audible from students located anywhere in the audience area. Automatic echo cancellation must be provided at the microphone mixer to enable effective two-way communication without the distraction of echoes.

27.8.12 Power and Data

As well as to equipment and racks, power and data must also be available to the meeting participants (see below regarding the use of table boxes).

No trailing cables are to be allowed between the table and the walls as these are an WH&S risk. Floor-boxes should be located below tables to obviate the need for exposed cable paths.

Wireless network services should be available in videoconference spaces and subnet configuration should be planned in advance in collaboration with VAVS.

27.9 Specifications for Lighting Systems for Lecture Theatres

Lighting in all teaching spaces should conform to the minimum standards set out in AS1680.2.3 - 2008 Interior lighting - Educational and Training Facilities.

In addition, the design of lighting for teaching spaces must conform to the requirements set out in the current edition of the AETM *Audiovisual Guidelines for Tertiary Teaching Spaces*.

This guideline is intended to provide design parameters for lighting systems in lecture theatres to create an optimum visual environment for large-screen presentations. The parameters and specifications apply to a 'typical' lecture theatre and will be subject to variations to meet particular needs.

Aspects of these guidelines have been removed from Section 25 and are consolidated below for convenience.

27.9.1 Scope

The lighting design for lecture theatres and teaching spaces must allow an optimum visual environment for large-screen presentations. The importance of lighting design in lecture theatres used for video or data projection cannot be over-emphasised. Visibility of the projected image depends on relative brightness of the image versus ambient lighting falling on the screen. The aim is to minimise light falling on the screen, while providing sufficient light in the body of the theatre to allow students to take notes. This can be achieved with careful selection, arrangement and control of light fittings.

Control of the lighting shall include separate lecture theatre control panels (including teaching space lighting) with provision to be automated by the Theatre Control System. All lighting control operations are integrated into the theatre control system specified by VAVS.

27.9.2 Design Goals

a. General purpose house lighting must be even, should minimise shadows, and be sufficiently bright for reading and writing. Target lighting level is 320 lux.

b. Lighting for projection applications must be directional – i.e. 'vertical', with as little horizontal component as possible. Lighting must be zoned from front to rear to allow differential lighting or 'profiling'. The levels are controlled with multi-channel dimmers.

c. Transitions between different lighting configurations and levels should be by means of dimmer wherever possible to minimise sudden, large changes in brightness.

d. All theatre lighting (except exit and stair tread lights) must be remotely controllable from the Theatre Control Systems installed as part of the audio visual fit-out. This can be achieved with contactor switching of lighting circuits and digitally controlled dimmers.

   JCU has a preference for the control of lighting in lecture theatres to be by means of a C-Bus control system with an interface between an Extron system where necessary. This shall be by means of either a Extron - C-Bus Netlinx Module Interface or using C-Bus Auxiliary Input units. It is necessary to have some form of wall mounted C-Bus switches adjacent to the entry door to allow entry to the room for staff rather than trying to locate a touch panel on the lectern in the dark.

   The system needs to be simple/intuitive for cleaners and others not familiar with the operation of the system to be able to use it.

e. Lighting systems must not cause interference to any other audio-visual equipment in the theatre. This includes infra‑red (IR), acoustic and electrical interference. LED luminaires are preferred in locations of height and areas not easily accessible by ladder.

27.9.3 House Lighting

Lighting shall be arranged in zones from front to rear. In a larger theatre (typically greater than 15 metres from front to rear), lights may be arranged in three zones – front, middle and rear while in a smaller theatre (under 15 metres from front to rear), lights may be arranged in two zones – front and rear

Lights shall be spaced so there is significant overlap of beam patterns (so a lamp failure does not create an unusable dark zone).

Fluorescent light fittings (if used) shall be of 'rapid-start' type with a minimum of flicker and audible noise.

Light switching and dimming systems shall be as specified by JCU Design Guidelines Section 25 and be compatible with other building equipment and systems.

C-Bus relays can operate smaller lighting circuit loads without the need for interposing relays/contactors. Lighting circuits would normally be on either C-Bus dimmers, Dali controllers or in the case of LED using 0-10 volt Analogue Output Units.

It is envisaged that in large systems there would be a need for a system of interposing relays and contactors to provide the required controls functions, where this is the case provide a Man/Off/Auto manual override switch for every controlled circuit.

Each lighting circuit shall be controlled by a contactor, which in turn is controlled by a small relay with a 24V coil. The intermediate relay shall be controlled by a 'dry' (i.e. voltage-free) relay closure within the theatre control system specified by VAVS.
C-Bus contacts are typically 10 or 20 amps at 250v AC rating.

Light switching incorporated into dimmers is not recommended – because a dimmer failure can disable the entire lighting system in a theatre. Separate contactor switching offers some redundancy.

Dimmers should be specified to ensure software compatibility. It is essential that local theatre control be achieved in conjunction with the automated control system.

Dimmers shall be controlled by a serial data link from the theatre control system. There shall be separate control panels along with separate lighting control for all dimming circuits. They shall be installed adjacent to each Entry/Exit point in the lecture theatre. These additional control panels shall operate in conjunction with the automated control system. They shall not override the control system nor shall they be reliant on the automated system i.e. should the automated control system fail, these additional control panels must automatically operate the dimmable lighting circuits.

1. Where practical, the dimmer(s) shall be installed in or near the bio-box to facilitate control wiring and adjustment.

2. The dimmers shall not generate electrical interference to audio visual equipment or generate audible noise.

3. Combined dimming and switching units is not recommended.

4. Under no circumstances should dimmers be used to control fluorescent lighting.

5. Zones shall generally be configured from front to rear of the room.

   A typical configuration is:

   - Zone 1 Stage lighting (reading lights over lectern)
   - Zone 2 Front zone (FOH)
   - Zone 3 Centre zone
   - Zone 4 Rear zone (ROH)
   - Zone 5 Aisle lights
   - Zone 6 Spare

27.9.4 Lighting for Projection

'Teaching Stage Lighting': Directional lighting shall be installed over the lectern area. This shall comprise at least two narrow-beam adjustable lights (e.g. Profile spots or low voltage dichroic eyeballs) controlled from a separate dimmer channel to light the lecturer for videorecording or videoconferencing purposes. There shall be no spill onto the projection screens, and care shall be taken to avoid reflections off the lectern surfaces.

Board lighting shall provide an average level of 300 lux of light across the surface of the board, without creating glare for the viewers and without creating reflections that could obscure the information thereon.

Aisle lighting (where installed) shall be low-intensity and shall be configured for minimum spill onto projection screens (e.g. directed downwards).

Illuminated 'Lecture in Progress' signs shall be fitted on the outside of each entry door and switched via a contactor which in turn is controlled by the theatre control system.

27.10 Projection Room & Bio-box

For details of the design and location requirement for a Bio-box, refer to *Teaching Spaces* Clause 10.

Bio-box lighting shall include switchable work lights and manually dimmable down-lights over working areas.

A telephone shall be provided (restricted to internal calls).

At least 1 network connection shall be provided.

27.11 Audio Replay Systems and Public Address

Where required by the standards outlined above or where specifically briefed, a purpose designed audio system should be installed to provide the following functionality:

- Voice reinforcement (Public Address)
- High fidelity replay of program sources
- Assistive listening / hearing augmentation
- Recording (where required)

27.11.1 Scope

Audio system components will, as a minimum, comprise:

- One or more high quality speakers installed so as to provide uniform sound coverage of the listener area;
- Lectern microphone and provision for additional microphones to be connected;
- Radio microphone (where specified);
- Digital signal processing audio mixer to enable signal routing, level control, limiting/compression and equalisation of signals from microphones and line level audio replay equipment. The audio mixer will provide phantom power to microphones, interface to the lecture theatre control system and provide sufficient outputs for power amplifiers and recording devices;
- High quality audio power amplifiers with overload protection;
- Fit for purpose Infra-red assistive hearing technology

Large (>150 seats) or special purpose venues will have additional requirements, particularly where the venue is used for cinema studies, remote lecture telecasts/webcasts, or other theatrical activities. Audio Visual representatives of the University are to be consulted on special purpose requirements as well as the general classroom requirements.

27.11.2 Design

The audio design shall ensure an electro acoustical system that is capable of producing adequate sound level with high intelligibility at the listener position, is stable under normal operating conditions, and is free from noise and distortion.

Acoustic modelling of the proposed space should be considered at an early stage of the project to provide valuable data for determining speaker type and quantity, placement, amplifier power, and expected performance against the guidelines. Computer modelling may be arranged through the Architectural Design Team, independent Acoustic Consultants, or Sound System Designers associated with major suppliers of professional speaker systems.

27.11.3 Loudspeaker Selection and Placement

Loudspeaker type and position shall be based on achieving an effective coverage of the listening area while optimising the ‘gain before feedback’ of the microphone / loudspeaker system for the nominated presentation area.

The uniformity of audio coverage shall be determined by measurement and validation standard ANSI/INFOCOMM 1M-2009: Audio Coverage Uniformity in Enclosed Listener Areas to “ensure that every listener perceives approximately the same direct sound from the sound system, no matter where the listener is positioned within the specified listening area of the sound system”.

A combination of FOH and distributed speakers should be considered for medium to large venues to ensure all areas receive voice reinforcement which is direct, uniform in level and has high intelligibility.

Electronic delay and speaker zoning should be considered where the delay between the sound arriving at the listener from the primary source and distributed speakers interact to significantly affect the intelligibility (STI) or spatial image of the sound source.

Audio equipment chain performance should meet the specifications outlined in the relevant section of the AETM Audio Visual Design Guidelines.

27.11.4 EWIS

Emergency evacuations systems may require room sound systems to be muted in the event of an alarm. Advice should be sought from a Fire/Electrical Engineer as to what is required of the sound system in relation to evacuation alarms/announcements.

27.11.5 Equipment Installation

Audio systems shall be installed in accordance with section 27.7, current industry best practice models (refer Infocomm AV Installation Handbook 'The Best Practices for Quality Audiovisual Systems') and related Australian Standards.

27.11.6 Hearing Assistance

In lecture theatres and general teaching spaces, hearing assistance systems shall be via an approved infra-red (IR) hearing augmentation system installed in the room. International Standard Hearing Augmentation signage should be displayed in each space where provided.

The extent of the provision, as set out in BCA Section D3.7, shall be applied to any general teaching space in which voice reinforcement or sound amplification is provided. Hearing augmentation may be required in specialist teaching spaces regardless of the provision of reinforcement; the requirement must be established during the design briefing stage.

27.11.7 Wireless Microphones

All wireless microphones must be type approved by VAVS before installation. All equipment must operate on frequencies approved by the Australian Regulator for the purpose. VAVS maintain a register and will allocate the channels of operation for all wireless microphones based on the frequencies already in use in adjacent teaching spaces. Contractors should enquire which channels are available in the location prior to purchasing equipment to ensure that the chosen equipment is able to operate on the allocated frequencies.

27.12 Control System Integration

JCU VAVS recommends the use of integrated control systems for all spaces where Audio Visual systems are deployed. The control system used must be AMX and should always be specified in conjunction with the VAVS staff to be fully compatible with existing RMS reporting and management systems, network standards and programming requirements.

Functions should be automated such that a single button will turn the system on. Buttons and touch screens tabs will be available to select a projection input, select audio, deploy screens and blinds and adjust the lighting. Full manual over-ride should also be available, should the user wish to alter the pre-programmed lighting for example.

All touch screen designs should conform to University-wide standards to maximise usability and minimise the need for specific user training.

27.13 AV Cabling

27.13.1 Responsibility

In any project involving the installation of AV facilities, the contractor will be responsible for installing cables as specified by VAVS or the AV consultant.

27.13.2 Tails

Where termination is not to occur immediately, the contractor must leave 4 metre tails on cables terminating at the FOH equipment bench and any equipment racks; and 2 metre tails elsewhere. Excessive length of tails is to be avoided. If pre-terminated cables are used, any excess length shall be pulled back into a suitable void.

27.13.3 Cable Identification

The contractor must label all cables at both ends with a meaningful identification using an adhesive labeling system. The label shall include the cable number shown on the drawing and identify the source (including port or output number) and destination (with port or input number) of the cable.

27.13.4 Cable Ties

AV cables shall be secured using only Velcro cable ties. Nylon “zip ties” can be used where no damage to cables can occur as a result of using zip ties.

27.13.5 Cable Paths

Cabling should be concealed and run within wall and ceiling spaces wherever safe access to these spaces is possible. Where cabling must run on the surface of a wall or ceiling, JCU Estate Directorate approved ducting must be used. Contractors must seek prior approval from the JCU Project Manager or VAVS prior to installing ducting in any installation.

AV signal cables should be well separated from power and lighting cables which may cause interference. Minimum separation is 300mm.

Cables should be loosely bundled so that like signals are grouped together.

Cables routed through ceiling spaces shall be supported at all times by a cable tray or catenary wire.

Cables should be well supported to avoid any strain or stretch. Where a bundle of cables is run horizontally, the preferred method of support is to secure the bundle to a perforated cable tray with cable ties.

Cables should take the shortest practical path. This applies particularly to cables carrying video or computer signals.

A spare accessible cable path shall be provided between the 'teaching station' and location of data projector(s). Where the path rises vertically inside a wall, two 50mm conduits into the ceiling space

shall be provided. For solid plaster ceilings, suitably located access hatches (450mm square minimum) shall be provided to facilitate running extra cables.

In the case of tiered theatres, a minimum of two 50mm spare conduits shall be installed to provide capacity to install additional cables from the teaching station to the Bio-box in the future.

27.13.6 Cable Dressing in Equipment Racks

All signal and power cables within equipment racks shall be secured vertically (by means of cable trays built into the rack structure) and horizontally (using lacing bars).

Lacing bars shall be fitted at the rear of racks in all circumstances where four or more cables are to be connected.

When cables are loomed and bundled before being terminated, sufficient length shall be allowed so that connectors are not under strain when attached to the equipment. All dressing of cables must allow for appropriate bend radii so that cable performance is not degraded and shields are not damaged.

Where access is not available to the rear of racks, sufficient length cable looms must be provided so that the rack may be removed for maintenance.

Rack mount power boards shall be provided for all mains connections. Non-rack mount power boards are unacceptable.

27.13.7 Cable Protection

Prior to practical completion, any pre-terminated cables shall have any contacts protected from physical damage and contamination from dust or paint. As a bare minimum, connectors shall be protected with sturdy plastic bags taped over the cable ends.

27.13.8 Fire - Stopping

Any penetrations through slabs, walls or fire-rated panels shall be fire-sealed so as to meet the appropriate standard. Refer also to Building Code of Australia Volume 1 Chapter C. See also Section 30 Fire Services clause 23 – Fire Stopping.

27.13.9 Cable Types

Unless specified otherwise, the following cable types shall be used for AV installations:

Video (Coaxial cable)	RG59
Audio (balanced)	Single pair screened
Audio (unbalanced)	Single core with braded copper screen
Pre – terminated HDMI, DVI or DP cables	Patch Cables: suitable cables from the Extron range of Micro HR cables HDMI Micro Series (Digital). Plenum: Suitable cables from the Extron Plenum-rated ranges
Speaker (Figure – 8)	Double – insulated Fig 8 stranded cable 1sq.mm or larger
UTP Shielded	CAT6a STP (colour to be determined in consultation with VAVS)
Microphone	Canare Star Quad two pair screened

27.14 Drawings

Documentation requirements are as detailed in Sections 25, 30 and 34 of these Design Guidelines.

These requirements (in particular the requirement for documentation in PDF form) apply fully to audio visual. In particular note the following for Audio Visual:

Drawings shall clearly indicate locations of ceiling and wall access panels and any other necessary access panels.

Audio Visual Drawings shall include:

- As a minimum to be produced in CAD format
- full details of AV wiring showing approximate cable paths
- equipment locations
- cable types and quantities
- location of projection screens and whiteboards
- any fixed seating
- fixed joinery
- location of lighting dimmers and relevant electrical switchboards

Provide a separate drawing and/or a separate layer in CAD files. Combined power/AV or combined communications/AV drawings are not acceptable. Any enquiries are to be communicated to VAVS.

27.15 Operating & Maintenance Manuals

Documentation requirements are as detailed in Sections 25, 30 and 34 of these Design Guidelines.

These requirements (in particular the requirement for documentation in PDF form) apply fully to audio visual. In particular note the following for Audio Visual:

- The contractor must provide VAVS with copies of all control and DSP code to enable reload of faulty devices.
- The contractor must provide VAVS with a full list of all devices with assigned IP address, MAC address and manufacturers serial number.

27.16 Audio Visual Glossary

Word	Short - form Definition
AETM	Association of Educational Technology Managers (www.aetm.org) – an Australian Tertiary Education organisation responsible for AV standards and guidelines
AMX	A control system used by most universities which is manufactured by AMX Corp
ANSI	The American National Standards Institute - a standards organisation. Commonly used in conjunction with brightness or light output of projectors

Audio	Any audio signal in either analogue or digital format
AV	Audio Visual
Bio-box	A separate projection booth of control room at the rear of a theatre
CD	The common Compact Disc audio format
CDROM	The common Compact disc Read Only Memory data disc format
Classroom	General purpose teaching space with a flat floor and loose furniture
Data Projector	An electronic device capable of projecting an image from a computer or video source onto a large display screen. (the terms 'data projector' and 'video projector' are normally interchangeable
DVD	The common Digital Versatile Disc for video, audio or data storage and playback
FOH	'Front of House' - the front of the room the theatre
HD	High Definition; a display resolution of 1920 x 1080 pixels in 16:9 aspect ratio
HDMI	A method of connecting devices using digital signals to carry video and audio signals
Lecture Theatre	A general purpose teaching space which has fixed seating and a tiered or sloping floor. It is typically more intensively equipped for visual presentations
OHP	Overhead Projector an optical device for projecting transparencies onto a screen
PAL	The now superseded 'Phase Alternate Line' system of broadcasting analogue television signals in Australia
PC	A personal computer running under a Microsoft Windows platform
ROH	'Rear of House'
RGBHV	A method of connecting devices using five cables to carry red, green, blue, horizontal and vertical signals
SXGA	A display resolution of 1280 by 1024 pixels
UHF	The 'Ultra High Frequency' radio spectrum between 300MHz and 3,000MHZ
VHS	The common Video Home System videotape format
VHF	The 'Very High Frequency' radio spectrum between 30MHz and 300MHz
WXGA	Resolution of 1366 by 768 pixels in widescreen format
WUXGA	A display resolution of 1920 by 1200 pixels (widescreen format)
Video	Any composite or component video signal in either analogue or digital format
VAVS	Videoconferencing & Audio Visual Services. This section is a unit within JCU's Technology Solutions Directorate and are responsible for design installation, maintenance and support in centrally bookable teaching and meeting spaces.
XGA	Display image resolution of 1024 horizontal by 768 vertical picture elements (pixels)

27.17 Videoconferencing Glossary

Word	Short-form Definition
Classroom	General purpose teaching space with a flat floor and loose furniture
Lecture Theatre	A general purpose teaching space which has fixed seating and a tiered or sloping floor. It is typically more intensively equipped for visual presentations
Bandwidth	Bandwidth defines the amount of information that can be sent and received in a certain time frame. In Videoconferencing, the higher the bandwidth, the higher the quality of the picture and sound during the Videoconference. Lower bandwidths result in more choppy pictures and sound.
Bridge	In videoconferencing vernacular, a bridge connects three or more conference sites so they can simultaneously communicate
Camera Presets	Allows predefined camera angles to be programmed into a videoconferencing system

Codec	Coder-Decoder. A codec is the core (or "engine") of a videoconference system and is responsible for all of the encoding and decoding of information (audio, video). Before the transmission, the codec converts analog signals to digital signals and compresses the digital signals. Incoming audio and video must be decompressed and converted from digital back to analog
Compressed Video	The codec compresses the information into smaller pieces for easier and faster transmission. This allows the information to be transmitted faster over smaller capacity lines. Due to the compression and decompression of information some of the original quality of the video and sound are lost which results in diminished picture and sound quality.
Desktop Videoconferenc ing	Videoconferencing on a personal computer. This is the most economical type of Videoconferencing systems. It is most useful for individuals and smaller groups
Document Camera	A camera used during a videoconference for taking pictures of still images, pictures, graphics, pages of text, and 3-D objects. All images can be sent to a monitor or as part of a videoconference.
Document Sharing	Allows users on both sides of the videoconference to view and edit the same computer document.
Echo-cancellation	(also Automatic Echo Cancellation (AEC)) Process of eliminating echo in a videoconference system.
Far End	The remote equipment and venue connected as part of a video conference
Frame Rate	Frequency that the video frames are displayed on a monitor, typically described in frames-per-second (fps). The higher the frame rate the better the quality of the video.
Full Duplex	Sending audio data in both directions at the same time. Usually higher quality, but requires more bandwidth. Provides much more natural and useable audio to a videoconference because people on either end of the conference can speak at the same time.
Gateway	The interface between two opposing protocols, such as H.320 and H.323. By means of software and hardware, a gateway allows connection between otherwise incompatible networks.
H.239	ITU Standard for sending data long as a dual stream in a videoconference.
H.264	ITU Standard for video compression sometimes referred to as MPEG 4 part 10.
H.320 Standard	A commonly used video compression standard for videoconferencing over networks that provide fixed communication paths (such as the ISDN phone network). By defining standardized ways of performing all of the processing that has to be done by a videoconference system, systems from different vendors can communicate with each other as long as they all comply with the standards. H.320 references many other standards for specific tasks (such as audio coding or video coding).
H.323	This is also a top-level standard, like H.320, for videoconference systems. The difference is that H.323 defines methods to be used on what are called packet-based networks (which are also called IP (Internet Protocol) networks) like a typical business, school LAN or the Internet.
H.324	The standards used to specify voice and video transmission over traditional analogue phone lines.
Half Duplex	A telecommunication system where data can only flow in one direction at a time. For example, a half duplex speakerphone only allows one person to speak at a time.

High Definition 1080i/1080p	1080i is the designated name for one of the HDTV video modes. 1080 stands for 1080 lines of vertical resolution, while the letter "I" stands for interlaced or non-progressive scan. The horizontal resolution of 1920 dots across and a frame resolution of 1920 × 1080 or over two million pixels with an aspect ratio of 16:9. In addition a field resolution of 1920 × 1080/2 (interlaced) or about 1.04 million pixels.
ISDN	"Integrated Services Digital Network". A type of telephone network that uses digital service right up to the end user's equipment. This type of telephone network also uses separate paths or channels for signalling so that the signalling information does not interfere with the data being sent by the user. It provides communications of voice, video, and text between videoconferencing systems at a faster data transfer rates than analogue telephone lines. Used for videoconferencing to remote areas or certain secure networks.
Kbps	kilobits per second
LAN (Local Area Network)	A computer network linking workstations, file servers, printers and other devices within a local area, such as an office. LANs allow the sharing of resources and the exchange of both video and data.
Multipoint Videoconference (via MCU)	Videoconference with more than two sites. The sites connect via a video bridge, which is also called a Multipoint Control Unit (MCU).
Point-to-point Videoconference	Videoconference between two sites.
POTS (Plain Old Telephone System)	This is the traditional analogue system for voice.
PTZ (Pan, Tilt, and Zoom)	Remote control features that typically come with high-quality cameras that are used in room-sized videoconferencing systems.
Room-based Videoconferencing	Videoconferencing using a larger and more sophisticated system. These systems can be mobile stand-alone systems or customized for the needs of the user. These systems are more appropriate for large groups and more sophisticated techniques.
UPH	University Procurement Hub
Video Bridge	Computerized switching system (also known as MCU - Multipoint Control Unit), which allows more than two sites to communicate using videoconferencing. Many companies now offer bridging services for a set fee.
Videoconferencing	Interactive communication using video and audio to communicate over long distances. It combines the interactivity of the telephone with the visual stimulation of the television. Videoconferencing may also include graphics and data exchange.
WAN (Wide Area Network)	A communications network that services a geographic area larger than that served by a local area network or metropolitan area network. WANs include commercial or educational networks such as AARNet, Janet, and others.
AETM	Association of Educational Technology Managers (www.aetm.org) – an Australian Tertiary Education organization responsible for AV standards and guidelines
ANSI	The American National Standards Institute-a standards organisation.
Data Projector	An electronic device capable of projecting an image from a computer or video source onto a large display screen. (the terms 'data projector' and 'video projector' are normally interchangeable

AMX	A control system used by most universities which is manufactured by AMX Corp
VAVS	Videoconferencing & Audio Visual Services. This section is a unit within JCU's Technology Solutions Directorate and are responsible for design installation, maintenance and support in centrally bookable teaching and meeting spaces.
Sources:	Some definitions above derived from http://picturephone.com/learn/glossary.html Some text is reproduced from the AETM Audio Visual Design Guidelines – Tertiary Teaching Spaces (2nd Ed.)