THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

Property Services Design Standards and Guidelines

Section 14
Information Systems

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Connect

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Feedback

If you spot an error in this document, or you have a suggestion on how we can improve the document, please tell us about it by printing, completing and emailing the form in Appendix K to us at PSTechServices@auckland.ac.nz.

14 Information Systems

Table of Contents

List of Tables

List of Figures

14.1 Introduction

Introduction

This section shall be specifically read in conjunction with *Section 1 About Property Services Design Standards and Guidelines* and *Section 2 Project and Building Works Requirements* of the *University of Auckland's Property Services Design Standards and Guidelines*.

14.1.1 Purpose

The purpose of this section is to provide consultants, architects, designers, and engineers with design guidelines for the planning of spaces and pathways in buildings for telecommunications equipment and cable network infrastructure.

14.1.2 Applicable standards

This table lists the standards that are applicable to information systems.

These standards shall be referenced in any contract documents that are issued to telecommunications cabling or related work within University buildings.

Note: The latest version of each applies.

Table 1: Information Systems standards

Standard	No	Title
AS/NZS	3080:2003	Information technology - Generic cabling for customer premises
AS/NZS	3000:2007	Electrical Installations – Australia/New Zealand Wiring Rules
AS/NZS	3084:2003	Telecommunications Installations – Telecommunications Pathways and Spaces for Commercial Premises
AS/NZS	3085.1:2004	AS/NZS 3080:2003 Telecommunications Installations – Generic Cabling for Commercial Premises
AS/ACIF	S009:2006	Installation Requirements for Customer Cabling

14.1.3 Application

The University of Auckland uses the Standard AS/NZS 3080: 2003 as the primary reference for the planning and design of the layout of its telecommunications infrastructure. In order to avoid confusion and misunderstanding the Definitions in Section 3.1 of that Standard are used in this document and all documentation relating to telecommunications services. In particular the following definition should be noted:

"***3.1.58. Telecommunications***

A branch of technology concerned with the transmission, emission and reception of signs, signals, writing, images and sounds, that is, information of any nature by cable, radio, optical or other electromagnetic systems. "

Therefore, by definition, the term "telecommunications" includes all telephone, data, facsimile, modem, video, radio, TV, MATV, control, telemetry, public address, paging, messaging and like communications systems.

The University of Auckland network is large and geographically dispersed, so that instead of a single campus distributor there are four campus distributors each serving a sector of the Main Campus, and separate campus distributors at the Faculty of Medical and Health Sciences (FMHS) in Grafton, the Faculty of Education (FOED) in Epsom, the Marine Laboratory at Leigh and at the Tamaki Campus.

14.2 Design and Approval Process

The design of exclusive spaces and pathways for telecommunications purposes shall be in accordance with the guidelines in Standard AS/NZS 3084:2003.

Confirmation of the placement, size, layout and fit-out of ER, TR and LC spaces must be sought from the Network Engineering Manager, ITS or the designated telecommunications consultants at an early stage in the space allocation planning process for any new buildings or refurbishment of existing premises.

Likewise, the cable routes and pathways (cable trays, risers, etc.) between these facilities must be designed in consultation with the Network Engineering Manager, ITS or the designated telecommunications consultants and confirmed to be of appropriate size and within the standard distance limits.

The Network Engineering Manager, ITS or the designated telecommunications consultants will also provide the detailed design specifications and drawings for the layout of distributors, backing boards and cabinets. It is noted that penetrations, cable trays and trunking must be dimensioned so that the cable fill does not exceed 40% at installation.

14.3 Abbreviations

Information systems abbreviations

Table 2: Information Systems abbreviations

Abbreviation	Description
BD	Building Distributor
BX	Building Switch
CD	Campus Distributor
ER	Equipment Room
FD	Floor Distributor
TO	Telecommunications Outlet
TR	Telecommunications Room

14.4 System Information

14.4.1 General Structure

The structure of the integrated telecommunications cabling system used in The University of Auckland buildings is based on Standard AS/NZS 3080:2003. This is shown in the following diagram:

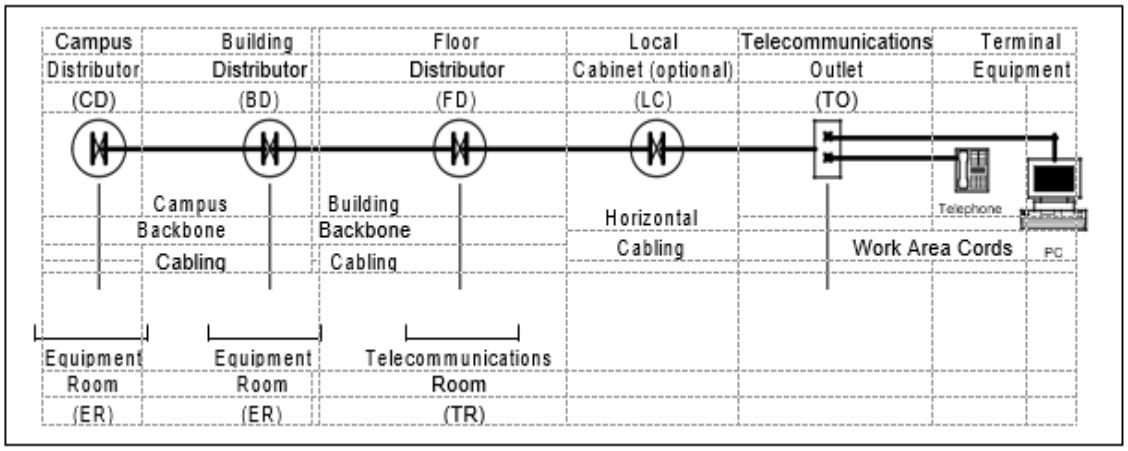

Figure 1: Integrated telecommunications cabling system

Terms in bold in the following description of the structured cabling infrastructure are defined in the Standard, and their meaning is well understood within the cabling industry.

An **equipment room (ER)** is provided in each major building to house the **building distributor (BD)** together with voice and data network equipment (including the Building Switch (BX)) mounted in racks or cabinets**. Campus backbone cabling** connects each BD to a sector **campus distributor (CD)**, which is housed in an ER near the centre of each campus sector.

A **telecommunications room (TR)** is provided on each floor of each building to house the **floor distributor (FD)** and data switches that may be required to serve the telecommunications requirements of that floor. **Building backbone cabling** connects each FD to the BD. FDs on the same floor and adjacent floors may also be interconnected by direct building backbone cabling links.

Large, multi-storey buildings may be treated as two or more logical buildings, with each wing of the building having its own Equipment Room and Building Switch. Alternatively, small outbuildings may be treated as logical floors and have a FD served from the BD in a larger adjacent building.

Telecommunications outlet (TO) sockets are installed in wall-mounted faceplates or on trunking. **Horizontal cabling** connects these TOs to the FD. Work area terminal equipment items such as telephones, fax machines, printers and computers are connected by means of a **work area cord** which is plugged into an adjacent TO. Patching or jumpering is completed as required at the FD and BD to connect each TO to the appropriate telecommunications switch port or service.

14.5 Identification and Labelling

The formats of administration identifiers used for record purposes for the cabling networks of The University of Auckland are detailed in a separate document "Telecommunications Administration Identifiers" in Appendix C. This document is based on the principles set out in Standard ANSI/TIA/EIA 606A

All items of telecommunications equipment and hardware require to be labelled. The information to be shown on the labels is generally either the full administration identifier or a part of it.

Further details are given in *Specification for Labelling* on page 44.

14.6 General Technical Requirements

14.6.1 Specifications for Cabling Contractors

Cabling contractors are to be provided with detailed specifications covering the required installation standards, materials and practices. These are covered in generic specifications that are included as required to form part of the contract documents for each cabling contract:

Table 3: Specifications for Cabling Contractors

Appendix	Specification Name	Page Number
Appendix A	Specification for Audio-Visual Cabling	20
Appendix B	Specification for Backbone Cabling	25
Appendix C	Specification for Cable Trays and Troughing	32
Appendix D	Specification for Documentation and Testing	35
Appendix E	Specification for Horizontal Cabling	38
Appendix F	Specification for Labelling	44
Appendix G	Specification for Pathways in Furniture	50
Appendix H	Specification for Underground Ducts	59

The following sections provide additional information about the provision and fit-out of spaces for telecommunications purposes, cable pathways, cables and other matters relating to the design of telecommunications facilities and infrastructure. Consultants shall provide to contractors within the tender documents full details of the required work including a written description of the scope of work, floor plans showing the positions of outlets and pathway routes for backbone cables, schematic diagrams, distributor face layout drawings showing where cables are to be terminated, detailed schedules and documentation and drawings describing any other special requirements for each specific works.

The specifications shall state that the contractor is to supply all cable and terminating hardware sourced in accordance with the requirements of the generic specifications. However, the Principal may supply any cabinets, floor-mounted frames or racks to be used in the works, and this option is to be resolved in discussion with ITS. Items supplied by ITS are at no cost to the contractor. Where the contractor is to supply the items, ITS will specify the manufacturer, model and size required.

For budget management purposes ITS will provide to the Property Services Project Manager details of the estimated costs of any cabinets, frames or racks, switches WLAN access points or other items which will be a charge against the project and shall be included in the budgetary price estimates for the project. The cost and time for testing and commissioning the telecommunications services by ITS will also be advised for inclusion in project cost estimates and project schedules.

14.6.2 Equipment Room (ER)

The ER must be located as near as possible to the centre of gravity of the building and be adjacent to main risers, main cable pathways and building entry points for campus backbone cables. This will usually mean that it is located adjacent to the central services core about halfway up the building. The ER must be not more than 90 metres cable route distance from any of the TRs in the building.

The main ER for a modest multi-storey building should normally have a size of not less than 10 square metres, and the width of the room shall not be less than 2800 to allow front and rear access to the racks. This is to allow adequate space for the installation of active data switching equipment, telephone switches, uninterruptible

power supplies, optical fibre transmission equipment and cable termination frames. Many buildings will require larger equipment rooms, typically of an area equal to 1% of the total floor area of the building in cases where server equipment is to be accommodated. Design should allow for the size of the equipment room to be increased if required later in the life of the building.

Design is based on the considerations in AS/NZS 3084:2003, Section 6.4 and Section ZB2.3. HVAC requirements are covered in Section ZB2.3.4.6, where the temperature range is specified as 18 to 24 degrees C, and the Relative Humidity between 30 and55%. As lead-acid recombination type or similar back-up batteries will be included in UPS equipment housed in the ER then air-conditioning will be required to keep the temperature at not more than 21oC to preserve the service life of the battery.

The ER should have an outward opening door at least 900 wide giving direct access from a "public" area such as a corridor. There must be good access from a loading dock, lift or similar place suitable for equipment delivery. Door locking is to be keyed to the University PABX Room master key system.

Equipment rooms shall not have water pipes, drainpipes, other piping or ductwork installed in, over, passing through or entering the room. They must be located at least two metres away from significant sources of EMF such as power transformers, large electric motors, generators and main electrical switchgear.

The floor loading capacity must be sufficient to carry both the distributed and concentrated load of the installed equipment. In general, the distributed load -bearing capacity shall be greater than 4.8 kPa and the concentrated loading capacity at rack locations shall be greater than 8.8 kN.

Lighting is required in each room to meet the requirements of Section ZB2.3.4.8. A level of 500 lux is required at 1m above floor level.

A liberal provision of electrical socket outlets is appropriate. The outlets serving the equipment racks must be on separate sub-circuits from other outlets and must not be on a circuit that is protected by an RCD. A 20A PDL 56 Series socket outlet is required adjacent to the rack for the connection of a UPS.

All wall and floor penetrations for cable pathways are to be fire-stopped. Floor penetrations in and above equipment rooms are to be bunded to a height of at least 50mm to prevent water running down cable risers and damaging cables and equipment.

Floor-standing racks and cabinets are to be secured to the floor to prevent toppling. Top bracing is not required for open-frame cabinets but must be provided for floor mounted frames. This will usually comprise Unistrut type members in a triangular arrangement attached to structurally adequate walls. Where multiple racks or cabinets are installed in a row, adjacent cabinets shall be securely fastened together.

14.6.3 Telecommunications Room (TR)

Each telecommunications room should be located at the centre of the area that it is to serve, and wherever possible not more than 90 metres cable distance from the ER. No part of the service area may be more than 90 metres cable distance from the TR. This usually means that the TR must not be more than about 50 metres in a direct line from any part of the floor that it serves. If the service area is more than about 100 metres long, then two TRs will generally be required.

Each TR for a typical building floor shall have an area of at least 8 square meters to allow for the accommodation of all telecommunications equipment and terminations, and to allow for growth during the life of the building. Generally, expansion of the TR at a later date will not be a practicable option.

The location of the TR should preferably be in or immediately adjacent to a service core area that is unlikely to be disturbed if the building is renovated or refurbished at a later date. Telecommunications rooms must be dedicated to telecommunications functions only and not be shared with electrical installations other than those for telecommunications purposes, shared with other users, or used as a storeroom.

Design is based on the considerations in AS/NZS 3084:2003, Section 6.3 and Section ZB2.2. HVAC requirements are covered in Section 6.3 and ZB2.2.7. The heat generated by active equipment will require positive pressure forced air ventilation from an adjoining corridor or office space. However, where a lead-acid recombination type or similar back-up battery is included in any equipment housed in the TR then air-conditioning will be required to keep the air temperature at not more than 21oC to preserve the service life of the battery. Planning for the eventual provision of air-conditioning operating 24 hours per day, 365 days per year, should be included in the design considerations of any TR in a new or refurbished area.

Lighting is required in each room to meet the requirements of Section ZB2.2.4.1. A level of 500 lux is required.

A liberal provision of electrical socket outlets is appropriate. The outlets serving the equipment rack must be on a separate sub-circuit from other outlets and must not be on a circuit that is protected by an RCD.

The door lock is to be keyed to the University PABX Room master key system.

All wall and floor penetrations for cable pathways are to be fire-stopped. Floor penetrations in and above telecommunications rooms shall be bunded to a height of at least 50mm to prevent water from flowing down cable risers.

14.6.4 Entrance Room

An entrance room may be required to accommodate the interface terminations and equipment between the building infrastructure and campus cabling or the cabling of other Service Providers. Space may be

required for cable distributors, racks or splice closures to accommodate changes from outdoor type cables to indoor type cables. A cable handling pit in the footway outside the building and ducts through the building foundation or wall into the entrance room may be required for both University network cables and other Service Provider cables.

Entrance Rooms must be located within 5 metres of the point of entry and in an area that is dry and not subject to flooding. The entrance ducts must be sealed against the ingress of moisture, gases or rodents.

In major buildings an alternate entrance facility may be provided to give a separate path to the campus distributor and thus improve network availability.

14.6.5 Distributor Backing Board

A backing board is installed in each ER and TR for the purpose of mounting the distributor and other equipment. The backing board is a panel of white plastic coated (or painted) plywood, 19mm thick and mounted on 100mm vertical timber framing at approximately 600mm centres to provide a space behind the backing board for concealing cables. The intermediate framing timbers are interrupted to allow cables to be run horizontally behind the backing board. Typical backing board layouts are shown in 0. Krone 66-way Profil backmounts or Highband 25-pair backmounts are installed on the backing board.

The position and size of each backing board is to be confirmed with the Network Engineering Manager, ITS, or the consultants before installation.

A dual switched electrical socket outlet is to be installed on or immediately below each backing board. All electrical outlets other than those feeding the rack are to be on a single dedicated sub-circuit

14.6.6 Cabinet or Rack

The University may supply an open sided floor-standing cabinet or rack where required to accommodate switches and optical fibre cable terminations. The size and position of the rack or cabinet is to be advised by the Network Engineering Manager, ITS or the consultant. A typical rack will have an 800 x 800 footprint and requires a 1000 clear workspace in front and 800 behind.

Any equipment or cable terminations must be installed at least 200mm above floor level.

14.6.7 Equipment Cords

Equipment cords (sometimes referred to as "data fly leads" or "hydras") are installed between termination modules on the ADC Krone backmounts and the rack or cabinet. Quantities and other details are to be confirmed with the Network Engineering Manager, ITS or the consultants. Normally at least two groups of 26 stranded copper equipment cords, blue in colour, will be required.

14.6.8 Telecommunications Outlets (TO)

The telecommunications outlets specified by the Standard are 8-position modular sockets, which are sometimes (incorrectly) referred to as RJ45 sockets. The pin-out pair assignment used by the University for all new work is T568A.

Only ADC Krone sockets shall be used. Only PDL 500 or 600 series or Worktop style face plates shall be used. Adaptors are available with label bezels for use in PDL 500/600 series or Worktop style face plates.

A double telecommunications outlet in a flush mounted faceplate is the standard provision for each workstation or desk position in office and general areas. Faceplates are usually installed in flush-boxes at 300 to 380mm or at 1200mm above floor level, but in any case, their positioning must be co-ordinated with electrical socket outlets (refer to *14.6.9 Electrical outlets* on page 17). C-clips shall not be used in place of flush boxes, but plastic, clip-in boxes may be used where outlets are being retrofitted. Plates for electrical and telecommunications outlets should be spaced horizontally at 150mm centres on the same level either side of a wall stud, or, if required at different heights they should be placed centrally one above the other, but the cables should be routed to opposite sides of a stud as they pass up inside the wall cavity to the ceiling space.

The density of provision should include service at all potential workstation or desk positions, allowing for desks to be rearranged to suit the requirements of the occupants. To achieve this, at least one double outlet plate should be installed for each 6.5 square metres of usable office space, or part thereof. However, in order to ensure that all parts of the room are able to be reached by a standard 3 metre work area cord there should be an outlet plate for each 6 metres, or part thereof, of usable perimeter wall.

The minimum provision for a work area shall be two outlet plates on opposite walls, as required by AS/NZS 3084:2003, Clause 6.2.

With regularly proportioned rooms these minimum outlet configurations will be required:

Table 4: Minimum outlet plate configurations by room area

Room area (m^2)	Outlet plate configuration
0.0 – 12.0	2 x double
12.0 to 19.5	3 x double
19.5 to 26.0	4 x double
26.0 to 32.5	5 x double

In order to ensure that access is unlikely to be obstructed by the slab-ends of desks or other furniture, outlets should be positioned at least 900mm from any internal corner.

For areas of unusual shape or with obstructions such as protruding columns, different configurations may be required.

The minimum size of outlet plate to be installed is a double telecommunications outlet. Single outlet plates are not to be used.

Any requirements for electrical and telecommunications outlets to serve photocopiers, printers, facsimile machines, vending machines, lift telephones, public telephones, information kiosks, wireless LAN access points, ceiling mounted projectors, EFTPOS terminals, IP video cameras, people counters, BMS or lighting controllers and other purposes should not be overlooked.

For other workspaces a double telecommunications outlet in a flush mounted faceplate or on trunking is installed at each point where service is likely to be required. In laboratories and wet areas other arrangements as described below may be appropriate.

Laboratories and Built-in Benches

Apart from outlets below whiteboards or at desk positions, all outlets in laboratories should be installed above bench level and co-ordinated with adjacent power outlets. Where appropriate, shuttered outlets should be used.

Classrooms

Outlets are normally installed on trunking beneath the desktop at the back of the desks. Desks must be fixed to the floor. Alternatively, desks can be serviced using "soft wiring" from wall mounted outlets or from floor boxes. For further considerations relating to cabling within furniture and partitions refer to *Appendix G Specification for Pathways in Furniture* on page 50.

Cable Trunking

Where trunking is provided the telecommunications outlets should be installed in the upper portion of the trunking using worktop or architrave type faceplates. Where the Contractor is to supply and install trunking this is identified in the Work Schedule. The approved trunking types are:

- Interserv 180/2 and 150/2 Cat6 Trunking
- Modempak Cat6 Skirting Trunking (170mm)
- Unistrut TD180 and TD155 Cat6 Skirting Duct

The normal requirement is for two compartments meeting segregation requirements, in colour grey, beige or cream. It is preferred that trunking be installed at a convenient working height and not at floor level.

The compartment for data cables must be dimensioned so that the initial cable fill does not exceed 40%. This means, for example, that a 60x60 trunking compartment can accommodate no more than twenty-eight 7mm diameter cables at installation.

For further considerations relating to cabling within furniture and partitions refer to refer to *Appendix G Specification for Pathways in Furniture* on page 50.

Wet Laboratories

In wet areas and other designated areas, the wall outlets are to be mounted at a height of approximately 2400mm above floor level.

Mid-floor Ceiling Droppers

Where mid-floor services are required in laboratories then 4-way or, 6-way outlet box assemblies with multiple four-pair Cat 6 cables contained within flexible conduit are to be installed. The assemblies are to be suspended from a secure screw eye by means of a galvanised steel chain at a height co-ordinated with suspended electrical outlets. The pre-fabricated boxes or assemblies may be obtained from Willis Consulting Limited.

Service Poles

In areas with island clusters of furniture or freestanding partitions the outlets may be cabled via a service pole from the ceiling. The outlets are to be installed on the service pole or partitions as for wall trunking.

Service poles must be rigidly fixed to the building structure. Care is to be taken to observe separation, segregation and earthing requirements when both electrical and telecommunications cables are reticulated in the same service pole.

For further considerations relating to cabling within furniture and partitions refer to refer to *Appendix G Specification for Pathways in Furniture* on page 50.

Floor boxes or troughing

In areas with island clusters of furniture or freestanding partitions the outlets may to be cabled from a floor penetration, floor box or troughing channel. The outlets are to be installed on the furniture or partitions as for wall trunking or may use "soft wiring" from the floor box. Furniture fed in this way must be fixed to the floor. Furniture fed from floor boxes shall be positioned so that cables exiting the floor boxes are not subject to kicking or damage from shoes, etc.

Refer to AS/NZS 3084:2003, Section 7.10, for further considerations relating to the design and use of floor troughing.

Furniture Pathways

A coordinated approach must be taken to the design of furniture pathways. In order to ensure compliance with the electrical safety requirements of the electrical Wiring Rules (AS/NZS 3000: 2007), and the requirements of AS/NZS 3084:2003, which in turn requires compliance with AS/ACIF S009:2006, particular attention must be paid to:

- The strategy for connecting building pathways to furniture pathways.
- The number, type and location of outlets and outlet plates.
- The size and minimum bend radius of each cable type.
- Pathway cross sections and cable capacities, angles and transitions.
- Separation and segregation from electrical cables.
- Separation of electrical and telecommunications compartment cover plates.
- Earthing of metalwork.
- Fixing of furniture to the floor.
- Protection of cables rising up from floor troughs or boxes.

These considerations are covered in more detail in to refer to *Appendix G Specification for Pathways in Furniture* on page 50. Recommended design guidelines are included.

14.6.9 Electrical outlets

The Standard AS/NZS 3084:2003 recommends in Clause 6.2 that a minimum of one power outlet should be installed with each telecommunications outlet. This means that a double electrical outlet should be installed adjacent to each double TO, and two double electrical outlets or a four-way electrical outlet should be installed adjacent to each triple or quad TO.

14.6.10 Underground Ducts

Campus backbone cables between buildings will generally be installed in underground ducts. Lead-ins to building entry points will generally have two 100mm UPVC ducts. For further details refer to *Appendix H Specification for Underground Ducts* on page 59.

Underground ducts shall include a drainage facility external to the building entrance point so that water entering the duct system cannot enter the building. Consideration should be given to the drainage of all pits on the duct route.

Telecommunications duct systems and pits should never be used as pathways for electrical cables or other non-telecommunications services.

The lids of maintenance holes and pits shall be designed for full roadway loading if there is any possibility that a vehicle may pass over them. Lids must be fitted with locks to prevent unauthorised access. The keying of the locks must differ from those used by Telecom and other major service providers.

14.6.11 Tunnels

Campus backbone cables between buildings may be installed in utility services tunnels. Not only must the required separation from electrical cables be observed but heating effects from hot water and steam pipes must be considered.

14.6.12 Pull Boxes

Readily accessible pull boxes may be required in ducted pathways to facilitate the installation of draw wires and cables. They are installed in straight sections of the duct, and not used in lieu of bends.

14.6.13 Cable Trays

Cable trays will be installed for cable support on all backbone cable routes and on major horizontal cable routes. Generally, cable trays will be required where there are more than 32 four-pair cables, but multiple catenary wires may be used in these situations where the installation of trays would be impractical.

Cable trays must have flat bottoms and be at least 100mm deep with no sharp edges. Cable ladder, ladder tray, mesh tray or tray with a deformed or corrugated bottom surface is not permitted. Where trays are installed in open ceiling areas, they must be fitted with lids to provide protection for the cables. All tee-junctions and bends must have curved sides with a radius of not less than 50mm.

For further details refer to *Appendix C Specification for Cable Trays and Troughing* on page 32.

14.6.14 Catenaries

Catenary wires will be installed for cable support on all horizontal cable routes in enclosed ceiling spaces with not more than 32 four-pair horizontal cables. For further details refer to *Appendix E Specification for Horizontal Cabling* on page 38 or *Appendix B Specification for Backbone Cabling* on page *25*.

In open ceiling areas the cables must be contained within a duct, trunking or raceway to provide complete enclosure of the cables. Cables must not be sprayed with paint or intumescent protective coatings.

14.6.15 Building Backbone Cables

Optical Fibre Cables

Building backbone cables from the BD to the FDs shall usually be single or multiple cables with 12, 24 or 48 Multimode or Singlemode fibres. These are not installed as part of the standard provision but are installed as and when specified.

For further details refer to *Appendix B Specification for Backbone Cabling* on page 25.

Four-pair Copper Cables

Building backbone four-pair cables shall generally use Cat 6A four-pair cables. Appropriate terminating hardware is to be used.

For further details refer to *Appendix B Specification for Backbone Cabling* on page 25.

Multi-pair Copper Cables for Voice

Building backbone multi-pair cables shall generally have 25, 50 or 100 pairs. The standard provision is to provide pairs from the BD to each FD at least equal to 10% of the number of outlets connected to the FD.

For further details refer to *Appendix B Specification for Backbone Cabling* on page 25.

14.6.16 Horizontal Cables

Optical Fibre Cables

Horizontal optical fibre cables may be installed to meet special requirements. These will generally be of 4-fibre construction. These are not installed as part of the standard provision but are only installed as and when required.

Four-pair Copper Cables

Horizontal four-pair cables shall meet Cat 6 requirements. The standard provision is one cable from the FD to each telecommunications outlet.

For further details refer to *Appendix E Specification for Horizontal Cabling* on page 38.

14.6.17 Existing Cables

Existing cables that are made redundant should, where practicable, be entirely removed.

14.6.18 Separation and Segregation from Power

The requirements of Standard AS/ACIF S009:2006, Clause 9.1, regarding separation distances and segregation barriers must be observed, for safety reasons. Further, the requirements of the cabling system manufacturer, ADC Krone, must be observed, and this requires in general a separation of at least 300mm between telecommunications and power pathways. There are circumstances (such as within channels in office furniture) under which this requirement may be relaxed for up to 5 metres adjacent to the telecommunications outlet.

14.6.19 Earthing

In order to reduce the risk of injury to personnel or damage to equipment from potential differences, all catenaries, cable trays, cabinets and frames are to be earthed. Particular care should be taken to ensure that metal cable trunking, service poles and partitions are properly earthed. These metal items are to be bonded to a separate communications earth terminal busbar at the main or nearest suitable electrical distribution board using 6 sq. mm earth wires with green/yellow PVC insulation.

Where there is adequate capacity for connection to an existing earth busbar this may be used.

Refer to the Specifications in the appendices for further details.

Appendix A Specification for Audio-Visual Cabling

A.1 General

Refer to the Preliminaries section of the Specifications and to the General and Special Conditions of the main Contract, which are equally binding on all trades.

A.2 Description of Works

The audio-visual cabling works comprise the provision of an audio-visual cabling system and associated support structures as described herein and as shown on the drawings.

A.3 Materials Supply

A.3.1 Cable Support

The audio-visual cable support infrastructure comprising cable trays, PVC raceways, catenaries and flexible conduits are to be supplied and installed by the contractor.

The main cable raceway, where shown in the drawings, is to be constructed using telecommunications cable tray (refer to *Appendix C Specification for Cable Trays and Troughing* on page 32) or Marley Ega Tube 100 x 75 troughing complete with lids. It should be installed beside the access catwalk in the centre of the ceiling space and from there to the Media Control Room ceiling where it drops to the top of the A/V rack. The contractor is to supply and install all support hardware including droppers and brackets as necessary to provide adequate mechanical support for the raceway when fully loaded with cables.

Where access to cable routes will be difficult after the completion of the works flexible PVC conduits 32mm diameter are to be supplied and installed from the main cable raceway to each equipment device location. The flexible conduits are to be strapped to catenary support wires at regular intervals and otherwise fastened to provide proper support.

A.3.2 Cable Termination Hardware

The cable termination hardware does not form part of this contract, and will be supplied and installed by others, except that, where shown on the drawings the contractor is to supply and install 2-gang flush boxes.

The cables when installed are to be left un-terminated. At the rack, sufficient length is to be left to enable any cable to be terminated anywhere within the rack. Where flush boxes are installed, one metre tails of cable are to be coiled up neatly inside the flush boxes. Where no flush boxes are specified, three metre cable tails are to be coiled neatly and bagged in plastic bags.

A.3.3 Cabinets and Racks

The cabinets and racks do not form part of this contract and will be supplied and installed by others.

A.3.4 Cables

All cables used in the installation are to be supplied and installed by the contractor. The following cable types are to be used, as shown in the Drawings:

- Belden 6400FE plenum rated, shielded, balanced, low-level audio cable.
- Belden 6300UE plenum rated, unshielded, high-level audio cable.

- Belden 1872A low skew data/video cable, Cat6.
- Belden 7989R very low skew data/video cable, Cat6.
- Belden 1279R 5-coax miniature RGBHV cable
- Extron MHR5 5-coax VGA video cable
- Argosy Image 360 Digital video cable
- Proel HPC620 2mm speaker cable

Some cable types are not stocked by the Belden agent Maser Communications (NZ) Ltd in Auckland and can be ordered for supply ex USA with a lead time of 2-3 weeks.

A.3.5 Other Materials

The contractor shall supply all other hardware, materials and incidentals necessary for the proper completion of the audio-visual services cabling works.

A.4 Standards

A.4.1 AS/NZS Standards

Unless otherwise specified all work shall be in accordance with the practices specified in AS/ACIF S009:2006. This document specifies, amongst other things, requirements for separation from power cables.

Where applicable the recommended practices in AS/NZS 3080:2003 are to be observed. This document specifies the requirements for Cat6 (Class E) cable installations.

A.4.2 Electrical Safety

In accordance with AS/NZS 3080:2003 Clause ZA.3.1, all work must satisfy the minimum segregation requirements specified in AS/NZS 3000:2007 and AS/ACIF S009:2006.

Particular attention must be taken to ensure compliance with:

- AS/NZS 3000:2007, Clause 1.5.11.5 Fundamental principles, Protection against abnormal voltages, Different circuits and installations,
- AS/NZS 3000:2007, Clause 3.9.8, Selection and installation of wiring systems, Installation requirements, Prevention of mutual detrimental effects between services, AS/ACIF S009:2006, Clause 5.9, Cable terminations,
- AS/ACIF S009:2006, Clause 9.1, Separation from LV power or HV circuits
- AS/ACIF S009:2006, Clause 16.3, Separation from LV power cables
- AS/ACIF S009:2006, Clause 16.4, Separation from HV circuits
- AS/ACIF S009:2006, Clause 18, Underground cabling.

A.4.3 Manufacturer's Standards

All cabling is to be installed in accordance with the manufacturer's requirements. Where a warranty certification is available the installation shall meet the requirements for certification and for the provision of a 20 year system performance warranty.

A.5 Catenary Installation

A.5.1 Catenaries shall be of at least 14 gauge high tensile galvanized steel insulated wire.

Catenaries shall be securely anchored at each end and well tensioned using galvanized steel turnbuckles, Hayes or Donalds style ratchet wire strainers. They shall not be end-fixed to partition walls of timber or steel stud construction. All anchors fixed into concrete, brickwork or blockwork shall use expansion fixings such as Rawlbolts or Dynabolts.

Catenaries shall be run parallel to the major axes of the building and should not deviate unless it is necessary to maintain clearance from other services.

Hangers shall be used to support catenaries at intervals of not more than 3 metres. They shall be positioned to clear all other services and the ceiling by at least 300mm.

Each catenary wire is to be bonded to a common earth point at the distribution board that serves the space in which they are installed.

A.6 Conduit Installation

Where access to cable routes will be difficult after the completion of the works flexible PVC conduits 32mm diameter are to be installed from the raceway to each equipment device location. The flexible conduits are to be strapped to catenary support wires at regular intervals and otherwise fastened to provide proper support.

Each conduit is to be fitted with a draw tape or wire to enable additional cables to be pulled in.

A.7 Cable Tray, Troughing or Raceway Installation

A.7.1 Manufacturer's Standards

Where not otherwise specified all cable trays, trunking and raceways shall be installed in accordance with the manufacturer's requirements.

A.7.2 Cable Tray Installation

On all backbone cable routes and on other cable routes where more than 32 cables are to be installed then a cable tray, trunking or raceway shall be used for cable support. Refer to *Appendix C Specification for Cable Trays and Troughing* on page 32.

A.8 Earthing

All exposed metalwork including catenaries, metallic cable trays, cabinets and frames are to be bonded to a common earth busbar at the electrical distribution board that serves the area concerned using 6 sq. mm earth wires with green or green/yellow PVC insulation.

Earthing is to be in accordance with AS/NZS 3000:2007, clause 5.6.2.7. For new installations install a brass earth busbar with 10 screw terminals and one stud. It shall be located at the main switchboard and installed in a plastic box clearly labelled "COMMUNICATIONS EARTH – DO NOT DISCONNECT". The main earth wire bonding the common earth busbar stud to the main building electrical earth shall be of 16 sq. mm with green or green/yellow PVC insulation.

A.9 Cable Installation

Installation practices shall conform to these guidelines and those given in AS/NZS 3080:2003 as well as those required by the cable manufacturer.

Audio-visual cables should be physically segregated from all other services or separated from them by at least 300mm throughout, except for the last 6 metres of cable at the outlet end where, if necessary, the minimum separation may be reduced to 50mm. Separation from electrical services shall be in accordance with AS/NZS 3000:2007.

Cables should be installed in flexible conduit or be secured neatly to catenaries and cable trays or raceways in bundles of not more than 32 cables with Velcro cable ties or binders fixed at intervals of not more than 400mm. Binders shall be at least 4mm wide and shall not be so tight as to cause damage or distortion to the cable sheaths. Not more than thirty-two individual cables are to be attached to one catenary wire. Cables are not to be exposed in areas with open ceilings, but must be installed within enclosed ducts, trunking or raceways for protection.

Cables are to be installed without tension. Particular care is to be taken at bends on cable trays and raceways where cables must be installed so that they follow smoothly the radius of the bend and do not pull against the inner edge of the bend or ride up over the side of the tray.

Cables shall be installed in a single length of between 10 and 90 metres without joint. Where cable runs exceed 90 metres the Engineer is to be consulted.

Cables shall be installed with as large a bend radius as reasonably practical, but in no case shall the bend radius be less than four times the outside diameter of the cable. The minimum bend radius for 4-pair UTP cables shall be not less than 50mm, as required by AS/NZS 3080:2003, clause 9.2.2.2.

Cables are to be concealed within walls and ceilings wherever possible.

Cables are to be run vertically within walls, deviating no more than 25mm from a straight line.

Holes through plates and dwangs are to be at least 20mm in diameter.

Where horizontal runs within walls are necessary then the cable shall be installed within 300mm of floor level and shall deviate not more than 25mm from a horizontal line. Holes through studs shall be at least 20mm in diameter.

Where cables are installed in trunking, cable trays or raceways the initial cable fill at the completion of this contract is not to exceed 40%.

Where cables pass through holes in structures the edges of the holes must be smoothed or bushed with close fitting plastic bushes.

All cables are to be clearly, permanently and uniquely labelled at both ends to enable them to be properly identified for testing and termination purposes.

All penetrations through firewalls and floors that are used for the installation of cables, whether they are new or existing penetrations are to be sealed with a proprietary intumescent fire-stopping compound or Firepro fire pillows immediately after the installation of the cables has been completed.

A.10 As-Built Documentation

A.10.1 Draft documentation

Four weeks prior to the scheduled date of practical completion, or the date of occupation if earlier, the contractor is to submit draft as-built plans showing cable numbering sufficient for the principal to prepare termination schedules.

The submission of a preliminary as-built documentation manual, including drawings and test results sufficient for the principal to take over and use the cables is a pre-condition for practical completion.

A.10.2 As-built Drawings

The audio-visual cabling contractor is to supply two copies (one CAD and one hard copy) of the following as-built documentation within ten days after practical completion plans showing the physical location of cables, terminations, racks, distributors and other installed items

As-built drawings shall be appropriately titled, identified, numbered and dated and shall include the name and address of the telecommunications service's contractor. The standard of preparation shall comply with AS/NZS 3085.1:2004. In particular, the triangular preferred symbols shown in Table A3 of AS/NZS 3085.1:2004 are to be used to designate outlets. A symbol legend shall be provided. Information shown on the drawings shall be compatible with labelled items on site. Room numbers as advised by the Principal shall be included on the drawings. These may not be the same as the room numbers shown on the construction drawings.

A.11 Testing, Certification and Documentation of Test Results

A.11.1 Progress Inspections

The Contractor is to provide the Engineer with notice of the commencement of cabling work in each lecture theatre and the projected completion dates so that progress inspections can be arranged.

A.11.2 Test Results

Test results are to be submitted on a CD in electronic format in the form of raw data (e.g. as *.mdb or *.flw files) as generated by the test set. Test results are to include the make, model and serial number of the test equipment used, together with evidence that the test equipment has been independently calibrated within the period of twelve months immediately prior to the date of the tests. Test results in MS Word or MS Excel or plain text formats are not acceptable.

Appendix B Specification for Backbone Cabling

B.1 General

Refer to the Preliminaries section of the Specifications and to the General and Special Conditions of Contract, which are equally binding on all trades.

B.2 Description of Works

The telecommunications services works comprises the provision of a fully engineered structured cabling system as described herein and as shown on the drawings.

B.3 Materials Supply

B.3.1 Termination Hardware

The cable termination hardware shall be supplied by the contractor and shall comprise only Krone manufactured items.

B.3.2 Cabinets, Racks and Boxes

The University may supply the cabinets or racks to be used in the installation. Upon confirmation by the Engineer of the quantities required the units may be available for collection from the IT Centre, 24 Symonds Street, after ten working days' notice of the requirement has been given to the Network Engineering Manager, ITS, prior to collection.

B.3.3 UTP 4-pair Cables

All cable used in the installation is to be provided by the telecommunications service's contractor. However, to ensure that an ADC Krone 20/20 system performance warranty is obtained for the works, The University of Auckland has entered into an agreement with ADC Krone New Zealand for the supply of all data type copper cables including:

- ADC Krone 4-pair UTP cable, Cat 6A,CopperTen (10G-A6TR-GYM2)

It is a condition of this agreement that all such cable used for The University of Auckland installations must be of ADC Krone manufacture.

B.3.4 Optical Fibre Cables

All optical fibre cables used in the works should be of ADC Krone manufacture if readily available, so that these links may be included in the 20/20 warranty test and certification programme. Cable from other manufacturers may be used if suitable ADC Krone cable is not available.

B.3.5 Other Cables

All cables other than 4-pair UTP cables and optical fibre cables used in the works (e.g. multi-pair cables for voice) may be purchased from other manufacturers, provided that they are compliant with the relevant clauses of the Cables section of this specification.

B.3.6 Other Materials

The telecommunications services contractor shall supply all other hardware, materials and incidentals necessary for the proper completion of the Telecommunications Services works.

B.4 Standards

B.4.1 AS/NZS Standards

Unless otherwise specified all work shall be in accordance with the preferred practices specified in AS/NZS 3080:2003 and associated documents, AS/NZS 3084:2003, AS/NZS 3085.1:2004, AS/NZS 3087.1:2003 and AS/ACIF S009:2006.

B.4.2 Electrical Safety

In accordance with AS/NZS 3080:2003 Clause ZA.3.1, all work must satisfy the minimum segregation requirements specified in AS/NZS 3000:2007 and AS/ACIF S009:2006.

Particular attention must be taken to ensure compliance with:

- AS/NZS 3000:2007, Clause 1.5.11.5 Fundamental principles, Protection against abnormal voltages, Different circuits and installations,
- AS/NZS 3000:2007, Clause 3.9.8, Selection and installation of wiring systems, Installation requirements, Prevention of mutual detrimental effects between services,
- AS/ACIF S009:2006, Clause 5.9, Cable terminations,
- AS/ACIF S009:2006, Clause 9.1, Separation from LV power or HV circuits
- AS/ACIF S009:2006, Clause 16.3, Separation from LV power cables
- AS/ACIF S009:2006, Clause 16.4, Separation from HV circuits
- AS/ACIF S009:2006, Clause 18, Underground cabling.

B.4.3 Manufacturer's Standards

All cabling is to be installed and tested in accordance with the manufacturer's requirements for certification and for the provision of an ADC Krone 20/20 year system performance warranty.

B.5 Cables

B.5.1 Campus Backbone Optical Fibre Cables (Outdoors)

Campus backbone cables shall be multi-core, loose tube cables with 6, 12, 24 or 48 LWP single mode fibres per cable.

Cables shall be constructed with a sheath that is suitable for installation in underground ducts. The sheath shall be coloured light green or black. Outdoor type cables shall transition from grease-filled outdoor type to non-grease filled indoor type cable within 5 metres of the building entrance point.

B.5.2 Building Backbone Optical Fibre Cables (Indoors)

Building backbone cables shall generally be multi-core cables with 6, 12, 24 or 48 OM1 or OM3 multimode fibres per cable, as specified. OM3 multimode optical fibre cable is preferred for all new work. In cases where cable length exceeds about 200 metres single mode cables shall be specified.

Cables shall be constructed with a low smoke zero halogen (LSZH) sheath that is suitable for installation on cable trays and in building risers. The sheath shall be coloured orange or black for OM1 cables, aqua or black for OM3 cables, and yellow or black for OS1 cables.

B.5.3 Optical Fibres

Backbone cables shall use:

- Class OM1 Multimode graded index fibres with 62.5/125-micron construction. Fibres shall have an attenuation of not more than 3.5dB per kilometre at 850nm and 1.5dB per kilometre at 1300nm. The minimum bandwidth of each fibre shall be 200MHz.km at 850nm and 500MHz.km at 1300 nm at 20°C.
- Class OM3 Multimode graded index fibres with 50/125-micron construction. Fibres shall have an attenuation of not more than 3.5 dB per kilometre at 850nm and 1.5dB per kilometre at 1300nm. The minimum bandwidth of each fibre shall be 1500MHz.km at 850nm and 500MHz.km at 1300 nm at 20°C.
- Class OS1 low water peak type Singlemode fibres with 9/125-micron construction. Fibres shall have an attenuation of not more than 1.0 dB per kilometre at 1310nm and at 1550nm.

B.5.4 Multi-pair Backbone Copper Cables for Voice

Campus backbone multi-pair cables shall generally have 25, 50 or 100 pairs. Cables shall be grease-filled PFUT and constructed with a sheath that is suitable for installation in wet conditions in underground ducts.

Outdoor type cables shall transition from grease-filled outdoor type to non-grease filled indoor type cable within 5 metres of the building entrance point.

Building backbone multi-pair cables shall generally have 25, 50 or 100 pairs. Cables shall be constructed with a sheath that is suitable for installation on cable trays within buildings.

Cable pairs shall meet Category 3 (Class C requirements as specified in AS/NZS 3080:2003, Section 6).

B.5.5 Four-pair Backbone Copper Cables

Building backbone cables shall be ADC Krone CopprTen Cat6A four-pair UTP cable meeting the requirements of Category 6A (Class EA) as specified in ANSI/TIA/EIA-568-B.2-10.

B.6 Cable Distributors

Distributor backing boards are to be supplied and installed as detailed in the drawings. The backing board is a panel of white plastic coated (or painted) plywood, 19mm thick mounted on 100mm vertical timber framing at approximately 600 centres to provide a space behind for the running of cables. The positioning of each backing board is to be confirmed with the Engineer or the Engineer's Representative prior to fixing.

A double switched electrical socket outlet is to be installed with each backing board, near the bottom right-hand corner.

ADC Krone Profil 66-way or HighBand 25 backmounts are to be installed on the backing board, as specified.

ADC Krone Profil backmounts are to be installed in accordance with the manufacturer's instructions with horizontal jumper guides at the top. A set of 50mm diameter holes at 150mm centres is to be drilled in the backing board behind each Profil backmount. The holes are to be angled upwards to the rear at an angle of 30 degrees.

ADC Krone HighBand 25 backmounts are to be installed in accordance with the manufacturer's instructions with single vertical cable management rings and covers at the edge, dual vertical cable management rings and covers between, and a cable

trough at the top of each vertical. For each vertical a full set of rectangular holes matching the holes in the back of the backmounts shall be cut in the backing board.

Floor-standing racks or cabinets supplied by the University are to be installed in the positions shown in the drawings. Floor standing racks and cabinets are to be bolted securely to the floor. Free standing channel frames must be fitted with top bracing which will usually comprise Unistrut members in a triangular arrangement attached to structurally adequate walls.

All racks and cabinets must be earthed in accordance with *B.12 Earthing* on page 29.

ETL flat steel cable management jumper bars and vertical cable management rings shall be supplied and installed in the rack or cabinet to provide proper support for all patch cords as shown in the drawings.

No cable terminations or active equipment shall be installed less than 200mm above floor level. Cable bundles or looms shall be routed within the rack so as not to obstruct equipment positions and not to impede air flow.

B.7 Equipment Cords

ADC Krone manufactured single ended, plug terminated Cat6A stranded equipment cords are to be supplied and installed in groups of twenty-six cords between the distributor and the equipment rack. Equipment cords are to be coloured blue and are to be of sufficient length to connect without strain to switches placed anywhere within the cabinet or rack. Each equipment cord is to be sequentially numbered at both the plug end and the distributor end, and all plugs are to be fitted with matching coloured boots or non-snagging latches.

For all new work the equipment cords are to use the pair assignment (pin-out) T568A as shown in AS/NZS3080:2003 Figure ZA.2(a).

Equipment cord labels on the distributor are to be coloured purple in accordance with the requirements of *Appendix F Specification for Labelling* on page 44.

B.8 Cable Terminations

B.8.1 Copper multi-pair and UTP terminations

Multi-pair backbone copper cables are to be terminated on distributors using ADC Krone HighBand 25 Category 3 modules as required in the drawings and schedules.

Four-pair Cat6A UTP backbone cables are to be terminated on ADC Krone CopperTen 20-pair modules as required in the drawings and schedules.

Optical fibre terminations

Unless otherwise specified, optical fibre cables are to be terminated in the equipment cabinet or rack using SC or LC connectors on 24-way 19-inch rack mount patch panels (7033 1 090-00 Fibre Patch Panel sliding Less Fronts, Plastic), or in 24-port termination/splice boxes mounted on the backing board. For larger installations ADC Krone FL2000 series products may be used.

The following colour-code convention shall be used:

- The colour beige shall be used to identify OM1 multimode connectors, adapters and outlets.
- The colour aqua shall be used to identify OM3 multimode adapters.
- The colour blue shall be used to identify singlemode (physical contact type) connectors, adapters and outlets.

B.9 Double-ended Patch Cables

All double-ended patch cables and jumpers will be supplied and installed by the University and are therefore not included in this contract.

B.10 Catenary Installation

Wherever not more than 32 four- pair UTP cables are to be installed on a route in an enclosed space then a catenary wire shall be used for cable support. Catenaries shall be of at least 14-gauge high tensile galvanized steel insulated wire.

Catenaries shall be securely anchored at each end and well tensioned using galvanized or plated steel turnbuckles, Hayes or Donalds style ratchet wire strainers. They shall not be end-fixed to partition walls of timber or steel stud construction. All anchors fixed into concrete, brickwork or blockwork shall use expansion fixings such as Rawlbolts or Dynabolts which should be set at right angles to the catenary.

Catenaries shall be run parallel to the major axes of the building and should not deviate unless it is necessary to maintain clearance from other services.

Hangers shall be used to support catenaries at intervals of not more than 3 metres. They shall be positioned to clear all other services and the ceiling by at least 300mm.

Each catenary wire is to be bonded to a common earth point at a conveniently located distribution board.

B.11 Cable Tray Installation

Wherever more than 32 four-pair UTP cables are to be installed on a route in an enclosed space then a cable tray shall be used for cable support. However, in situations where the installation of a tray would be difficult, multiple catenaries may be installed, but each must support not more than 32 cables.

Cable trays shall be in accordance with *Appendix C Specification for Cable Trays and Troughing* on page 32.

B.12 Earthing

All catenaries, cable trays, cabinets and racks are to be bonded to a common earth busbar at the nearest main electrical distribution board using 6 sq. mm earth wires with green/yellow PVC insulation. These cables are to be securely bolted to bare metal faces using crimp lugs and star washers.

For new installations install a brass earth busbar with 10 screw terminals and one stud, in accordance with AS/NZS 3000:2007, clause 5.6.2.7. It shall be located at the electrical distribution board and installed in a plastic box clearly labelled "COMMUNICATIONS EARTH – DO NOT DISCONNECT". The main earth wire bonding the common earth busbar stud to the distribution board electrical earth shall be of 16 sq. mm with green/yellow PVC insulation.

B.13 Cable Installation

Installation practices shall conform to these guidelines and those given in AS/NZS 3080):2003 as well as those required by the manufacturer. ADC Krone requires that the "Random lay" method is used for all Cat6 and Cat6A cables installed.

Telecommunications cables should be physically segregated from all other services or separated from them by at least 300mm throughout. Separation from electrical services shall be in accordance with AS/NZS 3000:2007.

Cables should be secured neatly to catenaries and cable trays in bundles of not more than 24 cables with Velcro cable ties or binders fixed at intervals of not more than 400mm. Binders shall be at least 10mm wide and shall not be so tight as to cause damage or distortion to the cable sheaths. Not more than 24 4-pair UTP cables are to be attached to one catenary wire. Cables are not to be exposed in areas with open ceilings, but must be installed within enclosed ducts, trunking or raceways for protection.

Cables are to be installed without tension. Particular care is to be taken at bends on cable trays where cables must be installed so that they follow smoothly the radius of the bend and do not pull against the inner edge of the bend or ride up over the side of the tray.

Cables shall be installed in a single length of between 15 and 90 metres without joint.

Cables shall be installed with as large a bend radius as reasonably practical, but in no case shall the bend radius be less than four times the outside diameter of the cable. The minimum bend radius for 4-pair cables larger than 6mm diameter shall be not less than 50mm, as required by AS/NZS 3080:2003, clause 9.2.2.2.

Cables are to be concealed within risers and corridor ceilings wherever possible.

Cables may be run vertically within walls, deviating no more than 25mm from a straight line.

Holes through plates and dwangs are to be at least 20mm in diameter.

Where horizontal runs within walls are necessary then the cable shall be installed within 300mm of floor level and shall deviate not more than 25mm from a horizontal line. Holes through studs shall be at least 20mm in diameter.

Where surface wiring cannot be avoided the Engineer is to be consulted before work proceeds.

Where cables pass through holes in structures the edges of the holes must be smoothed or bushed with securely fitted plastic bushes.

All penetrations through firewalls and floors that are used for the installation of cables, whether they are new or existing penetrations are to be sealed with a proprietary intumescent fire-stopping compound or Firepro fire pillows immediately after the installation of the cables has been completed.

All penetrations through floors within Equipment Rooms, Telecommunications Rooms or risers are to be bunded to a height of 50mm.

Where cables are installed in trunking the initial cable fill is not to exceed 40%.

Where cables are pulled into ducts, a draw tape or wire must be installed with the cable to facilitate the installation of future cables in the same duct.

B.14 As-Built Documentation and Testing

B.14.1 Documentation

As-built documentation is to be prepared and submitted in accordance with the requirements of *Appendix D Specification for Documentation and Testing* on page 35.

Testing is to be carried out in accordance with the requirements of *Appendix D Specification for Documentation and Testing* on page 35.

B.15 Labelling

B.15.1 Identifiers

The numbering scheme for record and database purposes for all items relating to the cabling network is described in the document "Telecommunications Administration Identifiers", see page 67.

A copy of this document can also be obtained on request from the Network Engineering Manager, ITS, The University of Auckland.

B.15.2 Labelling

All telecommunications cable terminations, hardware and equipment installed under the contract are to be permanently and neatly labelled as required in *Appendix F Specification for Labelling* on page 44.

Appendix C Specification for Cable Trays and Troughing

C.1 Description of Works

This specification describes the requirements for the provision of cable pathway systems using cable trays, troughs or trunking as described herein and as shown on the drawings.

C.2 Materials Supply

The contractor shall supply all of the materials, fixings, supports, protective coverings and incidentals necessary for the proper completion of the telecommunications pathway works.

C.3 Standards

C.3.1 AS/NZS Standards

Unless otherwise specified all work shall be in accordance with the preferred practices specified in AS/NZS 3080:2003, AS/NZS 3084:2003 and AS/ACIF S009:2006. Note particularly the minimum bend radius requirements in AS/NZS 3080:2003 Clause 9.2.2.2 Table 25.

C.3.2 Electrical Safety

In accordance with AS/NZS 3080:2003 Clause ZA.3.1, all work must satisfy the minimum segregation requirements specified in AS/NZS 3000:2007 and AS/ACIF S009:2006.

Particular attention must be taken to ensure compliance with:

- AS/NZS 3000:2007, Clause 1.5.11.5 Fundamental principles, Protection against abnormal voltages, Different circuits and installations,
- AS/NZS 3000:2007, Clause 3.9.8, Selection and installation of wiring systems, Installation requirements, Prevention of mutual detrimental effects between services,
- AS/ACIF S009:2006, Clause 5.9, Cable terminations,
- AS/ACIF S009:2006, Clause 9.1, Separation from LV power or HV circuits
- AS/ACIF S009:2006, Clause 16.3, Separation from LV power cables
- AS/ACIF S009:2006, Clause 16.4, Separation from HV circuits,
- AS/ACIF S009:2006, Clause 18, Underground cabling.

C.3.3 Manufacturer's Standards

All cable trays shall be installed in accordance with the manufacturer's requirements.

C.4 Cable Tray Application

On all backbone cable routes and on those horizontal cable routes where more than 32 four-pair UTP cables are to be installed then a cable tray or trunking shall be used for cable support.

C.5 Cable Tray Design

C.5.1 Tray Types

- **Horizontal trays**

  The cable tray or trunking shall have a flat bottom so as not to degrade transmission performance through structural return loss irregularities. To allow for loose lay of cables, high-sided (100mm minimum) cable trays or 150x100 metal cable trunking shall be used. Cable mesh tray, cable ladder or ladder-tray (such as Unistrut Uni-ladder or Supatray) shall not be used, unless a flat sheet of suitable material is fixed to the bottom of the tray with pop rivets or truss head screws. Cable tray with a corrugated or deformed bottom surface is not to be used.

- **Vertical trays**

  Trays for installation in a vertical plane must facilitate the tying of the cables at regular intervals. To this end, high sides are not a requirement, but trays must be perforated or slotted to provide for the tying of cables with Velcro or similar straps.

C.5.2 Design Capacity

The dimensions of the tray or trunking shall be such that the initially installed cables do not occupy more than 40% of the design capacity. The design capacity shall be determined by calculating the cross-section of the tray or trunking as equal to the width of the tray multiplied by a cable stacking depth of 90mm. The cable tray should use manufacturer's standard sizes of 100, 150, 200, 300 or 450mm as required to achieve the required capacity.

Where cable trays are installed vertically only a single layer of cable bundles can be fixed to the tray, hence the vertical tray shall be twice the width of the horizontal tray in order to provide the same capacity.

C.6 Cable Tray Installation

All joints and changes in direction shall be securely bonded using matching proprietary fittings. Radiused curves shall be used on the inside of all changes in direction or level, to ensure that no cables are subjected to a bending radius less than 50mm. Where cables pass over the edge or end of a cable tray a split tube or other device shall be used to ensure that the cable minimum bending radius is achieved. A split PVC tube of 100mm diameter may be used for this purpose.

Trays are to be adequately supported using galvanized or plated steel brackets and hangers at intervals of not more than 1200mm. No Ezyfix attachments shall be used to fix hangers to the building structure. Supports shall be independent of the ceiling supports.

Trays shall be finished smooth. There shall be no sharp edges, burrs, nuts, bolt heads or sharp protrusions inside the tray that might cause injury or damage to cables or personnel during or after installation.

Where cable trays are installed within ceilings there shall be at least 75mm clear between the ceiling tile and the bottom of the cable tray and its supports.

The clearance above the cable tray shall be at least half the width of the tray with a minimum of 100mm.

C.7 Earthing

Each section of cable tray or troughing shall be bonded to a common earth busbar at the nearest main electrical distribution board using 6 sq. mm earth wires with green/yellow PVC insulation. These cables are to be securely bolted to bare metal faces using crimp lugs and star washers.

For new installations install a brass earth busbar with 10 screw terminals and one stud, in accordance with AS/NZS 3000:2007, clause 5.6.2.7. It shall be located at the electrical distribution board and installed in a plastic box clearly labelled "COMMUNICATIONS EARTH – DO NOT DISCONNECT". The main earth wire bonding the common earth busbar stud to the distribution board electrical earth shall be of 16 sq. mm with green/yellow PVC insulation.

Appendix D Specification for Documentation and Testing

D.1 General

Refer to the Preliminaries section of the Specifications and to the General and Special Conditions of Contract, which are equally binding on all trades.

D.2 As-Built Documentation

D.2.1 Draft documentation

Twenty working days prior to the scheduled date of practical completion, or the date of occupation if earlier, the contractor is to submit draft as-built plans to the Network Engineering Manager, ITS, showing outlet numbering sufficient for the Principal to prepare jumpering and patching schedules.

The submission of a preliminary as-built documentation manual, including drawings and test results sufficient for the Principal to take over full running of the services is a pre-condition for Practical Completion.

D.2.2 Submission of documentation

The as built documentation shall be submitted in the form of a Manual, in both hard copy and electronic form. The manual shall include:

- Cover page and title page
- Table of contents
- Details of the main contractor and telecommunications subcontractor
- General description of the installation and work done, including cable type and size, hardware and equipment manufacturer and model
- Originals of manufacturer's data sheets for all installed items, including cables, termination modules, outlets and other hardware and equipment
- Set of indexed as-built drawings in A3 size
- Cabling system warranty certificate (when available)
- Test results for all commissioning tests.

Binders shall be Esselte (or equivalent) A4/3/26, 38 or 50 PVC Overlay Binder Black, with the title page inserted on the front cover with the following information:

The University of Auckland

(Official building name and number)
(Official project name and/or stage)
(Volume 1 of n (if required))

Operating and Maintenance Manual for

Telecommunications Services
(Month and year (of Practical Completion)

Architect:	Building Contractor:
(Name)	(Name)
(Mailing address)	(Mailing address)
(Phone number) (Fax number)	(Phone number) (Fax number)
Telecommunications Consultant:	Telecommunications Contractor:

(Name)	(Name)
(Mailing address)	(Mailing address)
(Phone number) (Fax number)	(Phone number) (Fax number)

The contractor shall submit one electronic copy of the manual on the same CD as the as-built drawings. The manual is to be in MS Word document format.

D.2.3 As-built Drawings

Notwithstanding the requirements for as -built documentation set out elsewhere in the contract documents, for the purpose of obtaining an ADC Krone 20/20-year system performance warranty only, the telecommunication services contractor is to supply two copies (one CAD and one hard copy) of the following as-built documentation within ten working days after practical completion:

- Floor plans showing the physical location of telecommunications outlets, terminations, distributors and other installed items
- Backbone cabling diagrams showing the interconnection and numbering of all cable pairs and other installed items
- Face layout diagrams of the distributors, racks and cabinets on which the cables are terminated
- Room layouts of all equipment rooms telecommunications rooms in which work has been carried out.

As-built drawings shall be appropriately titled, identified, numbered and dated and shall include the name and address of the telecommunications service's contractor. The standard of preparation shall comply with AS/NZS 3085.1:2004. In particular, the triangular preferred symbols shown in Table A3 of AS/NZS 3085.1:2004 are to be used to designate outlets. A symbol legend shall be provided. Information shown on the drawings shall be compatible with labelled items on site. University Room numbers as advised by the Principal shall be included on the drawings. These may not be the same as the room numbers shown on the construction drawings.

Floor plans of existing buildings in AutoCAD version 14 are available from Property Services for updating and including in the as-built documentation.

D.3 Testing, Certification and Documentation of Test Results

D.3.1 Progress Inspections

The Contractor is to provide ADC Krone New Zealand with notice of the commencement of cabling work and the projected completion date so that progress inspections can be arranged.

D.3.2 Copper Cable Testing

A test set approved by ADC Krone for 20/20 warranty purposes is to be used to test each four-pair UTP cable for compliance with Cat 6 requirements in accordance with AS/NZS 3087.1:2003 using the full auto-test schedule for permanent link. The latest software must be downloaded to the test set from the manufacturer's website. These settings should be used:

Table 5: Copper Cable Testing Settings

Approved Tester	Agilent WS350	Omniscaner 1 or 2	Fluke DSP 4000 Series	Fluke DTX Series
Cable Spec	KRONE C6TR TrueNet	KRONE TN6TR		
NVP	70% (=default)	70% (=default)	70% (default = 69%)	70% (default = 69%)
Connecting hardware	Krone / TrueNet XC6T			Permanent link adapters
Permanent link	Default Class E	Go to: Auto Test / Enter / Class E Link	Go to: Set UP / Choice / Page Down / ISO11801 PL Max Class E	Go to: Set Up / Twisted Pair / UTP

All equipment cords are to be tested for correct wire-map.

D.3.3 Optical Fibre Cable Testing

- Each fibre is to be tested following installation and termination using a calibrated optical source and power meter in accordance with the methods described in the ADC Krone document "PERFORMANCE TESTING OF OPTICAL FIBRE LINKS FOR COMPLIANCE WITH ISO/IEC 11801". This document describes the test methods set out in ISO/IEC 14763-3 - Testing of optical fibre cabling. A copy of this document can be obtained from the following website: http://www.adckrone.com.au/ADC/site_images/Standards/OFTestingV9_1&3T071012.pdf
- If there are any splices within the installed fibre link then an OTDR test is to be performed to confirm that individual splice losses are within the allowable range. A launch cable and a tail cable appropriate to the OTDR being used and of the same type of fibre as that under test must be used to ensure full visibility of the pigtail splices.

D.3.4 Test Results

- A headroom of 3dB is to be achieved on all Cat6 UTP test results for PSNEXT and PSELFEXT.
- No "FAIL" results are permitted in test results for UTP cables.
- No "STAR PASS" results are permitted without prior consultation.
- No over-length results are permitted without prior consultation.
- No "GAIN" results are permitted in test results for optical fibre cables.
- Test results are to be submitted on a CD in electronic format in the form of raw data (e.g. as *.mdb or *.flw files) as generated by the test set. Test results in MS Word or MS Excel or plain text formats are not acceptable Test results are to include the make, model serial number and software revision of the test equipment used, together with evidence that the test equipment has been independently calibrated not more than twelve months prior to the date of the tests. All tests are to be "Full Plot Enabled".

D.3.5 Witnessing of Tests

The Contractor is to provide ADC Krone New Zealand with at least three days' notice of the tests so that witnessing may be arranged.

Appendix E Specification for Horizontal Cabling

E.1 General

Refer to the Preliminaries section of the Specifications and to the General and Special Conditions of Contract, which are equally binding on all trades.

E.2 Description of Works

The telecommunications services works comprises the provision of a fully engineered structured cabling system as described herein and as shown on the drawings.

E.3 Materials Supply

E.3.1 Termination Hardware

The cable termination hardware shall be supplied by the contractor and shall comprise only Krone manufactured items.

E.3.2 Cabinets, Racks and Boxes

The University may supply the racks or cabinets to be used in the installation and in that case upon confirmation by the Engineer of the quantities required the units will be available for collection from the IT Centre, 24 Symonds Street, after ten working days' notice of the requirement has been given to the Network Engineering Manager, ITS, prior to collection.

E.3.3 UTP 4-pair Cables

All cable used in the installation is to be provided by the telecommunications service's contractor. However, to ensure that an ADC Krone 20/20 system performance warranty is obtained for the works, The University of Auckland has entered into an agreement with ADC Krone New Zealand for the supply of all data type copper cables including the following:

- ADC Krone 4-pair UTP cable, Cat 6,TrueNet (TN6TMT-GY11B)

It is a condition of this agreement that all such cable used for The University of Auckland installations must be of ADC Krone manufacture.

E.3.4 Optical Fibre Cables

Optical fibre cables used in the works may be of ADC Krone manufacture if readily available, so that these links may be included in the 20/20 warranty test and certification programme.

E.3.5 Other Cables

All cables other than 4-pair UTP cables and optical fibre cables used in the works (e.g. multi-pair cables for voice) may be purchased from other manufacturers, provided they are compliant with the relevant clauses in *E.5 Cables* on page 39.

E.3.6 Other Materials

The telecommunications services contractor shall supply all other hardware, materials and incidentals necessary for the proper completion of the telecommunications services works.

E.4 Standards

E.4.1 AS/NZS Standards

Unless otherwise specified all work shall be in accordance with the preferred practices specified in AS/NZS 3080:2003 and associated documents, AS/NZS 3084:2003, AS/NZS 3085.1:2004, AS/NZS 3087.1:2003 and AS/ACIF S009:2006.

E.4.2 Electrical Safety

In accordance with AS/NZS 3080:2003 Clause ZA.3.1, all work must satisfy the minimum segregation requirements specified in AS/NZS 3000:2007 and AS/ACIF S009:2006.

Particular attention must be taken to ensure compliance with:

- AS/NZS 3000:2007, Clause 1.5.11.5 Fundamental principles, Protection against abnormal voltages, Different circuits and installations,
- AS/NZS 3000:2007, Clause 3.9.8, Selection and installation of wiring systems, Installation requirements, Prevention of mutual detrimental effects between services, AS/ACIF S009:2006, Clause 5.9, Cable terminations,
- AS/ACIF S009:2006, Clause 9.1, Separation from LV power or HV circuits
- AS/ACIF S009:2006, Clause 16.3, Separation from LV power cables
- AS/ACIF S009:2006, Clause 16.4, Separation from HV circuits,
- AS/ACIF S009:2006, Clause 18, Underground cabling.

E.4.3 Manufacturer's Standards

All cabling is to be installed in accordance with the manufacturer's requirements for certification and for the provision of an ADC Krone 20/20-year system performance warranty.

E.5 Cables

E.5.1 Four-pair Horizontal Copper Cables

Cable pairs shall meet Category 6 (Class E) requirements as specified in AS/NZS 3080:2003.

E.6 Cable Terminations

Copper cables are to be terminated on distributors using Krone Highband Ultim8 8-pair modules installed on ADC Krone Profil 66-way backmounts on wall mounted backing boards or on Krone HighBand 25 modules as required in the drawings and schedules.

For details of distributors, backing boards and backmounts refer to *Appendix B Specification for Backbone Cabling* on page 25. Where Local Cabinets are used the cables are to be terminated on patch panels and Krone modules as described in the Telecommunications Services Specification for Local Cabinets.

For all new work the patch panel outlets and work area outlets are to use the pair assignment (pin-out) T568A as shown in AS/NZS3080:2003 Figure ZA.2(a).

E.7 Double-ended Patch Cables

All double-ended patch cables and jumpers will be supplied and installed by the University and are therefore not included in this contract.

E.8 Catenary Installation

Wherever not more than 32 four- pair UTP cables are to be installed on a route in an enclosed space then a catenary wire shall be used for cable support. Catenaries shall be of at least 14-gauge high tensile galvanized steel insulated wire.

Catenaries shall be securely anchored at each end and well tensioned using galvanized or plated steel turnbuckles, Hayes or Donalds style ratchet wire strainers. They shall not be end-fixed to partition walls of timber or steel stud construction. All anchors fixed into concrete, brickwork or blockwork shall use expansion fixings such as Rawlbolts or Dynabolts, which should be set at right angles to the catenary.

Catenaries shall be run parallel to the major axes of the building and should not deviate unless it is necessary to maintain specified clearance from other services.

Hangers shall be used to support catenaries at intervals of not more than 3 metres. They shall be positioned to clear all other services and the ceiling by at least 300mm.

Each catenary wire is to be bonded to a common earth point at a conveniently located distribution board.

E.9 Cable Tray Installation

Wherever more than 32 Cat6 four- pair UTP cables are to be installed on a route in an enclosed space then a cable tray shall be used for cable support. However, in situations where the installation of a tray would be difficult, multiple catenaries may be installed, but each must support not more than two bundles of 32 cables.

Cable trays shall be in accordance with *Appendix C Specification for Cable Trays and Troughing* on page 32.

Mesh trays, J-hooks or saddles are not be used.

E.10 Earthing

All catenaries, cable trays, cabinets and racks are to be bonded to a common earth busbar at the nearest main electrical distribution board using 6 sq. mm earth wires with green/yellow PVC insulation. These cables are to be securely bolted to bare metal faces using crimp lugs and star washers.

For new installations install a brass earth busbar with 10 screw terminals and one stud, in accordance with AS/NZS 3000:2007, clause 5.6.2.7. It shall be located at the electrical distribution board and installed in a plastic box clearly labelled "COMMUNICATIONS EARTH – DO NOT DISCONNECT".

The main earth wire bonding the common earth busbar stud to the distribution board electrical earth shall be of 16 sq. mm with green/yellow PVC insulation.

E.11 Cable Installation

Installation practices shall conform to these guidelines and those given in AS/NZS 3080:2003 as well as those required by the manufacturer. ADC Krone requires that the "Random lay" method is used for all Cat6 and Cat6A cables installed.

Telecommunications cables should be physically segregated from all other services or separated from them by at least 300mm throughout, except for the last 6 metres of cable at the outlet end where the minimum separation may be reduced to 50mm. Separation from electrical services shall be in accordance with AS/NZS 3000.

Cat6 cables should be secured neatly to catenaries and cable trays in bundles of not more than 32 cables with Velcro cable ties or binders fixed at intervals of not more than 400mm. Binders shall be at least 4mm wide and shall not be so tight as to cause damage or distortion to the cable sheaths. Not more than thirty-two 4-pair UTP cables are to be attached to one catenary wire. Cables are not to be exposed in areas with open ceilings, but must be installed within enclosed ducts, trunking or raceways for protection.

Cables are to be installed without tension. Particular care is to be taken at bends on cable trays where cables must be installed so that they follow smoothly the radius of the bend and do not pull against the inner edge of the bend or ride up over the side of the tray.

Cat6 UTP cables shall be installed in a single length of between 10 and 90 metres without joint. In cases where the total length of the work area cord, patch cord and equipment cord exceed 10 metres, the maximum length of the horizontal cabling is to be reduced accordingly.

Cables shall be installed with as large a bend radius as reasonably practical, but in no case shall the bend radius be less than four times the outside diameter of the cable. The minimum bend radius for 4-pair cables after installation shall be not less than 50mm, as required by AS/NZS 3080:2003, clause 9.2.2.2. ADC Krone also requires that the minimum bend radius after installation shall be not less than 50mm.for Cat6A cables and 25mm for Cat6 cables.

Cables shall be concealed within walls and ceilings wherever possible. Cables shall be separated by at least 300mm from fluorescent light fittings and other sources of electrical noise. Cables shall be separated by at least 300mm from low voltage electrical cabling unless a suitable barrier or divider is provided.

Cables shall be run vertically within walls, deviating no more than 25mm from a straight line.

Holes through plates and dwangs are to be at least 20mm in diameter.

Where horizontal runs within walls are necessary then the cable shall be installed within 300mm of floor level and shall deviate not more than 25mm from a horizontal line. Holes through studs shall be at least 20mm in diameter.

Where wiring cannot be concealed within walls and surface wiring is unavoidable the Engineer must be consulted before work proceeds. Surface-run cables shall be concealed in Neatcap or similar capping installed in a corner or against a doorframe to make the installation as inconspicuous as possible. Staples shall not be used for fixing cables to surfaces.

Any new trunking to be installed should use an approved product with two separate compartments for telecommunications and electrical cables, and separate lids or lid sections for each service:

- Interserv 180/2 and 150/2 Cat6 Trunking
- Modempak Cat6 Skirting Trunking

- Unistrut TD180 and TD155 Cat6 Skirting Duct

The trunking should be in colour grey, cream or beige unless otherwise specified. Telecommunications outlets should be installed on the upper compartment of the trunking using bezels, architrave or worktop style faceplates. Where required, sections of the same trunking should be used for vertical droppers from the ceiling.

Where cables are installed in trunking the initial cable fill is not to exceed 40%.

Where cables pass through holes in structures the edges of the holes must be smoothed or bushed with securely fitted plastic bushes.

All penetrations through firewalls and floors that are used for the installation of cables, whether they are new or existing penetrations are to be sealed with a proprietary intumescent fire-stopping compound or Firepro fire pillows immediately after the installation of the cables has been completed.

The requirements and special considerations for cabling and pathways within furniture, demountable partitions, workstation clusters, reception desks, printer stations and the like are covered in the Telecommunications Services Specification for Pathways in Furniture.

E.12 Telecommunications Outlet Installation

E.12.1 General

Outlets are to be installed in flush boxes mounted either horizontally or vertically as specified. These are normally positioned at either 300mm or 1200mm above floor level and must be coordinated with, and segregated from, adjacent electrical socket outlets. Adjacent telecommunications and electrical outlet plates should be spaced horizontally at 100mm centres on the same level and separated by a wall stud.

For all new work the telecommunications outlet sockets are to use the pair assignment (pin-out) T568A as shown in AS/NZS3080:2003 Figure ZA.2(a).

The manufacturer's requirements for maximum pair untwist and sheath stripping lengths shall be strictly observed.

E.12.2 Special Requirements

In laboratories and wet areas special outlet arrangements using trunking, service poles, ceiling mounted outlets or droppers may be specified. Installation details will be shown on the drawings.

E.12.3 Outlets in Furniture

The special considerations relating to the installation of outlets within furniture, demountable partitions, workstation clusters, reception desks, printer stations and the like are covered in Appendix G Specification for Pathways in Furniture on page 50.

E.13 As-Built Documentation and Testing

E.13.1 Documentation

As-built documentation is to be prepared and submitted in accordance with the requirements of the Telecommunications Services Specification for Documentation and Testing.

E.13.2 Testing

Testing is to be carried out in accordance with the requirements of *Appendix D Specification for Documentation and Testing* on page 35.

E.14 Labelling

E.14.1 Identifiers

The numbering scheme for record and database purposes for all items relating to the cabling network is described in the document "Telecommunications Administration Identifiers", on page 67.

A copy of this document can be obtained on request from the Network Engineering Manager, ITS, The University of Auckland.

E.14.2 Labelling

All telecommunications cable terminations, hardware and equipment installed under the contract are to be permanently and neatly labelled as required in *Appendix F Specification for Labelling* on page 44.

Appendix F Specification for Labelling

F.1 General

F.1.1 Administration identifiers

The format of administration identifiers used for the cable network of The University of Auckland is set out in the document" Telecommunications Administration Identifiers" on page 67.

A copy of the document can also be obtained on request from The University of Auckland, ITS, Network Engineering Manager.

This is based on the considerations in AS/NZS 3085.1:2004, 5.3, and ANSI/TIA/EIA 606A, Administration Standards for Telecommunications Infrastructure.

F.1.2 Information to be shown

The information to be shown on labels is generally either the full administration identifier or a part of the identifier, as detailed in *F.3 Labelling* Rules on page 45.

F.2 Requirements for Labels

F.2.1 Visibility

The size, colour and contrast between lettering and background must be selected so that the identifier can be easily read. Labels shall generally have black characters at least 3mm high (i.e. a font of at least 14 point) on a white background unless specified otherwise. All labels shall be generated by a printing machine or engraving machine using a common font such as "Arial" and not handwritten.

F.2.2 Durability

Labels shall be resistant to the environmental conditions, such as heat, moisture or ultraviolet light, at the point of installation. They shall have a design life of at least 20 years.

F.2.3 Colour Coding of Distributor Fields

Colour-coding of termination fields can simplify administration by making the structure of the layout more obvious. The labels to be used for distributor fields shall be of different colours as follows:

Table 6: Distributor fields colour coding

Termination Type	Colour	Typical Application
Demarcation point	Orange	PSTN exchange connection
Network connection	Green	User side of PSTN exchange connection
Common equipment	Purple	PBX, switches, LAN equipment, servers, multiplexers.
Telephone system	Red	Key telephone or sub-PBX system
Campus backbone	Brown	Inter-building cabling
Building backbone 1st level	White	Equipment Room to Telecommunications Room
Building backbone 2nd level	Grey	Telecommunications Room to Telecommunications Room
Horizontal	Blue	Horizontal cabling terminated in Telecommunications Room
Other	Yellow	Alarms, security, BMS, A/V

F.2.4 Work to be included

Labels for all distributors, racks, cabinets, verticals, terminations and cables installed under the contract shall be supplied and installed by the contractor.

There are no telecommunications labelling requirements for campus sectors or buildings. These are covered by wayfinding and signage systems installed by Property Services.

Door labels for Equipment Rooms and Telecommunications Rooms will normally be supplied and installed by Property Services

There are no telecommunications labelling requirements for cable pathways.

F.3 Labelling Rules

F.3.1 Telecommunications Spaces

Equipment Rooms

A Traffolyte (black on white) or other suitable door label shall be fixed to the Equipment Room Door with this form:

AAA.BBB Telecommunications Equipment Room ER-CCC.DDE

Where:

- AAA = building number
- BBB = room number
- ER = "Equipment Room"
- CCC = building number
- DD = floor number (with leading zero)
- E = serial letter (usually "A") assigned by ITS.

The label shall be made using letters at least 20mm high.

Example of a Telecommunications Equipment Room door label:

730.115 Telecommunications Equipment Room ER-730.01A

Telecommunications Rooms

A Traffolyte (black on white) or other suitable door label shall be fixed to the Telecommunications Room Door with this form:

AAA.BBB Telecommunications Room TR-CCC.DDE

Where:

- AAA = building number
- BBB = room number
- ER = "Equipment Room"
- CCC = building number
- DD = floor number (with leading zero)
- E = serial letter (usually "A") assigned by ITS.

The label shall be made using letters at least 20mm high.

Example of a Telecommunications Room door label:

730.216 Telecommunications Room ER-730.02B

Distributors, Racks and Cabinets

A Traffolyte (black on white) or other suitable label shall be fixed to the top front of each distributor, rack and cabinet with this form:

AAAA BB

Where:

- AAAA = "Distributor", "Rack" or "Cabinet".
- BB = serial number (e.g. "01") assigned by ITS.

Example of a Telecommunications rack label:

RACK 01

Labels for distributors, racks and cabinets shall be readily visible and legible from a distance of at least 2m. A minimum lettering height of 10mm is recommended.

Distributor Verticals

A Traffolyte (black on white) or other suitable label shall be fixed to the middle top of each vertical or rack or cabinet face showing the vertical identifier (refer to *Appendix J Telecommunications Administration Identifiers* on page 64) with this form:

A

Where:

- A = serial letter (“A”, “B”, “C”, etc.) assigned by ITS.

Example of a Telecommunications rack label:

B

Termination Positions

On racks and cabinets each Rack Unit (RU) positions shall be labelled from top to bottom starting with “01” at the top. The labels shall be fixed to the left-hand side of the front of the rack or cabinet clear of the mounting of patch panels and equipment, to aid in the identification of individual panel or equipment positions.

Individual termination positions do not require labelling. However, the patch panels or modules may be serially numbered by the manufacturer to aid in the identification of individual sockets or cable pair positions on the panel or module. In such cases the numbering should not be obscured.

F.3.2 Cables

Backbone Cables

Each backbone cable shall be marked at both ends within 300mm of the end of the cable jacket. A labelling method complying with the requirements of 2.1 and 2.2 above shall be used. The labels shall be secured to the cable sheath. Each backbone cable shall be labelled with the cable administration identifier (refer to *Appendix J Telecommunications Administration Identifiers* on page 64) of this form:

ABC-DDD.EEF-GGG.HHI-JJJ-KK

Where:

- A = Cable hierarchy (Campus or Building)
- B = Cable media (Copper, Fibre or Utp)
- C = Category (3, 5, 6, Multimode, Single mode)
- DDD= building number at first end.
- EE = floor number at first end.
- F = ER or TR alpha serial identifier at first end.
- GGG = building number at second end.
- HH = floor number at second end.
- I = ER or TR alpha serial identifier at second end.
- JJJ= number of copper pairs or fibres with leading zeroes (e.g. 004, 025, 200).
- KK = Cable serial number

Example of a backbone cable label:

CFM-722.02B-730.01A-012-02

For multi-pair cables the cable administration identifier shall be shown on a label in a Krone label holder that is installed immediately above the first module on which the cable is terminated. For cables of more than 100 pairs, labels shall be installed at intervals of 100 pairs (i.e. after every ten modules).

For optical fibre and other cables, the cable administration identifier shall be shown on a label that is fixed to the patch panel or termination shelf.

For four -pair UTP cables in the backbone, the cable administration identifiers for a group of similar cables shall be shown on a label in a Krone label holder that is installed immediately above the module on which the first cable is terminated. In this case the label format shall be as follows:

AAA-AAA.AAA-AAA.AAA-AAA-AA to BB

Where:

- AAA-AAA.AAA-AAA.AAA-AAA-AA = cable administration identifier for the first cable in the group
- BB = serial number (last) part of the cable administration identifier for the last cable in the group

Example of a backbone cable group label:

BC6-722.01B-730.02A-004-01 to 08

Horizontal Cables

Horizontal cables do not require labels on the cable jacket.

At the distributor the cable administration identifier for the first horizontal cable shall be shown on a header label in a Krone label holder that is installed immediately above the first module on which the first cable is terminated. The cable administration identifier (refer to *Appendix J Telecommunications Administration Identifiers* on page 64) of this form:

ABC-DDD.EEF-GGG

Where:

- A = Cable hierarchy (Horizontal)
- B = Cable media (Copper, Fibre, Utp or coaXial)
- C = Category (3, 5, 6, Multimode, Singlemode)
- DDD = building number of termination
- EE = floor number of termination
- F = ER or TR alpha identifier
- GGG = Cable serial number

Example of a horizontal cable header label:

HC6-730.01B-001

Where the horizontal cable terminations extend over more than one vertical, a similar label holder is to be installed at the top of the second and subsequent verticals labelled with the cable administration identifier of the first cable terminated in that vertical.

For all horizontal cables that are terminated on Krone modules a mini-label shall be fixed to the top half of each module showing the following information for each cable terminated:

EEF-GGG

Where:

- EEE = floor number of termination (ER, TR or LC)
- F = ER or TR alpha identifier
- GGG = Horizontal cable serial number

Example of a horizontal cable mini-label:

01B-127	01B-128

Telecommunications Outlets

At the telecommunications outlet the cable administration identifier for each horizontal cable shall be shown on a label associated with the outlet. The following information shall be shown for each terminated outlet:

EEF-GGG

Where:

- EE = floor number of termination
- F = ER or TR alpha identifier
- GGG = Horizontal cable serial number

Example of a telecommunications outlet label:

01B-127

Appendix G Specification for Pathways in Furniture

G.1 Design

G.1.1 Introduction

This Specification deals with the design and specification of cabling pathways in furniture, fixed and demountable partitions, workstation clusters, reception desks, counters, printer stations and the like. It refers to the following Standards:

- AS/ACIF S009:2006
- AS/NZS 3000:2007
- AS/NZS 3080:2003
- AS/NZS 3084:2003
- AS HB 29:2000

These standards apply to the design and installation of cabling pathways but they do not generally make specific recommendations regarding the selection of design options, nor do they mandate specific requirements for the dimensions of pathways and spaces.

This specification sets out quantitative interpretations of the various requirements that must be met to ensure that electrical safety, interference, mechanical protection, environmental and other considerations that impact on the performance of the cabling system are satisfied in accordance with the standards and manufacturers guidelines.

G.1.2 Coordination and exchange of information

Reference: AS/NZS 3084:2003, 7.6

Requirements:

The following information generally needs to be shared among the manufacturer, customer, (consultant,) designer and installer (of open office furniture systems):

- The number, type and location of telecommunications outlets and electrical outlets in each work area.
- The diameter and minimum bend radius (installed and during installation) of each cable type.
- The strategy for connecting building pathways to furniture pathways, including the number, placement and cross-sectional area of the required interfaces.
- Furniture pathway cross-sections and cable capacities.
- The number of work areas in each furniture cluster (7.6).

How this can be achieved

All of the parties identified above should consult together during the planning and design stages of the project. In addition to furniture layouts, drawings of the furniture modules should be prepared showing the outlets, cabling routes, facilities and interfaces. Sufficient detail should be shown to enable confirmation that the requirements of all parties will be met.

Notes

It is usually worthwhile to assemble a prototype workstation cluster early in the project so that all parties can be satisfied that the requirements of this specification are fully met.

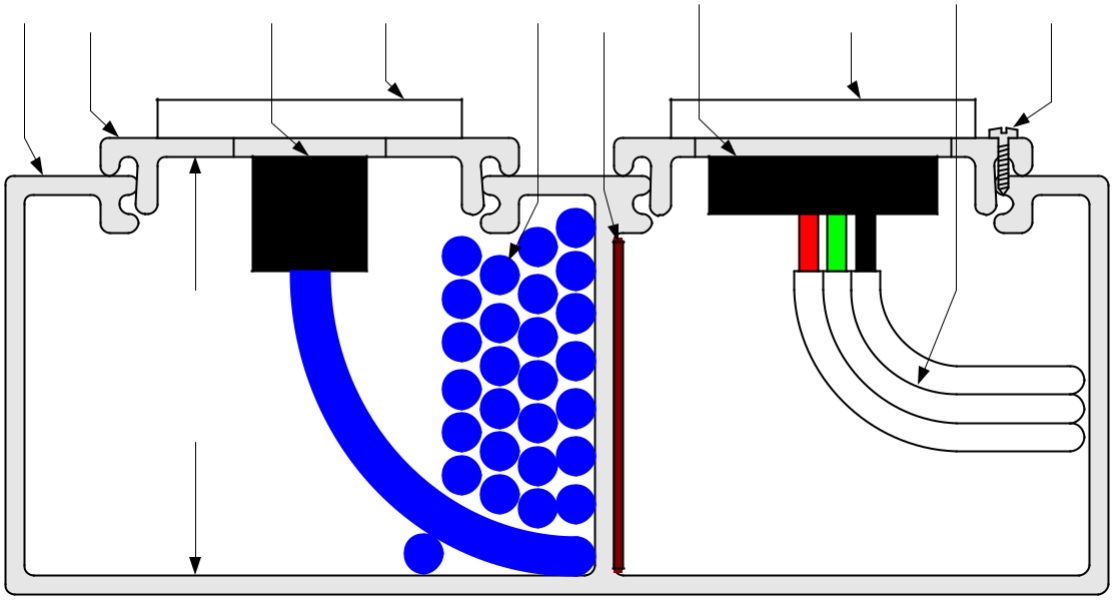

Figure 3: Trunking in the furniture

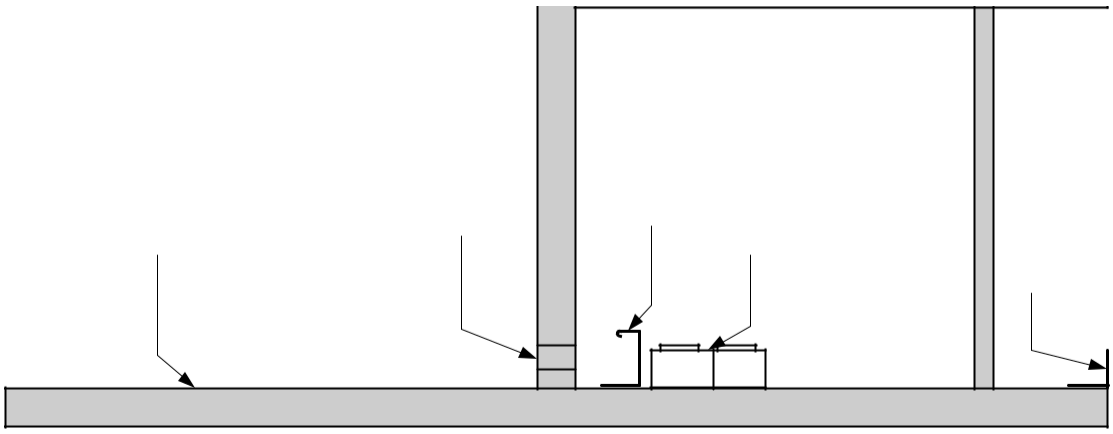

Figure 2: Access to the telecommunications and electrical compartments

G.1.3 Typical Preferred Arrangement

This describes a typical preferred arrangement that meets all the requirements identified in later sections of this specification.

- **General configuration**
  - Cables should be reticulated in two-compartment trunking with separate lids giving separate access to the telecommunications and electrical compartments (see Fig 2).
  - The telecommunications cabling should be run in the upper compartment.
  - The trunking should be an integral part of the furniture or should be rigidly fixed to the furniture at a height of between 300 and 600 above floor level (see Figure 2).
  - The furniture should be fixed to the floor.
  - Suitable flat-bottomed cord management trays and holes should be designed and supplied as part of the furniture to allow a safe and tidy installation of cords between the outlets and computers and telephones on the desktops.
- **Type and size of trunking**
  - Cables should be reticulated in two-compartment trunking with a fixed dividing barrier.
  - If the barrier is a separate component, then it must be fixed in place with a screw.
  - The size of the trunking must allow for the bending radius requirements (minimum 50 mm for Cat 6 UTP) to be met with a maximum 40% cable fill at initial installation. Allowance must be made for the reduced cross section at outlets, crossings and changes in direction.
  - Trunking with a 50 x 100 compartment for telecommunications cables and a 50 x 50 compartment for electrical cables is considered to be suitable. This will allow for up to 40 cables of 7mm diameter to be installed.
  - Where trunking runs exceed 6 metres in length the dividing barrier should include ferromagnetic material.
- **Safety and segregation**
  - The interface between the concealed fixed wiring and the visible flexible cords for both the electrical cabling system and the structured cabling system should be located in the same vicinity. This greatly simplifies the coordination issues.
  - All electrical wiring shall be contained within rigid metal trunking.
  - Trunking lids for the electrical compartment shall be firmly secured with screws that prevent accidental, inadvertent or unauthorised access to the wiring.
  - The trunking and the barrier separating the two compartments must be earthed.
  - Telecommunications cables shall not pass through the same holes as electrical cables.
  - Cabling routes shall be selected so as to minimise crossings of services.

G.2 Fixed Cabling

G.2.1 Electrical Safety

Hazard from electrical contact

Reference: AS/NZS 3000:2007, 1.5.4

Requirements:

- Barriers and enclosures shall be firmly secured in place and shall have adequate stability and strength. This means that covers, doors, panels, lids, etc must be firmly fixed, not just engaged in place (1.5.4.4 (b)). This applies to spaces within which the live terminals at the back of electrical socket outlets are exposed.
- The opening of enclosures shall not be possible without the use of a key or tool (1.5.4.4(b) (i)), or
- An interlocking device shall be fitted (1.5.4.4 (b) (ii), or
- An intermediate barrier shall be provided to prevent accidental contact with all live parts when the barrier or enclosure (lid) is removed (1.5.4.4 (b) (iii).

How this can be achieved

In b) above the requirement relates to enclosures containing live parts, such as the cavities which contain the exposed backs of electrical socket outlets. Such enclosures must not be accessible without the use of special tools or keys to remove fixing screws or unlock fittings. Care must be taken to ensure that such access is not possible from the other side of the partition or cavity or by removal of a panel on the opposite side of the ducting. A simple solution is to fit electrical outlets in suitable flush boxes (as in d) above) or use surface mounting blocks with the electrical cable passing through a bushed hole into the enclosure.

The use of an interlocking device is usually only economic for switchboard covers and the like.

Notes

- Barriers and enclosures must have adequate stability and strength to withstand any appreciable distortion that might be caused by the stresses likely to occur in normal operation. Outlet plates should not be mounted directly on composition board decorative panels, for example.
- Consideration should be given to external influences such as kicking in areas near floor level or knocking by mobile equipment or furniture.
- In the context of the above Standard the term "enclosure" means any enclosed space, including a wall cavity.

Separation and segregation from electrical services

Reference: AS/ACIF S009:2006, 9.1.2.2

AS/ACIF S009:2006, 16.3.

Requirements:

- The conductors and terminations of telecommunications cables shall not be located within the same enclosure as the uninsulated terminations of LV cables unless accidental access to the LV terminations by persons working on the telecommunications conductors and terminations is prevented by effective means (9.1.2.2).
- The conductors and terminations of telecommunications cables shall be separated from single insulated conductors and terminations of LV cables by

either a minimum distance of 150mm or by means of a permanent, rigidly-fixed barrier of durable insulating material or metal. If the barrier is metal, it shall be connected to a protective earthing conductor via a minimum 2.5mm2 green/yellow insulated conductor (9.1.2.3).

- Telecommunications cables shall be permanently separated from LV cables by:
  - a minimum distance of 50mm, or
  - a barrier of durable insulating material or metal, or
  - a timber or metal joist, stud, noggin or rafter of any thickness (16.3.1)
- Telecommunications cables shall not pass through the same hole as LV cables where they are within 50mm of any securing face of the building framework, irrespective of whether there is a barrier provided between the cables (16.3.2).
- Telecommunications cables which share ducting with LV cables shall be run in a separate channel of the common ducting provided the channel is separated by a fixed and continuous barrier of durable insulating material or metal (13.3.3).

How this can be achieved

It is considered best practice to run the telecommunications and LV cables in separate channels and to mount the telecommunications outlets on separate panels or panel sections from the electrical outlets so that the electrical cabling and terminals (at the back of electrical outlets) are not disturbed or exposed when the telecommunications outlets are removed for installation or maintenance purposes.

"Single –insulated conductors" in b) above includes the area at the back of an electrical outlet where the outer sheath of the electrical cable is removed to allow for termination of the individual wires. Since the standard University practice is to mount telecommunications and electrical outlet plates 100mm apart, which is closer than 150mm apart, it follows that a barrier, as defined in e) above, must be provided.

"Permanently" separated in c) above means that the services must be fixed so that they cannot sag or move in any way that would reduce the separation below 50mm.

Compliance with c).b above may be achieved by the enclosure of either the telecommunications cable or the LV cable in suitable conduit. It is usually simpler and cheaper to enclose the LV cable.

Separated routes and penetrations must be provided where cables pass from the furniture or partitions into the building structure. The provision of a barrier, sleeve or conduit within the same penetration is not acceptable.

"Permanent and rigidly fixed" in b) above and "Fixed and continuous" in e) above mean that:

- The barrier must be an integral part of the ducting or remain permanently fixed in place by screws, bolts or other locking fittings when covers are removed, and must not be able to be dislodged.
- There must be no gaps or penetrations in the barrier. However, breaks in the barrier are permitted at intersections of modular office furniture including abutments to service columns, provided that: (a) these can be opened for inspection, (b) cables do not cross into other channels, and (c) fixings are fitted where required to maintain segregation at changes in direction of any cabling in the ducting.

Notes

In the context of the above Standard the term "enclosure" means any enclosed space, including a wall cavity.

Low voltage is defined in AS/NZS 3000:2007 as any voltage exceeding 50 V a.c. or 120 V d.c. but not exceeding 1,000 V a.c. or 1,500 V d.c. This includes 230-240 volt single-phase and 230/400 volt three-phase electrical services.

The requirements for separation from high-voltage cables are covered in AS/ACIF S009:2006, 16.4.

Separation and segregation from non-electrical services

Reference: AS/ACIF S009:2006, 9.2.2

Requirements:

Telecommunications cables, conductors and terminations shall be separated from non-electrical hazardous services by a minimum distance of 100mm (9.2.2).

How this can be achieved

Care must be taken to ensure that telecommunications cable pathways do not pass close to hazardous services such as gas or steam pipes and fittings.

Notes

A hazardous service includes any pipe containing corrosive or flammable liquid or gas or any substance exceeding 60°C.

Earthing

Reference: AS/NZS 3000:2007, 3.9.4.4.

Requirement:

It is not mandatory in the Wiring Rules for metallic cable trunking or trays to be earthed. However, there is provision in Section 3.9.4.4 (b) for the protection of wiring concealed in walls by means of an earthed metallic enclosure. Further, it is prudent to ensure that all exposed metalwork is bonded to the protective earth system to provide protection against earth faults giving rise to hazardous potential differences. Refer to AS/NZS 3000:2007, 5.6.7.2.

How this can be achieved

All metal enclosures, trunking, trays and catenary wires and parts thereof that are used for the enclosure or support of cables or the mounting of electrical outlets should be bonded to the protective electrical earth.

Notes

Only one earth connection should be made from each interconnected and bonded system, and the connection should be made at the nearest electrical distribution board.

G.2.2 Interference

Reference: AS/NZS 3080:2003, ZA.3.2.

Requirement:

To minimise coupling of noise and other interference between telecommunications cabling and other electrical systems the following should be considered:

- Increased separation beyond mandatory requirements.
- Use of surge suppressors and other devices designed to limit electrical transients in communications and electrical cabling and equipment.
- Use of enclosed, grounded, metallic ducting or conduit. The use of ferrous materials may reduce induction.

- Ensuring that open or non-metallic telecommunications pathways do not closely parallel potential noise sources such as electrical power wiring, radiofrequency sources, inverters, induction heaters, arc welders, large motors and generators (ZA.3.2).

How this can be achieved

It is considered good practice to either increase the separation beyond the mandatory requirement or to use a barrier of ferrous material to reduce interference from electromagnetic induction.

Notes

A steel conduit or trunking surrounding one service also serves the required purpose.

G.2.3 Pathway size

Reference: AS/NZS 3084:2003, 7.1.

Requirement:

The initial fill must not exceed 40% of the design capacity. This makes allowance for:

- The loose lay of cables without stresses being imposed by the pathway,
- Future cables (e.g. optical fibre to the desk) to be installed, and
- Bend radius requirements to be met at changes in direction of the pathway (e.g. right-angled intersections.)

How this can be achieved

Calculation of the size of a pathway should be based upon the assumption that each horizontal cable occupies an area of 49mm2. Thus, for example, let us assume that we are designing a system that can have up to eight workstations in a cluster which is cabled from one end. This requires three telecommunications outlets per workstation; hence 24 horizontal cables need to be run. These cables will have a cross-section of 24x49 = 1176mm2. The cross-section of the cable trough, duct or channel must therefore be 2.5 times this area to allow for the 40% capacity factor, or 2940mm2. This can be achieved using a channel that is, say, 50x60mm, or a tube that is 65mm internal diameter.

Notes

This does not make any allowance for the cross-sectional area of the channel being reduced by outlets or other intrusions into the channel. An outlet on a flush plate on the front of the channel will limit the cabling capacity of the channel and an additional allowance of 500mm2 must be added to the design. In the above case this would require a channel of 50x70mm.

G.2.4 Cable bending radius

Reference: AS/NZS 3080:2003, 9.2.2.2.

Requirement:

The minimum bending radius (after installation) shall be not less than 25mm for four pair cables with diameter up to 6mm. For the minimum bending radius during installation (which may be greater), refer to the cable manufacturer's recommendations (9.2.2.2, Table 25, 1.5).

The minimum bending radius (after installation) shall be not less than 50mm for four pair cables with diameter over 6mm. For the minimum bending radius during

installation (which may be greater), refer to the cable manufacturer's recommendations (9.2.2.2, Table 25, 1.5).

How this can be achieved

The telecommunications outlet on a flush outlet plate protrudes into the cabling channel by up to 15mm. The cable exits from the back of the outlet, and hence must curve through an arc of 90 degrees to run longitudinally along the back of the channel. This means that either:

- The channel must be at least 65mm deep, measured from the front face, or
- In the case of a double-sided channel with a central division, penetrations are made in the division to allow the cable to laid in correctly, or
- If a shallower channel is used a mounting block may be used to move the outlet plate forward, proud of the surface of the channel by a distance equal to the difference between the channel depth and 65mm, or
- The outlet plate may be mounted in a standard flush box or surface mounting block with a depth of 65mm adjacent to the channel.

Notes

The manufacturer's recommended minimum cable bending radius for pulling-in of cables is usually greater than the installed minimum radius (refer to the table in AS HB29:2000, 4.2.3). Generally, it is necessary to use channels with removable lids or covers so that cables can be laid-in and not pulled-in around right-angled bends.

Cat6 UTP cables are generally more than 6mm in diameter, hence the 50mm bending radius limit applies for all installations where Cat6 cables are to be installed. Since the University has standardised on Cat6 cable for all new work, this higher bending radius applies to all new furniture and fittings.

G.2.5 Mechanical Protection

Reference: AS/ACIF S009:2006, 5.4

Requirement:

All parts of an installation shall be adequately protected against damage which might reasonably be expected to result from mechanical injury (5.4).

Conduits, trays and trunking shall have all sharp edges removed from their cable bearing surfaces (5.4).

How this can be achieved

The types of cables used in telecommunications cabling systems are not robust in that they do not have rugged sheaths or armouring. Particular care should be taken to provide durable protection for cables that run from the floor, wall or ceiling into modular furniture.

Any furniture module that contains fixed outlets and fixed wiring shall be secured in place so that it cannot be moved in normal use. Such movement could damage the insulation of electrical or telecommunications cables and present a hazard to users.

Furniture modules shall be bolted or screwed to the floor or adjoining wall. If this is not practicable, then the outlets should be installed in a floor box or wall outlet plate and cords used to connect the services to the work area equipment.

Cables that run from floor penetrations, floor troughing or floor boxes up into furniture must be protected by suitably robust rigid trunking. Experience has shown that flexible trunking systems or conduit are not sufficiently durable for this purpose.

Sharp edges on trunking or cable trays that are inherent in the design or result from sharp changes in direction must be smoothed and rounded or protected by suitable sleeves or grommets that are fixed in place so that they cannot easily be dislodged.

Notes

Telecommunications and electrical outlets under workstation desks should generally be installed at a height of at least 450mm above floor level so that they are out of the zone where they are likely to be kicked.

G.3 Flexible Work Area Cords

G.3.1 Separation and segregation

Reference: AS/ACIF S009:2006, 16.3.1.

Requirement:

Flexible work area equipment cords and electrical appliance cords are not required to be separated unless installed as fixed or concealed wiring (16.3.1, Note 3).

How this can be achieved

Do not fix or conceal work area cords.

Notes:

It is good practice to use an open cable management tray fitted beneath the desktop to safely stow surplus length of work area cords and keep them tidy. Trays made from sheet metal are preferred. Cords can be run from this cable management system through bushed access holes in the desktop to the terminal equipment.

G.3.2 Length of work area cords

Reference: AS/NZS 3080:2003, 7.2.2.2

Requirement:

Work area cords should not exceed 3 metres in length (refer to Notes below).

How this can be achieved

If any terminal equipment in a cluster is more than 3 metres from a wall outlet or floor box then the furniture must be fixed in place and the telecommunications outlet installed at or on the workstation at a point less than 3 metres from the terminal equipment, with concealed, separated or segregated fixed cabling to the floor distributor.

Notes

Horizontal cable link design is based on a fixed cable length of not more than 90 metres, plus a combined equipment cord + jumper + work area cord length of not more than 10 metres. Up to 7 metres is allowed for equipment cords and jumper cables in the telecommunications room.

Hence, in order to comply with the 100 metre limit of the standard, each work area cord must not exceed 3 metres.

Appendix H Specification for Underground Ducts

H.1 General

Refer to the Preliminaries section of the Specifications and to the General and Special Conditions of Contract, which are equally binding on all trades.

H.2 Description of Works

The telecommunications services work comprises the provision of an underground telecommunications cable duct system as described herein and as shown on the drawings. The cables will later be installed in the ducts as part of a separate cabling contract.

H.3 Materials Supply

The contractor shall supply all materials and incidentals necessary for the proper completion of the works.

H.4 As-Built Documentation

The contractor shall prepare by a plan showing the as-built route of the ducts, depth of cover, duct formation and other detail. As -built drawings shall be appropriately titled, identified, numbered and dated and shall include the name and address of the contractor. The standard of preparation shall comply with NZS 5902 parts 0 to 5. A symbol legend shall be provided. Information shown on the drawings shall be compatible with labelled items on site. Room numbers shall be included on the drawings.

Floor plans of existing buildings in AutoCAD version 14 are available from Facilities Management for updating and including in the as-built documentation.

H.5 Duct Materials

The ducts are to be 100mm nominal diameter UPVC in accordance with NZS 7643:1969, Code of Practice for the Installation of UPVC Pipe Systems.

Where drilling or thrusting is used as a means of installation thick walled PE duct in continuous lengths may be used.

The preferred colour for telecommunications ducts is white. Alternative colours may be used provided they are not the same as any of the colours specified for hazardous services:

Table 7: Duct colours for hazardous services

Colour	Hazardous Service
Orange	Electrical power
Yellow	Fuel, process, toxic or medical gases
Silver	steam
Brown	Flammable and combustible liquids
Violet	Acids and alkalis
Light blue	Compressed air

H.6 Quantities

Within the campus, four 100mm ducts in square formation or three ducts in triangular formation are to be installed in the main duct routes. Two ducts in horizontal formation are to be installed for building entries. Minor lateral routes or off-campus routes will generally comprise one 100mm duct.

H.7 Depth

On city Council road reserve, the cover is to be not less than 900 in carriageways and 600 in footways and elsewhere. A reduced cover of 450mm is permitted for building entries. On University and private property, the cover is to be not less than 500. No reduced cover shall be permitted without the written approval of the Engineer.

H.8 Protection and Warning Strip

All ducts shall have a white plastic warning strip or marking tape together with a 100 x 25 ground treated protection timber or similar protection installed 300 below ground level and at least 100 above the top duct over the entire trenched length.

H.9 Backfilling

The trench is to be thoroughly compacted during backfilling in layers of not more than 100mm using a plate compactor.

H.10 Duct Bends

Significant changes of direction are to be achieved using pre-formed duct bends with a radius of curvature of not less than 5 metres. At or within 500mm of a building entrance or access pit the radius of curvature may be reduced to 800mm. ***Small radius plumbing bends are not to be used.***

There shall be no more than two 90° bends in any one pull length between pits.

H.11 Cable Pits

Cable handling pits of nominal internal size 1200x600x600 with one or two lockable alloy lids are to be installed where building entry ducts branch off the main route. Pits of nominal internal size 600x600x600 with one lockable alloy lid are to be installed where the route changes direction by more than 90°. Where pits are installed in driveways or road crossings care must be taken to ensure that they have an appropriate design loading to withstand the passage of vehicles. Ducts are to be sealed into the pits at the points of entry.

The exact position of each pit is to be confirmed on site by the Engineer.

H.12 Joints

All joints in PVC ducts are to be socketed and made watertight using PVC solvent cement.

H.13 Building entries

The principal will identify and mark the building entry points. Concrete cutting of penetrations through foundations or walls may be required using a masonry core drill to produce a penetration 10mm greater than the duct OD.

The contractor shall be responsible for checking the condition of the structure, avoiding any building services in the vicinity of the penetration and ensuring that the penetration does not affect the structure or stability of the building.

The entry ducts are to be secured in place and sealed into the penetrations using a non-hardening mastic compound.

H.14 Cleaning and Draw Wires

Upon completion each duct is to be tested and cleaned using compressed air and a mandrel and swab to remove debris and a draw wire or non-elastic tape installed in each duct from pit to pit or duct entry point. The finished ends of each duct are to be sealed with a plug or suitable duct-stopping compound to prevent the ingress of rodents, insects or debris.

H.15 Disturbance and reinstatement

The ducts are to be installed with minimum disturbance to adjacent trees, structures and surfaces. The trench is to be hand dug within the drip line of trees to avoid root damage. All hard surfaces are to be restored to their original condition. The University will attend to the dressing and sowing of lawn areas and the replanting of gardens.

H.16 Maintenance

The installation contractor shall be responsible for making good any defects in the installation, including repair of hard surfaces and subsidences, for a period of 12 months after practical completion.

Appendix I Typical Backing Board Layouts

I.1 ADC Krone Highband 25 Backmounts

Typical Backing Board for Floor Distributors and Building Distributors with up to four ADC Krone Highband 25 900-pair verticals

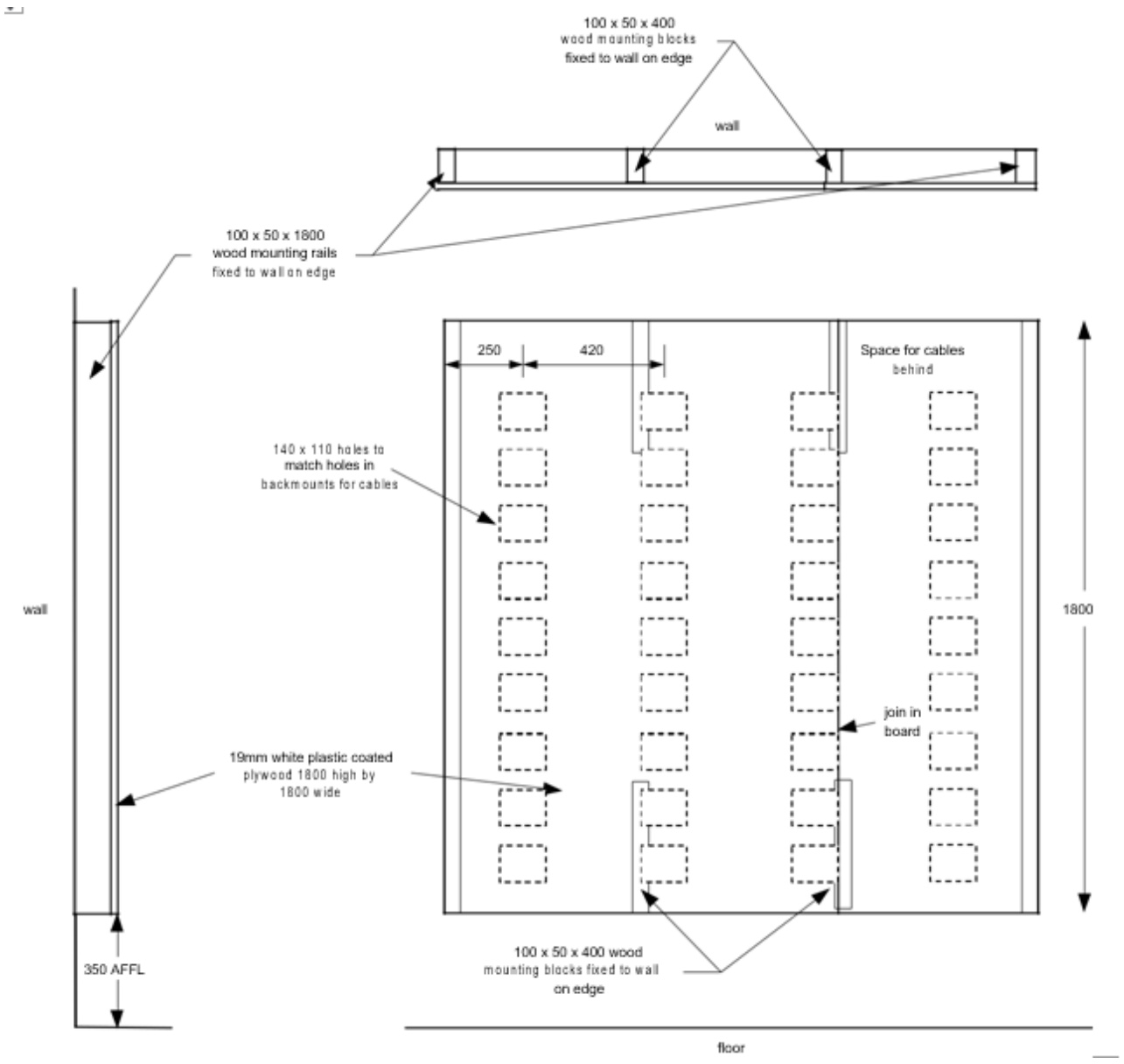

Figure 4: ADC Krone Highband 25 Backmount

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I.2 ADC Krone Profil Backmounts

Typical Backing Board for Floor Distributors and Building Distributors with up to eight ADC Krone Profil 600-pair (66-way) verticals.

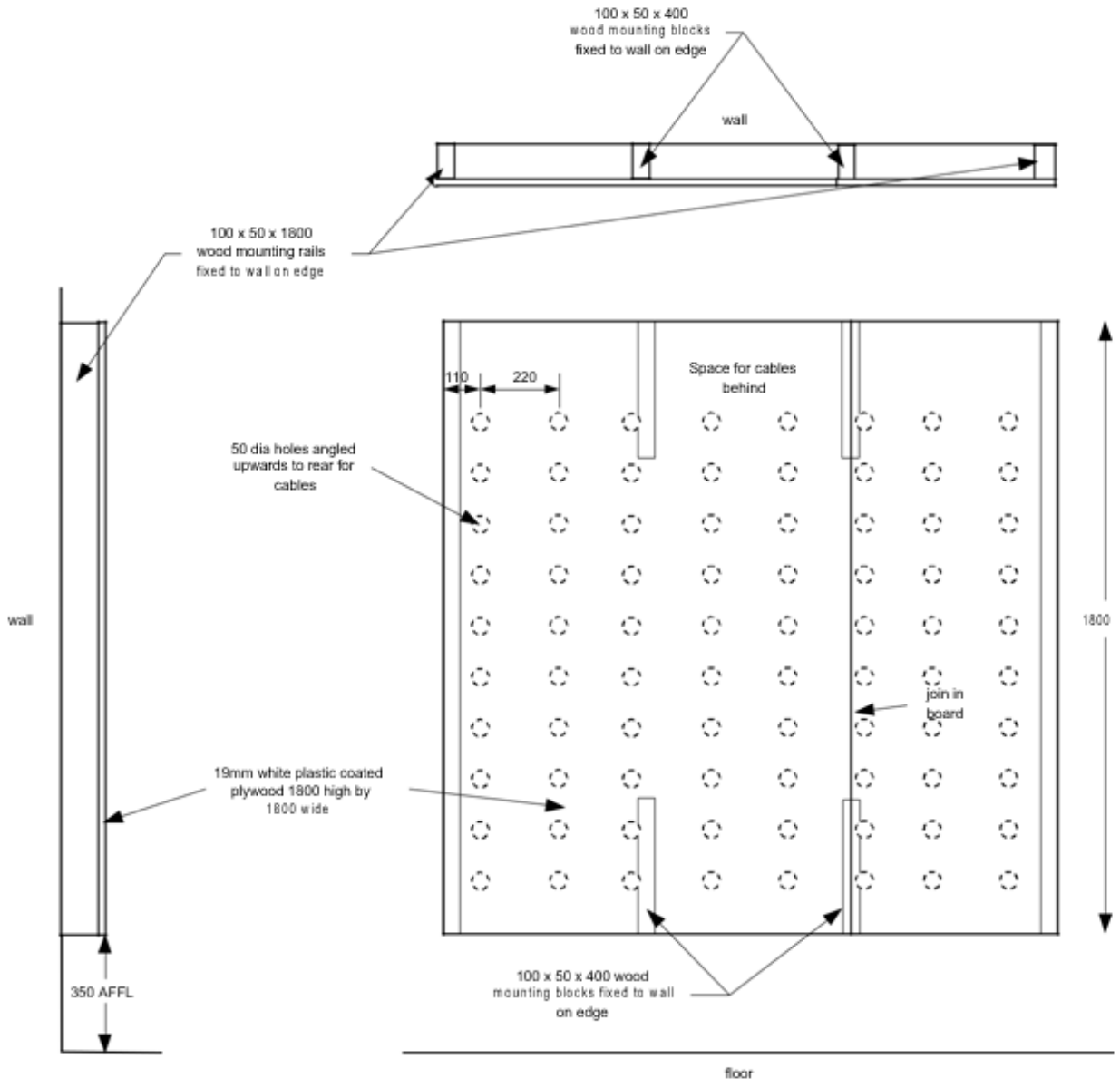

Figure 5: ADC Krone Profil Backmount

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Appendix J Telecommunications Administration Identifiers

J.1 Overview

This document sets out the format of the administration identifiers to be used for the telecommunications cabling system of the University of Auckland. It provides a uniform approach that is appropriate to the size and scope of the network for the use and benefit of the owners, end users, consultants, designers, contractors, suppliers, installers, managers and administrators.

The purpose of these administration identifiers is to provide a key to finding the recorded information within the administration system (whether it is a paper record, simple spreadsheet or comprehensive computer database system). Each identifier must be unique within a building.

It is expected that the use of these standard formats will increase the value of the University's investment in the infrastructure by reducing the cost of maintaining the system, extending its economic life and increasing the efficiency of its use.

This document was originally published in 1997 but has been substantially revised to bring it into line with current University terminology. In particular it has been updated to conform to the definitions in AS/NZS 3080:2003. Where appropriate it has been brought into line with the recommendations in the 2003 edition of ANSI/TIA/EIA 606A, Administration Standard for Telecommunications Infrastructure. This latter North American Standard is likely to be used as a model for administration software packages, and alignment with the recommended formats will greatly simplify the introduction of enhanced, computer-based management of structured cabling system infrastructure in the future by the University. It is also likely that the ISO and AS/NZS standards bodies will follow the lead given by the ANSI Standard when revising their own Standards. Not all of the identifiers recommended by ANSI/TIA/EIA 606A are covered in this document. Indeed, it is unlikely that the University will ever need to create formal records of earthing busbars or firestop locations.

This document should be treated as a guide, rather than a mandatory standard. It is recognized that some existing identifiers for buildings, floors, and spaces such as lobbies, corridors and stairwells do not comply strictly with these guidelines.

The information to be included on labels, and the colour coding of labels serve separate purposes in that they need to convey additional information about the cable or equipment. These requirements for labelling are covered in a separate ITS document; "Specification for Labelling".

J.2 Scope

The following tables set out in a simple format the essential information relating to identifiers. The following information is provided in each case:

Name

This is the standard name of the item to be identified.

Format

This shows the format of the identifier, including separator symbols. The characters used in the format are referred to in the following definition section.

Example

This gives a real example of an identifier that conforms to the format.

This specifies the types of characters that are permitted, and cross-references other identifiers that form part of this identifier.

Range

This specifies the range of permitted values, and defines the meaning of specific codes, such as campus sector codes.

Responsibility

This identifies the group within the University that is responsible for assigning and managing the various identifiers.

The parts of the campus, buildings and cabling system that need to be identified are as follows.

Spatial Information

Campus Sector

A campus sector is a collection of physically adjacent buildings and grounds that form a separately identifiable part of the University. Campus sectors are identified by numeric codes managed by Property Services.

Building

Each physically separate building requires a unique identifier. Buildings are identified by a Building Number system administered by Property Services.

Workspace

A workspace is any area within which telecommunications outlets might be installed at some time throughout the life of the system. All spaces are identified by Room Numbers which are assigned and administered by Property Services.

Equipment Room (ER) or Telecommunications Room (TR)

A space set aside for the installation of telecommunications equipment and/or the termination of telecommunications cables.

Cabling Information

Backbone Cabling

A campus backbone cable runs from an ER or TR in one building to an ER or TR in another building. It is usually installed in an underground duct or tunnel. A building backbone cable is run within the same ER or TS, or between one TS and another within the same building. It is usually installed within a riser or on a cable tray.

Horizontal Cable and Telecommunications Outlet (TO)

Each horizontal cable from a TS to a telecommunications outlet, and the associated TO itself, is uniquely identified. The definition includes all copper, UTP, optical fibre and coaxial cables that are terminated in a work area.

Termination Hardware

This is used to identify a particular rack, cabinet or distributor within which a cable is terminated, or equipment is installed.

Termination Position

This is used to identify the position within a rack, cabinet or distributor where a particular cable is terminated, or equipment item is installed.

Pathway Information

Campus Pathway

A campus pathway is a service tunnel or underground duct providing a route between two separate buildings for the installation of campus backbone cables.

Building Pathway

A building pathway is a riser or cable tray providing a route within a building for the installation of building backbone cables.

J.3 Telecommunications Administration Identifiers

J.3.1 Explanation

In the format definitions:

- A = alpha character
- N = numeric character
- O = open format, alpha or numeric character.

- The "first" end for a campus backbone cable (inter-building) is the end with the lesser building number.
- The "first" end for a building backbone cable (intra-building) is the end with the lesser alphanumeric ER or TR identifier.
- The "second" end in each case is the other end.
- Each Equipment Room (ER) and Telecommunication Closet (TC) will usually have a Room Number (e.g. 201.415A) as well as a corresponding ER or TC Identifier (e.g. ER-201-04A).

J.3.2 Spatial Identifiers

Campus Sector

Format	a
Example	2
Definition	1 character = (N) a = Campus Sector identifier
Range	1 = Library 2 = Arts 3 = Science 4 = Engineering 5 = FMHS 6 = Halls of Residence 7 = Tamaki 8 = Law 9 = global (all or many campus sectors)
Responsibility	Property Services

Building

Format	Abc = (NNN)
Example	201
Definition	3 characters = (NNN) a = Campus Sector identifier (see above) bc = Serial number starting from 01 (with leading zero) unique to each campus sector
Range	100 to 999
Responsibility	Property Services

Work Space

Format	Abc.defgh
Example	201.0415A
Definition	8 characters = (NNN.NNNNA) abc = Building Identifier de = Floor number starting from 01 = lowest occupied level fg = Room number starting from 01 h = Optional sub-space identifier starting from A
Range	100.0101 to 99.1216F
Responsibility	Property Services

Equipment Room or Telecommunications Room

Format	Ab-cde-fgh
Example	ER-102.04A
Definition	8 characters = (AA-NNN.NNA) ab = Type of room cde = Building Identifier fg = Floor number starting from 01 = lowest occupied level h = Equipment Room or Telecommunications Room serial identifier starting from A
Range	Type: ER = Equipment Room (houses main equipment and CD or BD) TR = Telecommunications Room (houses FD) LC = Local Cabinet (houses access switch and patch panel for lab)
Responsibility	ITS

J.4 Cabling Identifiers

Backbone Cabling

Format	abc-def.ghi-jkl.mno-pqr-st
Example	CFM-501.03A-502.05B-200-01
Definition	20 characters = (AAO-NNN.NNA-NNN.NNA-NNN-NN) a = Hierarchy b = Media c = Category def.ghi = ER identifier (excluding first two characters) for first end (see above) jkl.mno = ER identifier (excluding first two characters) for second end (see above) pqr = Cable size identifier (Copper pair count or optical fibre count including leading zeroes) st = Cable serial identifier (unique to end-to-end route) starting from 01

Range	**Hierarchy:** B = building backbone C = campus backbone **Media:** C = copper multi-pair F = optical fibre U = UTP four-pair X = coaxial **Category:** 3 = Category 3 cable 5 = Category 5 or 5E UTP 6 = Category 6 or 6A UTP A = audio-visual B = BMS, security and alarm E = Ethernet (thick) M = multimode optical fibre S = singlemode optical fibre T = Ethernet (thin)
Responsibility	ITS

Horizontal cabling and telecommunications outlet

Format	abc-def.ghi-jkl
Example	HU6-501.03A--027
Definition	12 characters = (AAO-NNN.NNA-NNN) a = Hierarchy b = Media c = Category def.ghi = TR identifier (excluding first two characters) (see above) jkl = Cable serial identifier (unique to TR) starting from 001
Range	**Hierarchy:** H = horizontal **Media:** C = copper multi-pair F = optical fibre U = UTP four-pair X = coaxial **Category:** 3 = Category 3 cable 5 = Category 5 or 5E UTP 6 = Category 6 or 6A UTP A = audio-visual B = BMS, security and alarm E = Ethernet (thick) M = multimode optical fibre S = singlemode optical fibre T = Ethernet (thin)
Responsibility	ITS

Distributor Termination Hardware (cabinet, rack or frame)

Format	abc-def.ghi-jkl
Example	HU6-501.03A--027
Definition	12 characters = (AAO-NNN.NNA-NNN) a = Hierarchy b = Media c = Category def.ghi = TR identifier (excluding first two characters) (see above) jkl = Cable serial identifier (unique to TR) starting from 001
Range	**Hierarchy:** H = horizontal **Media:** C = copper multi-pair

	F = optical fibre U = UTP four-pair X = coaxial **Category:** 3 = Category 3 cable 5 = Category 5 or 5E UTP 6 = Category 6 or 6A UTP A = audio-visual B = BMS, security and alarm E = Ethernet (thick) M = multimode optical fibre S = singlemode optical fibre T = Ethernet (thin)
Responsibility	ITS

Termination Position

Format	ab-cde.fgh-ij-klmno
Example	TP-102.04A-01-A0905
Definition	15 characters = (AA-NNN-NNA-NN-ANNNN) ab = TP (Termination Position). cde.fgh-ij = Distributor termination hardware identifier (see above). k = Vertical identifier (serial column (vertical, cabinet or rack) identifier (counting from left to right). lm = Module identifier (serial row (module or RU) identifier (counting from top to bottom). no = Position identifier (serial pair or connector (position) identifier (counting from left to right, or as labelled).
Range	**Vertical identifier:** A to Z **Module identifier:** 01 to 66 **Position identifier:** 01 to 48
Responsibility	ITS

J.5 Pathway Identifiers

Campus Pathway

Format	ab-cde.fgh-ijk.lmn-opq-rs
Example	PW-501.03A-502.05B-DCT-01
Definition	19 characters = (NN-NNN.NNA-NNN.NNA-NNN-NN) ab = PW (PathWay) cde.fgh = ER identifier (excluding first two characters) for first end (see above) ijk.lmn = ER identifier (excluding first two characters) for second end (see above) opq = Type rs = pathway serial identifier (unique to end-to-end route) starting from 01
Range	**Type:** DCT = duct system TRY = cable tray TUN = tunnel
Responsibility	ITS

Building Pathway

Format	ab-cde.fgh-ijk.lmn-opq-rs
Example	PW-501.03A-501.03B-TRY-01
Definition	19 characters = (NN-NNN.NNA-NNN.NNA-NNN-NN) ab = PW (PathWay) cde.fgh = ER or TR identifier (excluding first two characters) for first end (see above) ijk.lmn = TR identifier (excluding first two characters) for second end (see above) opq = Type rs = pathway serial identifier (unique end to end route) starting from 01
Range	**Type:** DCT = duct system TRY = cable tray TUN = tunnel
Responsibility	ITS

Appendix K Feedback Form

We love hearing from you. Please take a few moments to let us know how we can improve the *Property Services Design Standards and Guidelines*.

1.	**Name:**			
2.	Contact Details: (in case we need clarification)			
Complete this section if you have found a typo / formatting error. (If possible, attach a photo of the error)				
3.	Section No:		Page No/s:	
	Description of error:			
Complete this section if you have a suggestion about content.				
4.	Section No:		Page No/s: (if applicable)	
	Suggestion/s:			
Complete this section if you have any other suggestions for improvement.				
5.	Suggestion/s:			
6.	Email your feedback to PSTechServices@auckland.ac.nz			
Thanks for your feedback!				

Appendix L Index