10 – Mechanical Services

Version	Date	Authors	Summary of Changes
1.1	19 October 2010	Solomon Elijah	
1.2	08 February 2012	Solomon Elijah	Document completely revised
1.3	06 December 2012	Solomon Elijah	Referenced 19.29 to section 06
1.4	18 January 2013	Solomon Elijah	Modified Clauses 19.5.1.1, 19.5.2, 19.5.6.1, 19.7.2 & 19.28
2.0	02 March 2016	Kanthasamy Mohan	General Revision

Introduction

10.1. The Australian National University's (the ANU or the University) is committed to energy efficient design and low long-term maintenance costs associated with mechanical (and other) services and systems within buildings and on the sites of ANU campuses.

10.2. These Requirements need to be referred to before commencement of design of any mechanical service or system. For refurbishment of existing buildings where infrastructure limitations, such as available power supply, preclude provision of air-conditioning throughout, priority shall be given to provision of air-conditioning to essential areas where a controlled environment is critical to the functions performed. Examples of such areas include PC-2 laboratories, computer areas, animal houses and clean rooms.

10.3. The Campus and Buildings Requirements Manual (the CBRM, the Requirements or the Manual) documents the minimum design and construction requirements for new, refurbishment or repurposed building works, landscapes and engineering/infrastructure projects on buildings, facilities and campuses of the ANU. The Requirements are prepared for the direction of a Consultant, Designer or Project Manager in the preparation of project specific documentation and in the delivery of project works.

10.4. This section of the CBRM outlines the ANU minimum requirements for air-conditioning and ventilation systems and services.

10.5. Notwithstanding any Consultant's particular discipline or area of responsibility, each Consultant and/or designer shall consider the document in its entirety. The complete CBRM consists of the following Sections which may be referred to within this Section:

Campus and Building Requirements Manual	
Section 01	General Requirements
Section 02	Architectural Requirements
Section 03	Roads, Car Parking & Civil Works
Section 04	Soft Landscaping
Section 05	Roofing, Roof Fabric & Roof Safety
Section 06	Building Management Systems
Section 07	Electrical Services
Section 08	Fire Protection Systems
Section 09	Hydraulic Systems
Section 10	Mechanical Services
Section 11	Lifts, Cranes & Vertical Transportation Systems
Section 12	Security, CCTV & Access Control

10.6. Sensible and appropriate levels of technology and design should be applied to obtain the correct level of quality and reduce energy wastage and carbon dioxide emissions arising from the building operation without reducing the functional standards necessary.

10.7. Mechanical services and systems shall be comprised of systems and equipment that have been tried and tested.

10.8. Mechanical services and systems will need to be adaptable and flexible due to the changing needs of the ANU. Systems are to be designed and zoned to accommodate the building design, proposed and future users.

10.9. In as much as the design can be developed to be efficient, the future operation and management of the building and its systems will have a huge bearing on energy consumption. To this end the designers shall liaise closely with the Principal's Representative to ensure all design features are clearly articulated and understood and systems properly handed over for successful operation of the systems.

10.10. The quality aspects of the services proposed will be provided to the Principal's Representative for review at all project stages.

10.11. A peer review of the designs, at various stages, may be arranged at the discretion of the Principal's Representative.

10.12. Specifications provided by the designer must be tailored to suit the specific project requirements and must not include generic or non-applicable material.

Design Requirements

10.13. In designing and specifying a system due regard shall be given to the following criteria:

- Size or capacity of the system including peak and minimum loads;
- Performance requirements;
- Energy utilisation through seasonal cycles;
- Noise considerations;
- Location and space considerations;
- Owning and operating costs;
- Reliability;
- Ease of maintenance;
- Capability of future expansion;
- Separation of process and comfort cooling systems to ensure reliability; and
- Project specific energy targets.

10.14. Systems designed and specified must be suited to the purpose for which they are designed and installed, must be technically sound and must meet the current requirements of the National Construction Code (NCC) and any other applicable Standards, Regulations or Acts in force at the time.

Environmentally Sustainable Design

Passive Design Considerations

10.15. The Project Team shall give consideration to the benefits derived from incorporation of passive design measures from the earliest stages of the design process.

10.16. The mechanical services designer, in conjunction with the Project Team, will propose, analyse, develop and implement passive design measures to reduce thermal plant sizing and maximise energy efficiency of the building.

10.17. Passive design measures to be considered include but are not limited to the following:

- Building orientation and floor plate configuration;
- High performance glazing and facade design;
- External shading elements; and
- Natural ventilation (where appropriate).

System Selection

10.18. The mechanical services designer shall undertake analysis of various system types during the concept design phase to identify appropriate energy efficient system selections and secondary energy efficiency measures to be incorporated into the mechanical services design.

10.19. System design should consider and utilise, for maximum efficiency and enhanced user comfort, features of the prevailing climate. For Canberra this includes a high diurnal range, a low wet-bulb temperature, low average wind speed and low average ran days.

10.20. System design measures to be considered include but are not limited to the following:

- Outdoor air economy cycle on air handling plant;
- Mixed mode active/passive systems;
- Utilise free cooling where suitable;
- Chilled and heated water temperature reset;
- Heat recovery and thermal storage systems; and
- Use of Variable Speed Drives (VSDs) on system components with variable demands.

10.21. A value engineering analysis shall be undertaken during the concept design phase to assess appropriateness of the potential system types and energy efficient design measures to validate the final systems selections. A cost benefit analysis shall be prepared where payback periods of 5, 10, 15 and 20 years shall be presented to the ANU for consideration. The requirements for preparation of a cost benefit analysis shall be confirmed with the Principals Representative.

10.22. The value engineering analysis, including detailed life cycle costing, shall incorporate as a minimum the following elements:

- Capital expenditure;
- Recurrent maintenance and repair costs;
- Payback periods;
- Replacement at end of economic life; and
- Energy usage costs.

10.23. The value engineering analysis shall be based on the building's operating schedule and take into consideration areas and systems with extended hours of operation (i.e. the economic service life of equipment serving a 24 hour facility will be significantly shorter than for a typical weekday office type application).

10.24. Life cycle costing shall be determined over a 30 year period for major projects and account for cost of equipment replacement which may be required during the life of the building.

Existing Installations

10.25. In areas where an existing installation is in place, consideration should first be made to the possibility of extending the system to take in the proposed additional load. The proliferation of diverse self-contained systems in the same location is to be avoided.

Hours of Operation

Hours of operation of air-conditioning systems are to suit the application and user requirements. For comfort air-conditioning of small spaces, the preference is for operation via BMS time-schedules with over-ride push-button functionality set initially for two hours. A number of research laboratories, libraries, computer facilities and other areas may require 24 hour operation. Detailed requirements for the operation of air-conditioned spaces must be clarified with the Principal's Representative at an early design stage.

Mechanical Systems Design Parameters

Outdoor Design Conditions

Summer

10.26. Design ambient conditions for selection of air-conditioning equipment, chillers, cold room, constant temperature room and freezer room equipment and the like shall be as follows:

ANU campuses	Summer Design, 8-10 hrs/day	Summer Design, 24hrs/day	Average Daily Range, °K	Average Yearly Range, °K	Elevation, meters above MSL	Latitude, South
ACT-Acton, Fenner Hall, Spring Valley Farm	36.2°C DB/ 20.8°C WB	37.1°C DB/ 21.4°C WB	15.0	33.5	565	35°27’
ACT-Mt Stromlo	36.5°C DB/ 19.5°C WB	37.5°C DB/ 20.0°C WB.	15.0	33.5	742	35°19’
NSW-Kioloa	28.5°C DB/ 17.0°C WB	29.0°C DB/ 17.5°C WB	10.0	26.0	12	35°32.7’
NSW-Coonabarabran, SSO	36.3°C DB/ 22.3°C WB	39.2°C DB/ 24.7°C WB	18.0	34.5	1,164	31°16.5’
NT-NARU	34.5°C DB/ 27.7°C WB	35.0°C DB/ 28.0°C WB	7.0	16.0	30	12°28’

Notes to Table:

- Dry Bulb Temperature (DB), Wet Bulb Temperature (WB), Relative Humidity (RH),Mean Sea Level (MSL).
- Siding Spring Observatory (SSO), North Australian Research Unit (NARU).
- Comfort applications for all ACT campuses & SSO site: Air cooled condensing unit/air cooled chiller to be selected for 37°C DB ‘air-on’ condition.
- Critical/process applications for all ACT & SSO campuses: Air cooled condensing unit/air cooled chiller to be selected for 40°C DB ‘air-on’ condition.
- For all cold rooms and freezer rooms the condenser ‘air-on’ condition to be used for sizing and selection of air-cooled condensing units is 43°C DB.
- For evaporative coolers/cooling towers, where permitted, the design WB shall be 22°C for critical applications, otherwise 21°C WB shall be used.

Winter

10.27. Design ambient conditions for selection of heating equipment, heating boilers, constant temperature room equipment and the like shall be as follows:

ANU campuses	Winter Design, 8-10 hrs/day	Winter Design, 24 hrs/day
ACT-Acton, Fenner Hall, Spring Valley Farm	-2.5°C DB, 80% RH	-4.5°C DB, 80% RH
ACT-Mt Stromlo	-3.0°C DB, 80% RH	-5.0°C DB, 80% RH
NSW-Kioloa	5.0°C DB, 80% RH	3.0°C DB, 80% RH
NSW-Coonabarabran, SSO	-3.5°C DB, 80% RH	-5.0°C DB, 80% RH
NT-NARU	18.0°C DB, 85% RH	17.0°C DB, 85% RH

Notes to Table:

- Library applications: Use -3.0°C DB, 80% RH for heat loss estimating and -3.0°C DB 'air-on' condition for air cooled condensing unit/reverse cycle chiller selection.
- Comfort applications for all ACT campuses & SSO site: Air cooled condensing unit/reverse cycle chiller to be selected for -2.5°C DB 'air-on' condition.
- Critical/process applications for all ACT campuses & SSO site: Air cooled condensing unit/reverse cycle chiller to be selected for -5°C DB 'air-on' condition.

Indoor Space Design Conditions

Summer

10.28. Unless stated otherwise, room design conditions for assessment of cooling loads shall be based on the following:

Comfort applications	
Offices, Libraries, Study Rooms, Laboratories* and the like	24°C DB +/- 2°C DB; 50% RH
Auditoriums, Conference Rooms, Exercise Rooms and the like	22°C DB +/- 2°C DB; 55% RH
Machinery Workshops	26°C DB; 40% RH
Critical/process applications	As determined in consultation with the user and recorded in the user brief
Passive/Naturally ventilated areas	As determined in consultation with the user and recorded in the user brief

Notes to Table:

- *Some laboratories may require narrower temperature tolerances.
- For facilities such as laboratories which must be cooled and heated on a 24/7 basis, the temperature set point may be different to that during normal working hours.

Winter

10.29. Unless stated otherwise room design conditions for assessment of heating loads shall be based on the following:

Comfort applications	
Offices, Laboratories and the like	21°C DB +/- 2°C DB
Auditoriums, Conference Rooms, Exercise Rooms and the like	21°C DB +/- 2°C DB
Workshops	20°C DB
Entry air-locks, foyers, break-out spaces, circulation spaces (including waiting areas that are part of such spaces), break-out rooms and the like	21°C DB +/- 3°C DB
Shower rooms, Change/Locker rooms, Cleaners Rooms and the like – source of heated make-up air from circulation space.	21°C +/- 3°C DB
Toilets	Unconditioned
Large store rooms for distributing items of equipment that are likely to be occupied for 30min or more	21°C +/- 3°C DB
Critical/process applications	As determined in consultation with the user and recorded in the user brief
Passive/Naturally ventilated areas	As determined in consultation with the user and recorded in the user brief

Occupancy and Ventilation Rates

10.30. For animal facilities, the following are the minimum outdoor air ventilation requirements:

#Laboratory animals (rats, mice, etc.)	15 room volumes/hr
Laboratory animals in IVC enclosures	+15 room volumes/hr to the room in which the IVC cages are housed
*Birds	8 room volumes/hr
Insects, Lizards, other *animals	8 room volumes/hr

Notes to Table:

- +The actual outdoor air change for each IVC enclosure will probably exceed 100 cage volumes/hr.
- #These are for some older facilities where laboratory animals are housed in cages.
- *These apply to those birds and animals where behavioural studies are being carried out.

10.31. While the maintenance of negative air pressure with respect to the surrounding areas is the norm for the purpose of odour control, in animal facilities, there are applications where positive pressure is required to be maintained with respect to the surrounding areas. Therefore the user will require to be consulted in each case and the design parameter indicated in the Final Sketch Plan (FSP) Report.

Mechanical Services for Laboratories and Critical Applications

Laboratory Design

10.32. Design of air-conditioning and ventilation systems to laboratory areas is to take into consideration the impact of localised effluent removal systems at the source of contaminant generation and the resulting reduction of outside air flow rates required, rather than be based on generic air change rates.

Critical Areas

10.33. Critical areas, including laboratories where applicable, shall be supplied with essential services including power, chilled water, condenser water, humidification, heating, ventilation and controls. The systems shall be designed so the appropriate load shedding occurs.

10.34. Single point of failure analysis is to be completed for critical areas with agreement of solutions with the Principal's Representative.

Cleanrooms

10.35. The Principal's Representative shall liaise with users in determining the production requirements of the cleanroom to ensure the design process is followed to be able to achieve sign off and shall include design, installation and commissioning qualification processes.

10.36. Cleanroom redundancy details shall be referred to the Principal's Representative for review.

Specific Equipment Requirements

Chillers

10.37. Chillers and chilled water systems shall be analysed during the design phase to determine the most suitable type of system for the installation. A cost benefit analysis is required comparing, at a minimum, the following factors:

- Air-cooled vs water cooled systems;
- Multiple chillers vs single chiller;
- Fixed speed Primary only vs Primary/secondary; and
- Chiller installation configuration and staging. Equal sized, low load chillers, Series pipework, Parallel pipework, Series-Counterflow pipework etc.

10.38. Given the low proportion of time that the chiller will run at full load in Canberra, the analysis must be weighted toward low load efficiency and minimum turndown capability. The analysis and recommendations shall be provided to the Principals Representative for review.

10.39. Chillers serving process cooling other constant load applications year round must be fitted with a free cooling mode of operation that can run simultaneously with mechanical cooling.

10.40. All chillers should be optioned with CHW temperature reset functionality, and demand limit capacity control.

10.41. ANU Facilities and Services shall be able to monitor the chiller operating parameters directly via the chiller native BACnet HLI controls.

10.42. All chillers must feature variable speed compressors. Any chiller operating in a standalone configuration must feature twin independent refrigerant circuits and compressors.

10.43. For the purpose of commonality, the ANU prefers Carrier, Trane, York or Daikin (or equal equivalent) central chilling equipment. These brands are preferred in terms of the ready availability of technical support and moderate cost of spare parts; although other brands will be given due consideration. Written applications with supporting documentation shall be submitted to the Principals Representative for approval to use alternative brands of plant.

Heating Hot Water Generators (Boilers)

10.44. Heating water generators shall be factory assembled units, complete with burner, combustion chamber, refractories, heat exchanger/s, flue connection, piping and valves, instrumentation, control system and control panel, safety and heating water generator protection devices and auxiliary equipment as necessary for the satisfactory operation of the heating water generators.

10.45. Condensing heating water generators may be offered subject to review and approval of the Principals Representative, based on HHW system operating temperatures and materials used in the

generators and flues construction. Part load performance characteristics shall be submitted to the Principals Representative for review.

10.46. For the purpose of commonality, the ANU prefers Hunt (or equal equivalent) central heating plant for heating capacities in excess of 300kW output and Raypak (or equal equivalent) central heating plant for heating capacities up to and including 300kPa. These brands are preferred in terms of the ready availability of technical support and moderate cost of spare parts; although other brands will be given due consideration. Written applications with supporting documentation shall be submitted to the Principals Representative for approval to use alternate brands of plant.

Pumps

10.47. Pumps shall be selected to achieve the lowest practical power absorbed at the specific operating conditions. Pumps shall be selected with 20% spare capacity in airflow.

10.48. Pumps shall be of vertical in-line centrifugal type for smaller systems or back pull out centrifugal type for larger pumping systems. Pumpsets shall be complete with mechanical seal. All pumpsets shall be mounted on concrete plinths and have sufficient space for service, maintenance and installation of connected pipework and fittings. All pumpsets should be installed with flexible connections, strainers and test points on the inlet and outlet piepwork

10.49. All pumpsets should be provided with variable speed drive (VSD) motors. Pumpsets with motors of 0.37 kW and above power rating shall be suitable for three phase power supply.

10.50. Empirically derived pump curves shall be supplied with each fan in technical submittals and provided in Operating & Maintenance Manuals.

Fans

10.51. Fans shall be selected to achieve the lowest practical power absorbed at the specific operating Conditions. Fans shall be selected with 20% spare capacity in airflow.

10.52. All motors shall be either induction (3 phase over 0.37kW) or EC type with suitable enclosures.

10.53. Empirically derived fan curves shall be supplied with each fan in technical submittals and provided in Operating & Maintenance Manuals.

Ductwork and Pipework Reticulation

10.54. In the design of air and water distribution systems, due regard shall be given to first cost and operating cost and where necessary effective attenuation must be provided to achieve the required noise levels.

10.55. Duct and pipework runs within the building are to be preferably run in risers or ceiling spaces for minimum aesthetic impact and must be adequately supported.

10.56. Main risers (air and water) must be sized to handle an increase of 20% in air/water quantity, and fans and motors must be selected with this in mind.

10.57. Pipework reticulation must feature isolating valves on all branches. Pipework to include strainers and binder points across all installed equipment, coils, and valves. Blend valves to be installed at the highest point in all pipework circuits.

Air Handling / Fan Coil Unit

10.58. Large built up central air handling units (AHUs) are to be avoided. Packaged type AHUs are preferred. Air handling units shall incorporate heating coils and the use of terminal re-heat shall be avoided for the purpose of energy conservation unless dictated by the application.

10.59. Packaged AHUs should be readily disassembled to enable ready removal of fans, coils, trays and filter frames.

10.60. Consideration of demand based outside air rates should be given to all AHUs/FCUs with dedicated outside air systems. AHUs/FCUs shall be able to run a full outside air economy cycle on demand. Pre-cooling of the outside air using an air-to-air or air-to-water heat exchanger system shall be considered and evaluated for each system.

10.61. The outside air / return plenums shall be provided as part of all main air handling unit.

Cooling Towers

10.62. Where cooling towers are used, strict adherence to *AS/NZS 3666:2011 Air-handling and water systems of buildings* shall be followed.

10.63. Careful consideration must be given to the sighting of cooling towers with respect to adjacent exhaust system discharge points and adjacent ventilation openings and acoustic constraints.

10.64. A minimum 100 mm diameter drainpipe connection shall be installed for quick draining. Ladders, handrails and maintenance access platforms for cleaning and servicing of components on the top of the tower must be provided. Ladder, handrails, platforms and kick plates shall comply with the requirements of statutory authorities.

10.65. Platforms shall be provided around the entire top of each tower. The access arrangement shall be documented by the designer and not designed by the supplier of the cooling tower. Submit details of stair and platform arrangement to the Principals Representative for review. Access ladders and restricted platforms will not be accepted.

10.66. Side stream filtration shall be incorporated into the condenser water systems sized to suit the application. Provide basin sweeping piping with inductor nozzles to effectively prevent sediment from collecting in the cold water basin, with pipe for connection to the side-stream filtration system.

10.67. Where cooling towers are appropriate for heat rejection of specialist laboratory cooling water systems, closed circuit cooling towers are to be considered.

10.68. Water treatment shall be provided by the incumbent water treatment specialist of ANU (Hydro Industries Pty Ltd).

Storage Tanks

10.69. All storage tanks shall feature the following fittings and features as a minimum:

- A bolted and flanged gasketed manhole of at least 450 mm clear internal diameter;
- Flanged pipe nozzles; suitably sized for the maximum flow rate;
- A half coupling at the bottom of the lower dished end for draining purposes;
- A half coupling for air venting and a safety valve near the highest point of the top dished end;
- A half coupling for vacuum break purposes at the highest point of the top dished end;
- A half coupling connection near the highest point for a temperature gauge; and
- Two or more lifting lugs of Carbon Steel to *AS 1548:2008 Fine grained, weldable steel plates for pressure equipment*; with 60 mm diameter holes.

10.70. Ensure that the storage tanks are provided with water distribution headers and/or baffles in capacities larger than 2000 L water volume storage capacity. At least two strategically located manholes shall be provided for tanks of 10,000 L or more in capacity. Tanks shall be etch-primed and painted; suitable for application of thermal insulation on site.

10.71. For chilled/process cooling water tanks the chilled water leaving the chiller/process cooler shall be brought into the tank at high level and the leaving water drawn at low level. For heating water tanks the heating water from the heating appliance shall be brought into the tank at low level and the leaving water drawn off at high level.

Expansion Vessels for Water Reticulation Systems

10.72. Sealed expansion vessels shall be used to provide make-up water to all chilled, heating and process water recirculation systems. These shall be located so as to provide make-up on the low pressure side of a recirculating water system. For heating water systems these should provide make-up water to the return line, upstream of the boiler inlet port. Such vessels shall be sized to take up the contraction/expansion volume of the system.

Water Treatment Systems

10.73. Chemical dosing systems shall be provided for all heating and cooling recirculating water or glycol systems. These shall consist of vertical cylindrical dozing pots fabricated of AISI 304 stainless steel. Vessels shall be complete with the following:

- Charging funnel for introducing chemicals;
- Air venting port with pipe having a reverse 'U' bend;
- Inlet and outlet pipe connections in the same vertical plane;
- Drain port at lowest level;
- Minimum of three legs, each with feet for fixing to the floor slab of the plant room; and
- Isolating valves for the tail pipe of the funnel, each inlet and outlet pipe connection and drain connection.

10.74. Consideration should be given to engaging the company currently contracted to the ANU (Hydro Industries Pty Ltd) for the treatment of existing cooling towers (against legionella), condenser water, heating water, PCW and chilled water systems, as well as to conduct the required servicing during the defects liability period.

10.75. Water treatment chemical composition should be compatible with all materials installed within the CHW/HHW system, with particular emphasis on the materials used within the heating hot water generator's heat exchanger.

Packaged DX Air Conditioning Systems

10.76. DX systems should not be installed if central CHW/HHW plant can be utilised. The lower efficiencies of DX air equipment can be accepted based on a usage profile and size of the application being unique, the energy consumption costs, the building aesthetics, the available space for equipment installation. If a DX system is to be installed in lieu of a central CHW/HHW system, then written approval must be received from the Principals Representative.

10.77. The DX plant and equipment shall be provided on a separate electrical control panel. All control and indication points shall be available via a native Bacnet HLI.

Steam Boilers and Steam & Condensate Reticulation Systems

10.78. On the Acton campus the need for steam boilers is generally associated with research activities which are generally critical as far as building operation is considered. Boiler selection shall be based on assessment of the peak load that the facility is likely to cater to, with adequate allowance for future additions. Steam demand charts shall be included in the FSP Report. This should show the steam demand plotted during a day's duty cycle of the boiler. A list of steam consuming equipment stating dry steam usage (Kg/hr) at start-up and during normal operation as well as pressure required at the inlet to the equipment (kPa) should also be included.

10.79. If users of the facility assign a 'critical' rating for steam boiler operation to ensure business continuity, it is recommended that a dual natural gas fired boiler system be sized and selected. Selection of boilers shall be based on the maximum steam demand. The extra allowance on capacity shall be as follows:

- Boilers that operate during normal working hours: 20%
- Boilers that operate on a 24/7 year round basis: 10%

10.80. Each boiler shall be sized to take 100% of the maximum steam demand (including allowance for future loads).

10.81. In sizing the boiler, it may be noted that normal steam consumption of equipment operating simultaneously shall be used rather than summation of the maximum steam consumption figures; unless otherwise dictated by equipment operation.

10.82. Generally an unattended, vertical, tubeless, packaged Hunt Alfarel steam boiler (or equal equivalent) shall be selected for steam output capacities <500 kW (798.5 Kg/hr of dry saturated steam from and at 100°C). For steam output capacities >500 kW an unattended, natural gas fired, packaged water tube boiler of Forbes-Bryant (or equal equivalent) shall be selected.

10.83. Vertical tubeless boilers shall be fully automatic, packaged entities that are designed and manufactured to recognised, and in compliance with, standards as well as statutory authorities requirements.

10.84. Horizontal, water tube boilers shall be fully automatic, packaged entities that are designed and manufactured to recognised, and in compliance with, standards as well as statutory authorities requirements.

10.85. Boilers shall generally be installed on concrete slabs within plant rooms that are located at the highest level of the facility. A suitable metal roof shall preferably be provided for the boiler room. If this is not feasible, and boiler plant rooms are at lower or intermediate levels, a natural gas monitoring system with alarms shall be installed in that plant room.

Equipment Identification

10.86. All items of equipment must be suitably identified with Traffolyte labels of an approved size and type. Identification markings should comply with *AS 1345 Identification of the contents of pipes, conduits and ducts*. All thermometers, pressure gauge tappings, remote sensing points and the like, must be similarly labelled to indicate their function.

Colour Schedule for Plant and Equipment

10.87. All plant and equipment in plantrooms, services risers and whenever exposed to view must be painted.

10.88. Where colours are not specified for particular items of plant, the Principal's Representative shall be consulted before colours are nominated.

10.89. All pipework, valves and fittings must be colour banded. Pipework identification must be achieved throughout using Safetyman pipe markers and labels to indicate content and flow.

Labelling and Bar Coding of Equipment

10.90. All equipment, plant, switch rooms and controls shall be identified using engraved Traffolyte labels fixed in a suitable manner using adhesive, rivets or screws.

10.91. Labels shall consist of black engraved letters/numerals on a white background identifying function, number and, where appropriate, circuit number.

10.92. All electrical equipment, motors and the like shall be fitted with rating plates fixed to ensure easy identification.

10.93. All pipes and conduits shall be labelled with adhesive labels showing type of service, direction of flows, etc.

10.94. Name plates shall be provided to all mechanical services plant and equipment in plant rooms/enclosures/elsewhere. Labels shall be engraved Traffolyte fixed in an approved manner. Temperature, relative humidity and pressure sensors/controllers, CO_2 sensors, gauges, temperature and remote sensing points, etc; and control valves shall be similarly labelled to indicate their function. A valve schedule shall be provided in each plant room indicating valve number and function. Labelling of control valves, balancing valves, etc. shall be by means of stamped brass tags identifying valve function, size and number tied to each valve by wire or chain.

10.95. Labels in the form of name plates shall be provided to all equipment, plant and apparatus in plant rooms and in the field labels shall be engraved Traffolyte fixed in an approved manner. Sensors for temperature and relative humidity, pressure, CO_2, thermometers, pressure gauge tappings, remote sensing points and valves shall be similarly labelled to indicate their function. A valve schedule shall be provided in each plant room indicating valve number and function.