**Property Services Design Standards and Guidelines**

## Section 4

# Mechanical Services

Version 1.0

# Document Control Information

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### Document Control

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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 A to us at PSTechServices@auckland.ac.nz.

# 4 Mechanical services

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# 4.1 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 (University) Property Services Design Standards and Guidelines.

## 4.1.1 Purpose

The purpose of this section is to outline the design considerations which need to be considered during the mechanical services design of all Capital, Minor Capital and Maintenance project building works. Specific mention is made to lessons learned from previous building projects, and with the intended use of this guide as a live document learnings from future are to be populated also to provide an ongoing feedback mechanism.

The guidelines outlined within this section are not project specific. It is the responsibility of the mechanical services consultant or designer to develop a design specific to the project design brief and objectives as well as satisfying site specific end user requirements.

Note: Where departures from these mechanical services guidelines are necessary or recommended, these shall be highlighted to Facilities Management (FM). Failure to do so may result in rectification at no extra expense to the University.

## 4.1.2 Regulations, codes and standards

Any design requirements outlined within this section which are in any way related to any statutory requirements and/or regulations, shall be taken as design requirements over and above the specified and required statutory requirement and/or regulation.

The mechanical services design must fully comply with the requirements of the latest revision of all relevant statutory requirements and regulations, including but not limited to:

- NZ Building Code, and relevant NZ and AS/NZ Standards
- NZ Building Act
- Health and Safety in Employment Act
- Dangerous Goods Regulations
- Electricity Act
- Electricity Regulations
- Electricity Codes of Practice
- Territorial Authority Requirements.

### 4.1.3 Applicable standards

This table lists the standards that are applicable to Mechanical Services.

**Note:** The list is not exhaustive and if superseded by other standard(s), the latest version and/or amendment applies.

**Table 1: Mechanical services standards**

| Standard | No | Title |
|---|---|---|
| AS | 1397 | Continuous hot-dip metallic coated steel sheet and strip |
| AS | 1530 | Methods for fire tests on building materials, components and structures |
| AS/NZS | 1668.1 | The use of ventilation and air conditioning in buildings |
| AS | 1668.2 | The use of ventilation and air conditioning in buildings – Mechanical ventilation in buildings |
| AS | 1677 | Refrigerating systems |
| AS | 3500 | Plumbing and drainage |
| AS | 3666.1 | Air-handling and water systems of buildings |
| AS | 4254 | Ductwork for air-handling systems in buildings |
| AS | 4508 | Thermal resistance of insulation for ductwork used in building air conditioning |
| AS | 61800.2 | Adjustable speed electrical power drive systems – General requirements – Rating specifications for low voltage adjustable frequency a.c. power drive systems |
| AS/NZS | 1359 | Rotating electrical machines – general requirements |
| AS/NZS | 2107 | Acoustics – recommended design sound levels and reverberation times for building interiors |
| AS/NZS | 2293 | Emergency evacuation lighting for buildings |
| AS/NZS | 3000 | Electrical Installations (known as the Australia/New Zealand Wiring Rules) |
| AS/NZS | 3008.1 | Electrical installations – selection of cables – Cables for alternating voltages up to and including 0.61 kV |
| AS/NZS | 3013 | Electrical installations – Classification of the fire and mechanical performance of wiring system elements |
| AS/NZS | 3080 | Information technology – generic cabling for customer premises |
| AS/NZS | 3084 | Telecommunications installations – Telecommunications pathways and spaces for commercial buildings. |
| AS/NZS | 3439.1 | Low-voltage switchgear and control gear assemblies – Type tested and partially type tested assemblies |
| AS/NZS | 3439.3 | Low-voltage switchgear and control gear assemblies – Particular requirements for low-voltage switchgear and control gear assemblies intended to be installed in places where unskilled persons have access for their use – Distribution boards |
| AS/NZS | 61000.3 | Electromagnetic compatibility (EMC) |
| NZS | 3501 | Specification for copper tubes for water, gas and sanitation |
| NZS | 4219 | Seismic performance of engineering services |
| NZS | 7648 | Unplasticized PVC pipe and fittings for pressure applications |
| EN | 1886 | Ventilation for buildings – Air Handling Units – Mechanical performance |
| EN | 13053 | Ventilation for buildings – Air Handling Units – Rating and performance for unit's components and sections |

### 4.1.4 Design documentation

As well as design documentation outlined in *Section 2 Building and Building Works Requirements*, the consultant may be requested to make available to FM the following design documentation for their review:

- Air conditioning zone diagrams
- Air conditioning heat load calculations
- Dynamic thermal modelling, including summaries
- Computational Fluid Dynamics (CFD) analysis
- Building Information Models (BIM) throughout all design and construction stages.
- Building thermal envelope calculations (NZ Building Code Clause H1 compliance)
- Applied CHW and HHW diversity factors
- Producer statements as required by the contract and by the consenting authority. Additionally (and dependent on the extent of the works), this requirement shall extend to the design documentation / Producer Statements to support any seismic restraint as necessitated by the project.

# 4.2 Abbreviations

### Mechanical services abbreviations

Table 2: Mechanical services abbreviations

| Abbreviation | Description |
|---|---|
| AHU | Air handling unit |
| AOM | Auto-Off-Manual switch |
| BIM | Building Information Models |
| CDW | Condenser water |
| CFD | Computational Fluid Dynamics |
| CHW | Chilled water |
| DHW | Domestic hot water |
| EAF | Extract air fan |
| EMC | Electromagnetic capability |
| FCU | Fan coil unit |
| FIRED / SMKD / MD | Fire damper / smoke damper / motorised damper |
| HHW | Heating hot water |
| HX | Heat exchanger |
| KEF | Kitchen exhaust fan |
| LPHW | Low pressure heating hot water |
| MCC | Motor control centre |
| MCP | Motor control panel |
| MD | Motorised control damper |
| MSSB | Mechanical services switchboard |
| PCW | Process cooling water |
| RCD | Residual current device |
| VAV | Variable air volume box |
| VSD | Variable speed drive |

# 4.3 System Information

## 4.3.1 CHW and HHW infrastructure

This section should be read in conjunction with Section *3 Utilities Connections and Energy Management* of *Property Services Design Standards and Guidelines.*

Existing CHW provisions shall be used where it can be demonstrated that the required capacities can be achieved with existing infrastructure.

Generally, DX Split Systems shall only be used for spaces which have 24/7 conditioning requirements, areas of a critical nature, or where existing CHW provisions are not available within a reasonable proximity for smaller types of load.

Existing HHW provisions shall be used where it can be demonstrated that the required capacities can be achieved with existing infrastructure.

Where existing HHW provision are deemed beyond useable life, replacement systems shall be designed to include high efficiency or condensing boiler technology with the corresponding lower operational temperatures where applicable.

For larger capital and maintenance projects, the distribution of heating water between buildings should be avoided.

Gas, wherever possible, should be reticulated to the point of use for it to be converted to heat energy by dedicated local boilers.

**Note:**

- As-Built site and building services reticulation schematics and layouts for CHW and HHW distribution are available from University of Auckland FM. These must be reviewed by the relevant consultant or designer during design investigation.
- All site and building As-Built reticulation schematics and layouts must be updated in total as part of the project works.

# 4.4 Design Conditions and Parameters

**Introduction**

Careful consideration towards project specific design conditions and parameters must be considered by the Design Team in consultation with FM.

Property Services has a University policy obligation to minimise energy consumption, so it is essential that the Design Team maximises the use of passive environmental control methods. The use of external shading, high performance glazing systems, natural ventilation, thermal mass and similar measures shall be incorporated into the building design whenever possible. The decision to incorporate these features into the design shall be based on achieving acceptable internal conditions and a cost assessment. Dynamic thermal modelling shall be used to determine whether acceptable internal conditions can be maintained. The use of life-cycle costing rather than basic capital cost shall be used to determine financial viability.

The following design conditions and parameters shall be applied unless specifically advised otherwise within the project brief or design stages.

**Note:** Refer to *Section 2 Project and Building Works Requirements* of *Property Services Design Standards and Guidelines* for information on the University's academic year, hours of operation and occupant densities.

## 4.4.1 Diversity factors

As some University buildings / spaces are not occupied during the bulk of the summer cooling season (i.e. December through to February each year), relatively low diversity factors may be taken into account.

Applied diversity factors shall be made available to FM upon request during detailed design stage.

## 4.4.2 Temperatures

This table outlines required space temperatures:

**Table 3: Required space temperatures**

| Description | Temperature |
|---|---|
| **External Summer Design Conditions** | 25°C DB / 20°C WB (NIWA 2.5% design day) |
| **External Winter Design Conditions** | |
| For spaces occupied during normal University hours | 7.5°C DB (NIWA 2.5% design day) |
| For spaces with 24/7 requirement | 3°C DB |
| **Internal Summer Design Target Temperature – Air-Conditioned Spaces** | |
| Common areas and breakout spaces | 23°C, 55%RH nom. (no humidity control) |
| Offices $\geq$ 25m², executive offices, and meeting rooms | 22°C, 55%RH nom. (no humidity control) |
| Lecture theatres, seminar rooms and teaching spaces | 22°C, 55%RH nom. (no humidity control) |
| General laboratories | 22°C, 55%RH nom. (no humidity control) |

  

| Description | Temperature |
|---|---|
| Specialist laboratories and research areas | Project specific. May require humidity control. |
| **Internal Summer Operating Temperature – Air-Conditioned Spaces** | |
| Common areas and breakout spaces | Internal set-point temperature to be re-set depending on OAT. Initial straight-line compensation curve to be based on OAT <22°C, Room SP 22°C. OAT 27°C, Room SP 25°C. |
| Offices $\geq$ 25m², executive offices, and meeting rooms | Internal set-point temperature to be re-set depending on OAT. Initial straight-line compensation curve to be based on OAT <22°C, Room SP 22°C. OAT 27°C, Room SP 25°C. |
| Lecture theatres, seminar rooms and teaching spaces | 22°C, 55%RH nom. (no humidity control) |
| General laboratories | Internal set-point temperature to be re-set depending on OAT. Initial straight-line compensation curve to be based on OAT <22°C, Room SP 22°C. OAT 27°C, Room SP 26°C. |
| Specialist laboratories and research areas | Project specific. OAT compensated internal set-point temperatures shall be applied if this does not affect teaching and research operations. |
| **Internal Winter Design Target Temperature** | |
| Common areas and breakout spaces | 20°C |
| Offices $\geq$ 25m², executive offices, and meeting rooms | 20°C |
| Lecture theatres, seminar rooms and teaching spaces | 21°C |
| General laboratories | 20°C |
| Specialist laboratories and research areas | Project specific. May require humidity control. |

### 4.4.3 Water temperatures

Typical CHW temperatures of existing site wide CHW reticulation systems:

- 6°C LWT / 12°C RWT
- HHW temperatures of existing boiler plant are site specific. Request from FM.
- CDW temperatures of existing chiller plant are site specific. Request from FM.

### 4.4.4 Outside air rates

This table identifies the outside air rates for specific areas:

**Table 4: Outside air rates for specific areas**

| Area | Outside Air Rate |
|---|---|
| Lecture theatres | 10 l/s per person ($CO_2$ controlled) |
| Seminar rooms | 10 l/s per person ($CO_2$ controlled) |
| Teaching spaces | 10 l/s per person ($CO_2$ controlled) |
| Meeting rooms | 8 l/s per person (where space used for meetings $\leq$ 3hr long durations) |
| Breakout spaces / Common rooms | 8 l/s per person (may be $CO_2$ controlled) |
| Laboratories | 10 l/s per person |
| Studios | 10 l/s per person |
| Offices | 10 l/s per person |

**Note:** Where spaces are $CO_2$ controlled, the target is 800ppm.

### 4.4.5 Lighting and power densities

Lighting and power densities shall be assessed and advised project specifically by the project's electrical consultant or designer.

In the absence of these, these typical densities may be used as a guideline:

**Table 5: Typical lighting and power densities**

| Space reference | Suggested Lighting W/m$^2$ | Suggested Power W/m$^2$ |
|---|---|---|
| Large lecture theatres | 10 | 7.5 |
| Small lecture theatres | 10 | 15 - 20 |
| Seminar rooms | 10 | 7.5 |
| Teaching spaces | 10 | 7.5 |
| Meeting rooms | 12 | 25 |
| Offices | 2 | 20 |
| Studios | 10 | 5 |
| Breakout spaces | 10 | 5 |
| Laboratories | 12 | Must be project specific |
| Server rooms & Communications rooms | 10 | Must be project specific |

### 4.4.6 Acoustic criteria

Acoustic criteria shall be advised project specifically by the project acoustic engineer.

In the absence of these, these suggested criteria may be used as a target guideline:

**Table 6: Suggested acoustic criteria**

| Space reference | Suggested $PNC_{63\text{-}4k}$ |
|---|---|
| Lecture theatres | 30-35 |
| Seminar rooms | 30-35 |
| Teaching spaces | 30-35 |
| Meeting rooms | 30-35 |
| General offices | 35-40 |
| Studios | 45-50 |
| Breakout spaces | 40-45 |
| Laboratories | 35-40 |
| Server rooms and communications rooms | 55-60 |
| Toilets | 45-50 |

# 4.5 Lessons Learned

**Introduction**

As one of New Zealand's largest property owners the University has gained experience in the delivery of a broad range of buildings including residential, educational and leisure facilities. The intent of this section of these guidelines is to provide a feedback mechanism to apply any lessons learned from previous projects from an FM perspective. The following items should be considered during the delivery of future projects. The lessons learned as detailed below will be incorporated within the body of the main document during the next scheduled annual review.

## 4.5.1 $CO_2$ or Air Quality Sensor control on outside air systems.

Educational buildings operate with a large variance in occupancy patterns through the scheduling of classes. This is expected in lecture theatres and seminar rooms, but also true in adjacent areas such as crush spaces, reception rooms, waiting rooms, etc. These occupancy patterns pose the risk of over-supply of outside air during low occupancy periods with wasted energy costs through the conditioning of this air. In such cases demand-based ventilation shall be applied. Local modulating air dampers fitted in outside air ducts should be controlled via $CO_2$ or air quality sensors fitted in the occupied space.

## 4.5.2 Laboratory ventilation systems

Laboratory ventilation systems can pose specific problems due to their relative complexity. Varying demand of fume extract cupboards will require a varying supply of make-up air.

Bench extract systems and extract serving chemical stores add to the complexity of the ventilation across the suite of rooms contained within a single laboratory layout.

In addition, there will likely be a need to maintain pressure differentials across laboratory ancillary rooms. The following lessons learnt relate to laboratory ventilation:

- The cost of conditioning make-up air is a considerable operational expense to the University so the use of return air from the building common spill air path should be maximised.
- The required supply air flow is calculated by the BMS as an algorithm of the summation of the combined laboratory extract air systems as measured by in duct velocity sensors. It is essential that the velocity sensors are installed in accordance with manufacturers recommended lengths of straight duct prior to the sensor to avoid reading error through air turbulence.
- Fume cupboard fan maintenance costs and operational costs can be reduced with the use of manifold fan systems.
- The commissioning of laboratory ventilation systems shall include a test with all component parts operational simultaneously throughout all control parameters.

### 4.5.3 Installation of check meters

Refer to *Section 3 Utilities Connections & Energy Management* in *Property Services Design Standards and Guidelines*.

The following should be included as a specified finishing requirement on buildings:

- Maximo numbers shall be included in the 'As Built Single Line Diagram' to easily identify which check meter serves which Motor Control Centre (MCC).
- The accurate calibration of electrical check meters shall be included as a witnessed commissioning activity prior to building handover.

### 4.5.4 Fan Coil Unit water flow rates

When selecting Fan Coil Units (FCU's) it is common for the actual manufacturer's water flow through the coil to be greater than the original design schedule. This is a function of the specific coil characteristics and the need to avoid reduced heat transfer through laminar flow conditions.

The difference between design and actual flow rates is proportionally greater when smaller sized FCUs are selected, especially if, when approving technical submittals, the FCU air flow is taken as the driving variable rather than coil heating or cooling capacities.

These points relate to the FCU design selection and approval process.

- To avoid laminar flow conditions FCU design schedules shall not select heating coils with a capacity of less than 600W or manufacturers minimum flow.
- When approving the technical submissions of FCUs the governing factor of coil heating and cooling capacity should prioritise above air flow rate.
- Should a significant increased flow exist then associated pumps and pipes shall be resized to suit.
- The responsibility of checking pipe systems specifically against increased flow due to equipment selection shall be included within the General Specification as a Contractor responsibility and checked during review by the mechanical consultant.
- Control valves are to be sized with the correct authority against any increased flow rate.
- Commissioning of water systems shall not attempt to pass off any increased water flow as diversity. A clear description of the method of calculating commissioning diversity shall be included in the mechanical specification for application during commissioning.

### 4.5.5 Maintaining water flow to prevent 'dead legs'

On both heating and chilled water pipe runs connected to 3 or more terminal units controlled with 2 port valves there is a risk that 'dead legs' may form when the control valves close.

Maintaining minimum flow is required to prevent this and this can be achieved by applying one of these:

- The final terminal unit is to be controlled with a 3- port valve.
- A loop is included at the end of each run to maintain minimum flow.

### 4.5.6 Realistic space allocation within mechanical services risers

The detailing of services risers would normally be undertaken during shop drawing production, during detailed design there should be adequate space allowance within risers for:

- Internal duct insulation space allowance
- Space for duct shoes on branches
- Sufficient space for fire dampers, complete with fire sleeves (450mm standard)
- Space allowance for duct access panels
- Clear and safe maintenance access to dampers and actuators
- Sufficient commissioning space allowance for pitot test holes on branches.

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### 4.5.7 Inclusion of valves on pipework Shop, and As Built layout drawings

It is common practise during design for isolation and commissioning valves to be omitted on pipework layout drawings and instead reference made to the pipework schematic drawing. This poses the risk of valves being missed on both the Shop and As Built drawings. Valves are a vital piece of equipment for maintenance and they need to be included on plan layout drawings. The consultants drawing review of Shop and As Built drawings shall include this, together with sufficient commissioning access as a check item.

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# 4.6 Identification and Labelling

**Introduction**

Plant and equipment shall be identified in accordance with the requirements of the latest revision of appropriate Standards wherever applicable.

The guidelines mentioned in this section are to assist consultants and designers with understanding the University's standard requirements which can be considered over and above requirements of applicable Standards.

## 4.6.1 Plant and equipment

All plant and equipment shall be clearly identified with traffolyte labelling indicating the plant Maximo identification number.

Refer to *Section 2 Project and Building Works Requirements* of the University's Design Standards and Guidelines for Maximo numbering requirements.

## 4.6.2 Ductwork and pipework

All ductwork and pipework shall be clearly identified with self-adhesive labelling, whether in plantrooms, in ceiling spaces, or exposed.

Pipework and ductwork identification must indicate the service, flow direction arrows, and type as appropriate.

**Examples:**

- FLOW and RETURN on pipework
- SUPPLY, FRESH AIR SUPPLY, RETURN SUPPLY, RETURN and EXHAUST on ductwork.

## 4.6.3 Underground pipework

Underground pipework must be accurately surveyed then dimensioned on As-Built drawings.

Underground pipework shall have continuous warning identification tape and tracer wire installed above the pipework at an appropriate level.

The pipework itself shall be clearly labelled as above.

## 4.6.4 Switchboards and control panels

All mechanical services switchboards and control panels shall be externally and internally labelled. Internal components and controllers shall be labelled using self-adhesive labels. Pen markings are not acceptable.

Copies of wiring and panel diagrams shall be left within permanently secured sleeves on the inside of the MSSB or MCP door.

### 4.6.5 Valves

Valve tagging shall be project specific.

As a minimum, valves must be tagged whenever they have a functional requirement, and/or are of a critical or important nature. Such valves include but are not limited to these examples:

- Valves which are required to be left 'Normally Closed'
- Valves which serve other zones or buildings, i.e. where isolating a valve will have a consequence which is not apparent at the valve location
- Valves which require a specific maintenance activity (e.g. flushing bypass valves, purge valves within laboratories)
- Valves which are provided for an intended future connection
- Valves which have a specific function which may not be clear on site.

Valve tags shall be traffolyte.

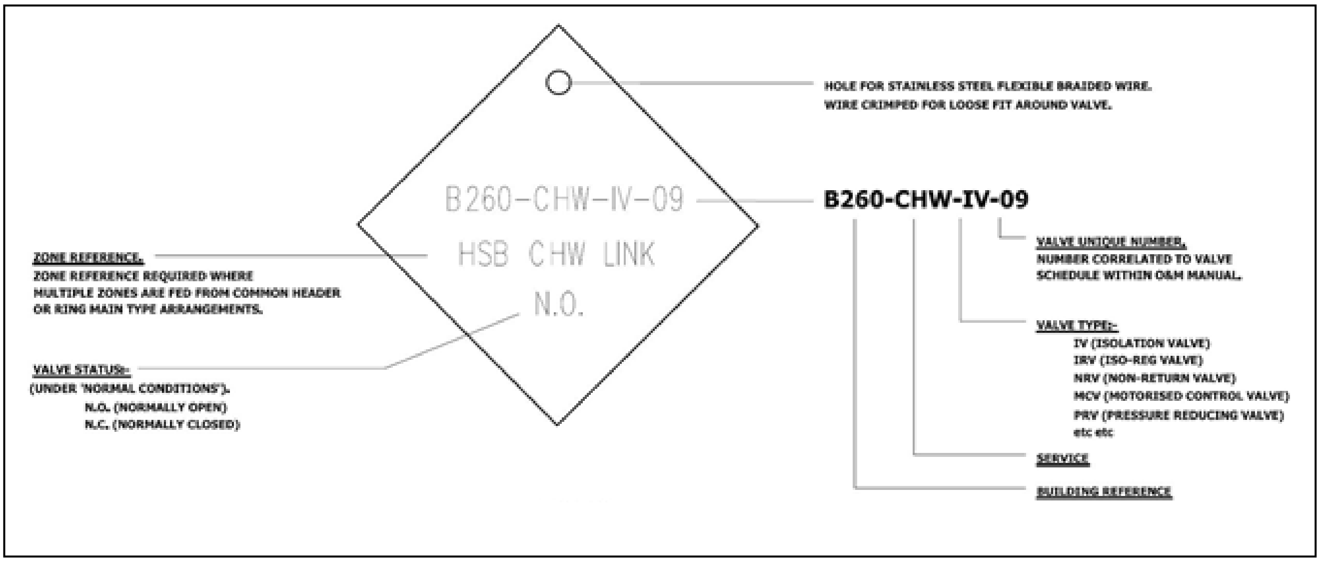


**Figure 1: Example valve tag**

Tagged valves must be scheduled within the O&M Manual with the valve tag reference number, location, and specific function listed. The valve tag reference number must also be indicated on As-Built schematic drawings. Valve tag references are **not** required to be Maximo asset registered.

### 4.6.6 Fire, smoke and control dampers

Fire and smoke dampers shall be labelled with self-adhesive labels that identify their assigned Maximo number.

Motorised control dampers of a 'general' nature shall be scheduled within the O&M Manuals and shall appear on all associated As-Built drawings, schematics and control diagrams consistently labelled.

Motorised control dampers which have a critical control function, and which appear on the BMS graphic, shall be physically labelled on site with the corresponding identification number.

# 4.7 Testing and Commissioning

## Introduction

This section must be read in conjunction with the section on Testing and Commissioning in *Section 2 Project & Building Works Requirements* of *Property Services Design Standards and Guidelines*.

Mechanical services testing and commissioning shall be executed by experienced and suitably qualified commissioning specialists.

All functional and operational requirements of the system installation shall be tested and fully proven, including where interfacing with other systems, and where controlled by the BMS.

A fundamental requirement of all commissioning activities is for there to be sufficient access to commissioning equipment including dampers, fire dampers, damper and valve actuators, flushing loops, valves, and measuring stations. This is a design requirement that should be considered during design development. Consultants' review of Shop and As Built drawings shall include access to commissioning equipment as a check item.

## 4.7.1 Water reticulation systems

Testing and commissioning shall commence only after the successful pressure testing and flushing in accordance with BSRIA guide AG 1/2001.1 Pre-commission Cleaning of Pipework Systems ($2^{nd}$ edition).

## 4.7.2 Systems and plant

Testing and commissioning of all systems and plant shall commence only after pre start-up commissioning checks by the Contractor to ensure all plant is correctly and safely connected.

Equipment suppliers shall be requested to attend site commissioning checks at the request of the contractor as required.

## 4.7.3 Air and water distribution systems

Commissioning of all air and water distribution system shall be executed in accordance with CIBSE commissioning codes A: Air distribution systems and W: Water distribution systems. BSRIA Application Guides should be referenced for more specific applications:

- BSRIA Application Guide 1/91 (VAV Commissioning Guide)
- BSRIA Application Guide 3/89.3 (Commissioning Air Systems - Application Procedures for Buildings)
- BSRIA Application Guide 2/89.3 (Commissioning Water Systems - Application Principles)
- BSRIA TN15/95 Retrofitting of Heating and Cooling Systems (Handover)
- BSRIA Application Guide 5/2002 (Commissioning management - how to achieve a fully functioning building)
- HVCA TR19 - Guide to good practice. Internal cleanliness of ventilation systems (Pre-commissioning: System Cleaning) [Incorporates previous publications; TR17 and TM2]

- BSRIA Application Guide 1/2001.1 (Flushing Procedure)
- BSRIA Application Guide 20/95 (Commissioning of pipework systems - design considerations)
- BSRIA Application Guide 16/2002 Variable flow water systems.

### 4.7.4 Electrical testing and commissioning

All circuits must be proven to ensure any installed equipment is safe to operate, safety and protective devices are correctly set, alarms register, and operation is functionally correct.

Pre-commissioning quality assurance and testing must be undertaken prior to any equipment being energized. This shall include the operational proving of all contactors, relays, actuators and interlocks etc.

All tests recommended by the manufacturer's installation instructions shall be conducted.

Calibration checks shall be made at full scale and recorded for all indicating instruments.

**Note:** Should any of the supplied and installed equipment fail any testing, the equipment shall be rejected, and any costs associated with the making good of the equipment shall be borne by the contractor.

### 4.7.5 Functionality testing and commissioning

The functionality and automatic sequencing of the installed system must be proven to completely satisfy the intent of the system design.

This shall include verification of control sequences associated with, but not limited to, these systems:

- Fire alarm mode
- Life safety systems such as smoke exhaust ventilation systems, stairwell and lift shaft pressurisation systems
- Essential power supplied systems
- Laboratory ventilation with all associated supply and extract systems operating simultaneously through all control parameters
- Lecture theatre interfaces in conjunction with Learning Environment Support Unit (LESU)
- Lighting control interfaces
- ‘Standby’ heating and cooling production plant
- Load sequencing of heating and cooling production plant.

**Note:** University of Auckland FM reserves the right to witness any testing and commissioning.

### 4.7.6 Verification testing

Testing shall be carried out in accordance with the latest revision of AS/NZS 3000 and shall mandatorily include:

- Continuity of the earthing system
- Insulation resistance
- Polarity and Phase Rotation
- Correct circuit connections

- Verification of earth fault loop impedance to ensure required disconnection of supply is achieved
- Operation of RCD units.

  

# 4.8 Air Conditioning and Space Heating Systems

### Introduction

The University strives towards being a New Zealand leading edge facility. With an awareness of ever evolving technology and engineering practice within the HVAC industry, the University has no set guidelines as to which types of system should be used for certain types of building or application.

These guidelines are an outline of some common elements associated with HVAC systems which are either preferred or not accepted by the University.

Proposed system types shall be approved by FM at Preliminary Design stage.

## 4.8.1 Space requirements

This section outlines the University's guidelines with regard to HVAC provisions for different types of spaces.

The guidelines within this section do not in any way relieve the consultant or designer from obtaining and following a project specific design brief.

The Consultant or Designer shall raise with FM any project specific requirements which may be in conflict with these guidelines.

This table outlines HVAC requirements for 'typical' University spaces:

**Table 7: HVAC Requirements for typical spaces**

| HVAC Provision | Space | Comment |
|---|---|---|
| Comfort air conditioning | • Lecture theatres<br>• Seminar rooms<br>• Teaching spaces<br>• * Libraries<br>• * General laboratories<br>• Meeting rooms and function rooms<br>• * Executive offices<br>• * Common rooms<br>• * Student breakout areas<br>• * General offices > 25m2 | • Listed spaces (indicated with an asterisk *) **may** be air conditioned spaces depending on the project brief, building layout, user requirements, capacity, etc. The use of natural ventilation if possible, in these spaces is strongly preferred.<br>• All other listed spaces **must** in all cases be provided with air conditioning.<br>• Wherever possible, systems shall be CHW coil type. DX systems shall only be considered where existing CHW connectivity is not feasible due to existing capacity limitations or distribution impracticalities, or where conditions are of a critical nature requiring 24/7 operation or regular after hours use.<br>• Lecture theatres and large seminar rooms shall have dedicated air handling plant. Systems shall have outside air modulation based on room monitored $CO_2$, together with occupancy detected operation.<br>• Humidity control is not required. |

| HVAC Provision | Space | Comment |
|---|---|---|
| Dedicated air conditioning | • Specialist laboratories<br>• Laboratory cool rooms, freezer rooms and other special materials stores<br>• Animal accommodation<br>• Communications and server rooms<br>• Security rooms | • To ensure operational control, unitary type systems serving a single space or a small number of spaces of the same nature shall be provided.<br>• Use of DX split systems for these spaces may be accepted.<br>• Any dedicated DX systems must have BMS monitoring provisions incorporated.<br>• Humidity control is a space specific requirement. Where humidity control is required, humidification shall be maintained by specialists, and shall be provided with dedicated heating source.<br>• Emergency or standby provisions are space specific requirement. |
| Natural ventilation | • Offices $\leq 25m^2$<br>• Atriums<br>• Perimeter spaces which serve as thoroughfares, common rooms, breakout spaces etc.<br>• Main switch rooms<br>• Plantrooms | • Plantrooms with heat generating or gas fired equipment may be required to have mechanical provisions made.<br>• Naturally ventilated spaces may also be considered for mixed mode ventilation where appropriate to ensure year-round conditions, e.g. ceiling fans, supply/exhaust fans, localised FCUs on BMS control, may be implemented.<br>• Sufficient space heating provisions must be provided to habitable naturally ventilated spaces. |
| Mechanical ventilation systems | Mechanical ventilation systems shall be designed and installed where required to meet NZ Building Code requirements such as:<br>• Fire and smoke control systems<br>• Toilets<br>• Car parks<br>• Workshops, studios, laboratories and the like whereby obnoxious and/or toxic fumes are generated<br>Dedicated mechanical ventilation systems shall also be designed and installed to satisfy health and comfort requirements where natural and other ventilation provisions may not provide sufficient conditions all year round, such as:<br>• Studios<br>• Workshops<br>• General laboratories<br>• Print rooms. | • Fire and smoke control ventilation systems shall be designed for compliance with AS 1668.<br>• Pre-heating coils shall be incorporated where these are providing fresh air supply to habitable spaces.<br>• Mechanical exhaust ventilation to copier/printers shall only be provided where copiers/printers are installed within dedicated spaces and where a high volume of printing and copying is produced. |

### 4.8.2 Air conditioning and space heating system guidelines

**Preferences**

These provisions are University preference:

- **CHW systems over DX systems** except where it can be demonstrated that DX split systems are more appropriate for the application, e.g. limited CHW capacity, CHW pipework reticulation is not within reasonable proximity, space has 24/7 requirement, space has after hours working requirement, space has critical condition requirement
- **HHW systems over electric systems** except where a coil design heating capacity is below 600 Watts or where design HHW flow rates result in laminar flow conditions within a coil.
- For multiple building or zone applications, localised boilers over large central boilers
- Main heating coils incorporated within AHUs to ensure fast warm-up during winter starts.

**Requirements**

These provisions must be provided where appropriate:

- Secondary CHW and/or HHW circuits incorporated into multiple air handling and/or terminal unit applications
- Variable flow secondary CHW and/or HHW reticulation systems
- Pressure independent control valves on large reticulation systems
- Large air handling systems must be VAV capable
- Back-up or dedicated heating plant provisions for DHW production where the primary heating source is via HVAC boilers i.e. to enable efficient summertime and out-of-hours DHW production
- Where electric heating elements are used, these shall be staged or have solid state relays for energy efficient operation. Maximum allowable heating element size $\leq$ 3kW
- BMS monitoring of spaces served by DX split systems.

**Not acceptable**

These provisions will not be accepted:

- Proprietary controlled systems without BMS BACnet interface
- Room air conditioning units (RAC or window units)
- A/C units without gravity condensate discharge, with the exception of proprietary ceiling units with integral pumps
- Un-flued gas fired heating appliances within habitable spaces.

### 4.8.3 Existing building guidelines

For re-fit within only part of an existing building, the existing building services arrangement shall be followed except where required to be upgraded due to existing condition, capacity limitations and/or current code compliance.

Consideration must be taken to ensure air conditioning zones are not conflicted upon.

# 4.9 Plantrooms and Equipment Locations

### Introduction

The purpose of this section is to outline the University's requirements with regard to the set-out and installation of University plantrooms and other equipment accommodation spaces.

To enable successful and effective maintenance of building and plant, specific consideration to the following guidelines must be considered.

## 4.9.1 Plantroom requirements

All central, primary, and 'large' mechanical services plant shall be housed in dedicated mechanical services plantroom spaces.

These plantroom guidelines apply to new and refurbished plantrooms.

**Table 8: Plantroom requirements**

| Requirement | Guideline |
|---|---|
| Plantroom locations and access | • Plantrooms shall have direct access from outside or from corridors (i.e. plantrooms shall not be internally 'land-locked').<br>• Plantrooms shall have full size walk-in doors which are lockable on a University plantroom key and may be fitted with electronic access control.<br>• Vertical stair/ladder access into plantrooms should be avoided. |
| Sealing of plantrooms | • Plantrooms shall be bunded and tanked as appropriate to avoid flooding of surrounding spaces and spaces below.<br>• Plantroom floors shall be sealed and painted.<br>• All plantroom penetrations must be sealed.<br>• Provide:<br>    • Conduits to all cabling penetrations<br>    • Sleeves to all pipework penetrations<br>    • Approved fire stopping to all penetrations through fire rated walls<br>    • Approved acoustic stopping to all acoustic rated walls. |
| Plantroom ventilation | • Provide plantroom ventilation in accordance with NZ Building Code requirements. Natural ventilation is preferable where this can be suitably achieved.<br>• Where plantrooms serve as fresh air handling plenums, ensure:<br>    • Intakes are suitably separated from exhaust discharges, landscaping and other areas which may be susceptible to fungal development within air intakes.<br>    • Intake velocities do not exceed maximum 1.25m/s to minimise dust and grit ingress. Provide mid-screen media to intakes as appropriate. Pre and final filtration shall be at units. |

| Requirement | Guideline |
|---|---|
| Plant spacing and access | • Provide additional plantroom space as required to facilitate the removal (and re-instatement) of any plant item without the disconnection and relocation of other installed plant, or partial demolition of the plantroom construction. Allowance for removable sections of ductwork, pipework, plantroom walls etc. is acceptable.<br>• Generous spatial allowance must be made for the regular removal and cleaning of water cooled chiller condenser tube bundles.<br>• Plantroom spatial and accessibility provisions shall be made to accommodate chiller removal. This shall include lifting beams where necessary.<br>• Plant shall be suitably positioned to allow for safe working service and maintenance access, which shall be as a minimum to the requirements of the suppliers/manufacturers written recommendations.<br>**Note:** Plant spatials which cannot achieve this requirement will be rejected and re-designed at no extra cost to the University.<br>• Any serviceable mechanical plant which is installed above 3m in height shall be provided with permanent stair/ladder access and sufficient safe working platform.<br>• Provide lifting beams for any maintainable plant items which are at height or of significant load, e.g. water cooled chiller evaporator and condenser vessel end caps (these are annually removed to facilitate clean out of tubes). |
| Plantroom hazards | • Any plantroom hazards shall be clearly identified on plantroom entry doors, as well as appropriate identification labelling and clearance lines within the room. |
| Plinths and mounts | • All floor mounted equipment shall be provided with concrete plinths.<br>• Provide a neoprene isolation pad between concrete bases and equipment feet.<br>• All soffit mounted plant shall be suspended on vibration isolation hangers.<br>**Note:** Extra care must be taken within existing buildings where suspending equipment and plant from existing structure. Obtain approval from a Structural Engineer where appropriate. |
| Floor wastes | • Provide strategically placed trapped floor wastes within mechanical plantrooms. Wastes shall be in accordance with AS 3500.2 and AS 3666.1.<br>• Ensure plantroom floors are sufficiently graded toward floor wastes. |
| Hose bibs | • Provide key stop hose bibs within mechanical plantrooms. |
| Lighting | • All plantroom lighting shall be coordinated and set-out around mechanical equipment and plant.<br>• Plantroom light fittings shall be all enclosed type fittings of a robust nature. Provide IP55 rated fittings where there is a potential risk of water exposure.<br>• Plantroom light switches shall be located immediately adjacent to plantroom doors. Provide 2-way switching as required.<br>• Emergency lighting shall be in accordance with AS/NZS 2293. |
| Power supplies | • Provide 20A power outlets for maintenance convenience within plantrooms.<br>• Provide 3 phase power outlets within central plant mechanical plantrooms. |
| Data connections | • Ensure data outlet provisions are coordinated, including the connection of BMS communication modules.<br>• Provide spare data outlets adjacent to MCCs for larger plantroom applications. This will facilitate future BMS modules or telephone connections. |

| Requirement | Guideline |
|---|---|
| MCCs | • MCCs must be located within the mechanical services plantroom of the plant they serve.<br>• Ensure MCCs are not at risk of water exposure from other building services or weather.<br>• MCCs must not be installed in areas such as exterior cupboards and enclosures.<br>• Ensure MCC clearances are in accordance with AS/NZS 3000. |
| Gas supplied plantrooms | • Provide emergency shut-off push buttons at plantroom exits to solenoid shut-off valves.<br>• Provide dedicated manual isolation valves. |
| Refrigerant detection | • Provide refrigerant leak detection systems in accordance with AS 1677.<br>• Leak detection systems shall come with local audible alarms and remote BMS monitoring. |
| Fire extinguishers | • Fire extinguishers must be installed within mechanical services plantrooms. |

### 4.9.2 Equipment locations outside of plantrooms

These guidelines shall be considered with regard to plant and equipment which is located outside of plantrooms, i.e. plant and equipment installed within ceiling spaces, exposed within spaces, and other general locations:

- Ensure plant and equipment is installed and located in a manner that ensures service and maintenance access can be readily and easily made
- Ensure plant and equipment has sufficient safe working clearances to enable service and maintenance activities. *Plant spatials which cannot achieve this requirement will be rejected and re-designed at no extra cost to the University*
- Ensure plant and equipment serviceable components have sufficient clearances for removal (e.g. filter withdrawal access, strainer access)
- Ensure coordination with other services
- Ensure high level plant, including plant within ceiling spaces, is not directly located above room equipment or fixtures which may cause potential disruption or risk to occupants or University equipment (e.g. plant shall not be installed directly above workstations, IT equipment, laboratory equipment, electrical switchboards or control panels)
- Plant and equipment shall not be installed at heights above 3m without permanent access provisions. Where permanent access provisions cannot be made, relocate plant to adjacent accessible locations (e.g. serviceable plant shall not be installed within ceiling spaces above lecture theatres).

### 4.9.3 Ceiling access panel standards

Ceiling access panels must be appropriately sized to facilitate complete access to the required component. Generally, these are sized as 600mm x 600mm.

They shall be hinged type, complete with square shank access latches.

Ceiling access panels shall be coordinated and provided to facilitate complete unobstructed access of plant and equipment. This includes plant and equipment which is not necessarily limited to:

- Plant and equipment which requires servicing, maintenance, future removal and/or inspection
- Mechanical or electronic equipment with moving or operational components which may require replacement in its service life

- Equipment which requires access for commissioning purposes
- Plant and equipment specifically installed for future connection
- Plant and equipment which serves a function associated with another space or building such as isolation valves and the like.

All ceiling access panels and ceiling tiles which are required to be removable for plant and equipment access, shall be labelled with self-adhesive or traffolyte labelling securely fixed to the access panel or the ceiling tile grid. Labels shall not be fixed directly to ceiling tiles.

Grouping of accessible components is acceptable to minimise the number of ceiling access panels.

Provision of ceiling access panels to enable access to major or long sections of concealed pipework, E4M and control cabling and ductwork need not necessarily be provided unless it has been determined that retrospectively accessing such systems will have a significant cost or impractical means of being accessed in the future, or similarly where it is known that future expansion will be made.

### 4.9.4 Ceiling tile sourcing

Ceiling tiles must be of locally sourced supply.

### 4.9.5 Ceiling access panels coordination with other trades

All equipment and plant must be properly coordinated with other trades and the building structure to ensure equipment and plant operation and access are not compromised in any way.

The University reserves the right to request that any equipment or plant positioned in the wrong location through improper and incorrect coordination be remedied at no extra cost to the University.

# 4.10 Equipment

### Introduction

The University, being owner-operators of their built environment, seeks equipment which is cost effective over whole life cycle cost.

## 4.10.1 Requirements

University of Auckland FM shall review all final equipment selections prior to procurement.

All equipment shall be designed, supplied, and installed in accordance with the requirements of the NZ Building Code, local regulations and territorial authority requirements, and AS/NZ Standards.

## 4.10.2 Key criterion for equipment selection

The key criterion for University equipment selections includes but is not limited to equipment which:

- Is fully compliant with current revisions of all local regulations, standards and energy performance requirements
- Preferably is locally sourced and supported
- Preferably has a proven University or New Zealand installation history
- Is energy efficient
- Is robust and unlikely to require major maintenance, overhaul or component replacement during its economic life cycle.

## 4.10.3 Equipment manufacture

The University prefers equipment manufacture types which are common throughout the University. This provides benefits of familiarity with performance and maintenance and means it is easier for the University to carry spare parts.

However, the University has no objection to alternative or new equipment manufacture types being offered on any of its projects should the offered equipment have performance and/or cost advantages which can be clearly demonstrated.

## 4.10.4 Noise and vibration

Mechanical services shall be designed and constructed to ensure all necessary precautions and measures are made to the installed plant and equipment to minimise the effects of noise and vibration transmission.

Acoustic requirements shall be project specific in accordance with the project's acoustic engineer's requirements. In the absence of an acoustic engineer, required noise levels shall comply with AS/NZS 2107.

All mechanical equipment shall be appropriately isolated from plant such as chillers, cooling towers, fans, AHU's, FCU's and pumps, in accordance with the manufacturer's recommendations and industry best trade practice.

Anti-vibration isolation material and mounts shall be specifically designed and provided to all plant.

### 4.10.5 Specific equipment guidelines and requirements

All mechanical services plant shall be selected and designed with consideration to the guidelines as described within this section.

This table is a list of equipment manufacture types which are currently favourable to the University; together with some University site specific design guidelines for University selected equipment.

**Note:** The table is not comprehensive and should not be considered as all-inclusive.

**Table 9: Mechanical equipment requirements**

| Equipment type | Manufacture types currently favoured by the University | University site specific remarks / Design guidelines |
|---|---|---|
| AHU | Temperzone, Cooke Industries<br>Swegon (or equivalent Ecovent certified) | • Preference shall be for "Ecovent' tested and certified AHUs<br>• Fans shall include motors of high efficiency ratings in accordance with Commission Regulation (EU) No 327/2011 and have AC motors of Efficiency class of minimum IE3. It is preferred that motors with efficiency of IE4 (Super-Premium Efficiency) are provided dependent on availability.<br>• Shall be fitted with internal lights.<br>• Shall be fitted with filter differential pressure gauges and BMS differential pressure sensors.<br>• Shall be VAV (not CAV) wherever possible.<br>• Must be installed with VSD even where CAV system.<br>• Shall be selected for minimum +15% fan and fan motor capacity to facilitate any future modification.<br>• Shall be factory fitted on bases high enough to facilitate trapped condensate connection.<br>• Drain pans shall be stainless steel sheet metal, not galvanized. |
| Airco Splits / VRF / VRV | Mitsubishi Electric<br>Daikin<br>Toshiba | • Split systems must be inverter type.<br>• Condenser units shall have casing and coil corrosion protection suitable for the Auckland CBD environment.<br>• In order of hierarchy for selection, above-ceiling ducted internal units shall be preferred, with cassette type units being be secondary in use. Hi-Walls, below ceiling, and floor mounted shall only be used when other options have been discounted<br>• Condenser units shall preferably be installed outside, not within plantrooms where plenumised.<br>• VRF/V systems shall include BACnet interface for BMS monitoring. Split systems shall have BMS temperature sensors within spaces where appropriate for remote monitoring.<br>• Condensate drains must be gravity fed. Condensate pumps are not acceptable.<br>• Systems shall be installed with factory dipswitch settings switched to ensure:<br>    • Indoor unit fans operate at constant fan speed<br>    • Temperature thermal offset disabled. |
| Attenuators | Cooke Industries<br>Noise Control Services<br>Fantech | |

| Equipment type | Manufacture types currently favoured by the University | University site specific remarks / Design guidelines |
|---|---|---|
| BMS Controls | Siemens Desigo | Refer to *Section 7 Building Management System (BMS)* of the *Property Services Design Standards and Guidelines*. |
| Boiler | Temperzone,<br>Rendamax<br>Aquatherm | • Boilers shall come complete with on-board boiler management control system.<br>• Where boilers are selected for a new reticulation system (and not connecting to existing reticulation system), the design flow temperatures (and boiler output), and all peripheral emitters shall be selected to maximise boiler efficiency (50°C flow and 30°C return) to ensure proportion of time for condensing<br>• Condensing type boilers are favourable for energy recovery.<br>• Boiler primary pumps may be integral of boilers for smaller applications. Similarly boiler primary pumps shall be controlled via boiler on-board controls.<br>• Natural draft flue arrangements are preferred.<br>• Boilers should be separate from domestic hot water provision. |
| Chiller | York<br>Trane<br>PowerPax | • Chillers shall have dual refrigerant circuits wherever possible.<br>• For individual chiller installations, chillers shall be capable of operating at minimum load of 15%.<br>• The selection of a single or multiple chiller arrangement shall be based upon the critical requirements of the faculty<br>• Chiller manufacturers minimum recommended loop volume must be verified and provided.<br>• Chiller performance shall be proven by test measurements and calculations at minimum, mid-range and maximum loads to satisfy chiller performance criteria. Tests shall be undertaken during summer conditions.<br>• Chiller vessels shall come complete with cathodic protection. |
| Cooling Tower | Aqua-Cool<br>Trane<br>IPSCO<br>Evapco | • Cooling tower fan motors must be VSD controlled.<br>• Cooling tower construction shall be predominantly fibreglass and stainless steel.<br>• Local hose taps must be provided to facilitate cleaning.<br>• Manual fast fill provisions must be made.<br>• Tower overflow must be visibly terminated to tundishes.<br>• Cooling tower performance shall be proven by test measurements and calculations to satisfy cooling tower performance criteria. Tests shall be undertaken during summer conditions. |
| Dampers | Holyoake Industries<br>Halton<br>Trox<br>Krantz | • Balancing dampers for air volumes above 350 l/s shall be opposed blade type.<br>• Balancing damper quadrants must be clearly marked in commissioned settings.<br>• Balancing dampers must be provided to all branches and sub branches to facilitate complete and correct air balancing.<br>• Butterfly type balancing types must be sheet metal type with lockable quadrants fitted. Provide neoprene grommets to damper shafts to prevent 'rattling' of dampers. |

| Equipment type | Manufacture types currently favoured by the University | University site specific remarks / Design guidelines |
|---|---|---|
| Electric re-heats | Hislop & Barley<br>Holyoake Industries<br>Avon Electrical | • Must be staged or modulated via solid state relays for energy efficient operation. Maximum single element stage/size shall be 2.5 - 3KW.<br>• Electric re-heats shall come factory fitted with heater safety protection devices.<br>• Heater elements shall be stainless steel. |
| Fans | FlaktWoods<br>Fantech<br>Fans Direct | • Fans shall have AC motors of efficiency class of minimum IE3. The contractor shall consider motors with efficiency of IE4 (Super-Premium Efficiency) dependent on availability<br>• Fans and fan motors shall be selected for minimum +10% capacity to allow for future alteration.<br>• Fans shall be selected on duty, efficiency, acoustic performance and maintainability. Fans shall not be oversized / selected to suit market availability. Of importance is ensuring the correct fans are selected to include sufficient time for delivery to meet contract duration/programme requirements.<br>• Where low duty single phase fans serve critical areas, or multiple fresh air supplies, fans shall be installed with speed controllers installed immediately adjacent to the fan.<br>• Where installed / proposed, all 3 phase fans shall be variable speed driven and shall be selected for highest efficiency motors for the application. |
| FCU | Ability<br>Temperzone<br>Sinko | • FCUs shall be selected for design duty at low fan speed.<br>• FCUs shall be selected factory fitted with speed controlled EC motors. AC motors are not acceptable.<br>• Ducted FCUs must be fitted with custom made acoustically insulated sheet metal supply and return air plenums.<br>• Condensate drains must gravity fall – condensate pumps are not acceptable.<br>• Provide extended drain trays under valve assemblies wherever possible. |

| Equipment type | Manufacture types currently favoured by the University | University site specific remarks / Design guidelines |
|---|---|---|
| Filters | Filtercorp<br>Camfil<br>Farr | • Filters shall be tested and classified in accordance European Standard EN779:2012.<br>• Panel filters shall be disposable type.<br>• Panel filters shall be to standard supply module sizes i.e. 600mm x 300mm and 600mm x 600mm.<br>• Wherever practicable, filter surface area shall be maximised for enhanced filter efficiency.<br>• Bags shall be minimum 8 pocket.<br>• Wherever practicable, G4 filters shall be bag type, not panel type.<br>• Filters shall be moisture resistant up to 100% relative humidity.<br>• Filters shall be accommodated within purpose-built support frames, sufficiently supported to prevent collapse, and readily removable without use of special tools.<br>• Ductwork or plenum mounted filters shall be provided with hinged access doors complete with gaskets and securing fixings.<br>• All plantrooms serving as fresh air plenums, and all electrical rooms with passive louvres shall have filtration screening air intake behind louvres.<br>• HEPA filters shall incorporate provisions which enable filter removal without requiring system isolation. |

Types applicable to University installations shall generally apply as follows:

| Class | Application |
|---|---|
| G1 | Insect screening to passive louvres to non-plenumised plantrooms, storerooms and the like. |
| G2 | • Plantroom inlet louvres where acting fresh air plenum.<br>• Electrical room passive louvres.<br>• FCUs, ACUs and other terminal units where ducted and pre-filtered fresh air supplies. |
| G3 | • FCUs, ACUs, and other terminal units where fresh air supplies are passive and/or not pre-filtered.<br>• 'Minor' fresh air intakes <500 l/s except where serving laboratories, electrical and server rooms or other spaces with high indoor air quality requirement. |
| G4 | • Fresh air intakes >500 l/s.<br>• All mechanical supplies within electrical rooms.<br>• AHU stage one filtration as required.<br><br>**Note:** AHU stage one filtration is not a standard University requirement. AHU stage one filtration shall be avoided especially where:<br>• Plantrooms have filtered intakes<br>• Plantrooms are situated in areas of high air quality (i.e. low dust, low hydrocarbon exposure).<br>• The HVAC application is not of a high quality or critical nature (e.g. lecture theatres, laboratories). |
| F7 | AHU final stage filtration except for F8 requirement below. |
| F8 | AHU final stage filtration within general laboratories. |
| H10-H14 | HEPA filtration shall be to high risk laboratory applications to user specifications. |

| Equipment type | Manufacture types currently favoured by the University | University site specific remarks / Design guidelines |
|---|---|---|
| Grilles and diffusers | Halton<br>Holyoake Industries<br>Trox<br>Krantz | • Grilles and diffusers shall be selected on the application and the rooms. Specific attention shall be given in selection to discharge, throw, and noise. In normal applications, and as a method to minimise the risk of 'dumping' the preference of the University is the selection of 'Swirl' diffusers. Due consideration of this shall ensure that these are selected to consider minimum flow volumes.<br>• Supply diffusers shall have sheet metal cushion heads to diffuser supplier's recommendations and acoustic requirements.<br>• Exhaust grille plenums shall be painted out black so sheet metal is not visible from grille front face. Consideration shall be given to any acoustic requirements and the positioning of these inlets in relation to sources of noise. |
| Heat exchangers (water) | Alfa Laval | • CHW HX must be insulated.<br>• Large HHW HX must be jacketed. |
| Louvres | Holyoake Industries<br>Colt<br>Osbournes | • Extruded aluminium construction.<br>• Intake velocities shall not exceed 2.5m/s to avoid moisture ingress. |
| Pumps | Grundfos<br>Wilo<br>Wallace<br>Ajax<br>Southern Cross | • Pumps shall be selected for minimum +20% capacity increase without motor or pump casing change to allow for future alteration.<br>• All pumps shall be provided with speed controllable EC motors or VSDs even where constant volume is required to facilitate speed adjustment for balancing purposes, and to enable soft start.<br>• Provide duty/standby pump configurations to all major central plant applications.<br>• Secondary HHW and CHW applications shall have dual pump arrangements wherever the installation network serves multiple buildings, is of a critical nature, and/or where the reticulation network is large. In such cases each pump shall be sized to accommodate minimum 60% of the system required total design flowrate. Each pump shall have a VSD.<br>• Suction and discharge pressure gauges must be provided. A common gauge (see Figure 2: Common gauge on page 36) will be acceptable.<br>• Provide binder tappings to pump and valve assemblies to facilitate commissioning measurement across strainers, pump, control valves etc.<br>• 3-way bypass control valves shall be installed only at index runs - not near pumps.<br>• Motors shall be totally enclosed, fan cooled, and have an IP56 rating. Ideally speed selection shall be limited to 1450rpm maximum.<br>• Motors in excess of 100kg shall be provided with a lifting eye. |

| Equipment type | Manufacture types currently favoured by the University | University site specific remarks / Design guidelines |
|---|---|---|
| Radiators | Energy Products<br>DeLonghi | • Shall be fitted with Heimeier or Danfoss thermostatic control heads. Heads shall come complete with clips to enable limiting of temperatures for energy saving.<br>• Radiators shall be selected for compliance with EN 442.<br>• Shall be fitted in room locations where unlikely to clash with furniture arrangements (present and future).<br>• Groups of radiators which form a zone shall be designed to include measures which enable isolation and control of zones, e.g. radiators on the north side of the building shall be separately circuited from radiators on the south side of the building.<br>• Radiators shall be slim line types, suitably robust and vandal proof for the application, with concealed wall brackets specifically designed to permit expansion and contraction of the heating pipework system as required. Radiator pipework shall be concealed within wall cavities, spandrels, and ceiling spaces wherever practically possible. Provide ready access to isolation and balancing valves as necessary.<br>• Isolation valves to facilitate radiator removal without impact on the complete installed network.<br>• When selecting radiators ensure the sizing of the mitter accommodates low flow temperatures.<br>• Air bleed provisions to accommodate venting of air at each radiator. |
| VAV | Holyoake Industries<br>Trox<br>Halton | • Shall be selected for minimum +15% additional capacity to allow for future alteration.<br>• Fan assisted VAV boxes shall be avoided. |
| VSD | Siemens<br>Vacon | Refer to *Section 8 Electrical for Mechanical and Associated Services* of *Property Services Design Standards and Guidelines.* |

**Common gauge figure**

This figure demonstrates a common gauge for a pump, as referred to in the table above.

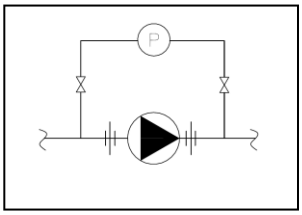


**Figure 2: Common gauge**

# 4.11 Ductwork

## 4.11.1 General

All ductwork shall be fabricated and installed to a high standard of workmanship; industry best practice and be compliant with the latest edition of SMACNA construction and installation standards and other relevant AS/NZ Standards.

All supports, stiffeners, brackets and frames shall be hot dipped galvanised and shall be constructed and installed in accordance with SMACNA standards.

All ductwork, except where specified to be stainless steel or plastic (for fume cupboards, etc.), shall be fabricated from galvanised mild steel sheet metal to appropriate SMACNA gauge thickness and in accordance with AS 1397 grade G2, coating class Z.300.

Ductwork shall be designed for air velocities in accordance with ASHRAE ductwork design guidelines. Major risers shall be designed to accommodate minimum +10% air handling capacity to facilitate potential fit-out alteration. All risers shall be air leakage tested prior to concealment.

Return air ceiling plenums are acceptable on intermittent floors; otherwise return air conditioning ductwork shall be ducted wherever possible. All open-ended ductwork intakes and discharges from/to free space shall have bellmouth entries.

To reduce air leakage in new reticulation systems, and where spirally wound ductwork is proposed, ductwork systems shall be proprietary comprising 'gaskets', an accepted example of this is provided by 'Spiro'.

For rectangular ductwork, joints shall be 'ductmate' flanged connected using self-tapping screws or pop rivets. Joints shall have rubber gaskets between flange faces and be sealed airtight using ductwork sealant. Ductwork systems shall be completely sealed air-tight around all seams, joins, corners, flanges, etc.

Fixings to ductwork shall not penetrate the ductwork envelope. Brackets 'drop-rods', etc. shall be coordinated (to all practical means) to use flanges as the point for fixing of ductwork to the structure.

Kitchen exhaust ductwork shall be fabricated and installed for full compliance with the requirements of Clause G4 of the New Zealand Building Code. For commercial kitchens where 'cooking' is undertaken, kitchen canopies shall be 'typically' a 'capture-air type system' incorporating supply and exhaust.

Exterior ductwork should be avoided wherever possible. If used, exterior ductwork shall be fabricated and installed to prevent pooling of water and to prevent ingress of water. Exterior ductwork shall be primed and painted, including all support systems, to ensure corrosion will not occur. Open ends must have vermin screens.

All open-ended ductwork must be covered during storage and construction to avoid ingress of dust into mechanical systems.

## 4.11.2 Access panels

Ductwork access panels shall be provided adjacent to each fire damper, smoke damper, duct mounted heating or cooling coil, at regular intervals on major risers, main branch connections and other locations deemed necessary to facilitate maintenance, cleaning and/or inspection. Access panels shall be proprietary types with mechanical latches or clamps not requiring tools to open and close.

### 4.11.3 Dampers

Balancing dampers shall be provided at all branch take-offs, plenum spigots, tee-sections and where otherwise required to facilitate complete and correct air balancing. Robust quadrants must be provided to allow the damper to be easily and accurately adjusted, then fixed in secure position without the quadrant becoming loose over time. Damper quadrant commissioned settings shall be clearly marked on the quadrant with permanent marker.

Motorised control dampers shall be opposed blade types such as Holyoake HCD, flanged configuration for ease of removal. Motorised control dampers shall be sized and selected to provide appropriate control at least possible resistance. Motorised damper motors shall be compatible with the BMS control system requirements, quiet in operation and non-overloading type. Minimum and maximum positions shall be adjustable via mechanical limit stops.

Fire damper clearances and access requirements must be sufficient to facilitate periodic drop testing. Any dampers which do not comply with this requirement will be rejected and remediated at no extra cost to the University. Fire dampers shall be supplied and installed to comply with the requirements of AS 1668.1, AS 1668.2 and AS 1530.4. Installations must also be made in accordance with the manufacturer's written recommendations.

### 4.11.4 Flexible ductwork

Flexible ductwork shall comply with the requirements of AS 4254, AS 4508 and the NZ Building Code.

Flexible ductwork, where used for transporting conditioned air, shall be acoustic type with aluminium inner and sleeved insulation outer. This vapour barrier shall be UV stable.

Flexible ductwork, where used for mechanical ventilation air transport, shall be unperforated aluminium foil type with 0,0,0,3 fire indices rating.

Flexible duct runs shall not exceed 1.5m in length with saddle supports at regular intervals. Where flexible duct runs are required to exceed 1.5m long runs, sectional lengths of rigid sheet metal ductwork shall be used.

Spigot take-offs on rigid ducts shall be circular or oval shape with a fitted butterfly damper.

Connection of flexible duct to spigots shall comprise of taping of the inner duct layer to the sheet metal spigot then secure fixing over the joint using hose type clips or banded ribbon. Taping alone is not acceptable.

Flexible ductwork shall not pass through any penetrations such as acoustic partitions, fire rated partitions, full height walls and floors. Rigid duct sleeves shall be used in such cases.

# 4.12 Pipework

## 4.12.1 General

Pipework shall be designed for industry best trade practice, and installations shall be only by skilled and suitably qualified pipework fitters.

Pipework water velocities shall be designed in accordance with ASHRAE pipework design guidelines.

Pipework of dissimilar metals shall not be used as far as practically possible.

Pipework risers shall be suitably sized to service every level within a building, even where not initially servicing every level. Allow for valved stubs to accommodate future buildings, levels/branches and other potential on-floor sub-branches for future connectivity. Isolation (IV) and isolation-regulating (IRV) valves shall be provided at every branch take-off so each branch can be isolated without causing disruption to the water service to other buildings, or levels within a building.

Dirt legs and drain cocks with hose connection fittings shall be provided at the bottom of each riser. Isolatable air bleeds fitted with automatic air vents shall be provided at the top of each riser. Drainage tundishes to waste shall be coordinated and provided at adjacent locations. Provision must be made to provide sufficient air venting to all system high points and drains to all system low points.

Pipework exposed within plantrooms or service areas shall maintain minimum 2.2m head height clearance. Pipework headers shall be provided with at least one spare flanged connection complete with lugged IV to facilitate future connection.

'Press Fit' systems shall be proprietary systems. Approved manufacturers being either Ke Kelit, 'steelFIX' or Kembla 'KemPress'. Preference shall be given to the system with the higher insurance rating. It is a University requirement that people installing and commissioning these systems be trained and certified by the manufacturer. The systems shall be designed, installed and tested in accordance with the manufacturer's requirements. No other alternative will be accepted.

External HHW and CHW pipework shall be avoided wherever possible.

PPR composite pipework will not be accepted. Any use will require removal and remediation by the contractor at their own cost.

## 4.12.2 Materials

Unless otherwise specified, pipes shall be manufactured of these materials and to these standards:

**Table 10: Pipework material specifications**

| Service | Size | Material | Jointing |
|---|---|---|---|
| HHW | ≤50mm | Black medium weight carbon steel (BS1387) | Screwed (BS 21), OR welded (BS 1965) |
| | | Copper tube (NZS 3501) | Brazed |
| | | Stainless steel | Welded EN 10312 (2005-12)<br>Press Fittings (EN10312) |
| | ≥65mm | Black medium weight carbon steel (BS1387) | Welded (BS 1965) |
| | | Stainless steel | Welded EN 10312 (2005-12) |

| Service | Size | Material | Jointing |
|---|---|---|---|
| CHW | ≤50mm | Black medium weight carbon steel (BS1387) | Screwed (BS 21), OR welded (BS 1965) |
| | | Copper tube (NZS 3501) | Brazed |
| | | Stainless steel | Press fit or fusion coupled to manufacturers requirements |
| | ≥65mm | Black medium weight carbon steel (BS1387) | Welded (BS 1965) |
| | | PPR | Fusion coupled to manufacturers requirements |
| CDW | All | Black medium weight carbon steel (BS1387)<br>For closed circuits only | Welded (BS 1965) |
| | | Copper tube (NZS 3501) | Brazed |
| | | Stainless steel | Spiro welded |
| | | PPR | Fusion coupled to manufacturers requirements |
| Refrigerant | All | Refrigerant grade copper tubing (NZS 3501) | Silver soldered |
| Condensate (exposed systems or from AHU's) | All | Copper tube (NZS 3501) | Silver soldered or Brazed |
| Condensate (from ceiling concealed systems) | All | uPVC (NZS 7648) | Solvent joined |

**Note:**

- Black medium weight carbon steel:
  - Shall only be used where connecting to existing systems
  - Will not be used on chilled water pipework in conjunction with Armaflex (or equivalent closed cell pipework) insulation.
- New pipework materials shall be compatible with existing systems e.g. dissimilar metals shall be avoided where possible.
- When using stainless steel pipework, the soluble chloride content in the insulation materials used must not exceed 0.05% by weight in accordance with DIN 1988, Part 7.

### 4.12.3 Joints

Mechanical pipework joints within wall cavities or finally inaccessible locations are not acceptable. Similarly, all welded joints within wall cavities or finally inaccessible locations shall be pressure tested prior to pipework concealment.

Non-permanent joints must be provided to all piping connections to coils, tanks, drip trays, flexible connections, valves and control valves etc.

Non-permanent joints shall be one of:

- Flanges for any pipe diameter
- Screwed unions for any pipe 50mm diameter or smaller
- Compression fitting and coupling for any pipe of 20mm diameter or smaller.

Non-permanent joints shall be easily accessible and shall permit dismantling without disturbing plant or other piping.

Compression fittings and pipe couplings must be installed in accordance with the manufacturer's recommendations. Crox fittings shall not be used.

### 4.12.4 Supports

Pipework shall not be hung from other pipes, ductwork or equipment.

Piping shall be supported by saddle rings, rollers, munsen rings and hangers at support spacing to prevent pipe deflection and excessive stress on the piping due to the pipe weight.

Supports should not offer any 'thermal bridges' and be insulated to minimise condensation or heat loss occurring.

Support fixings shall not weaken the supporting structure. Extra care must be taken when supporting pipework systems within existing buildings. Approval form a Structural Engineer shall be sought where deemed necessary.

Vertical risers shall be adequately supported at each floor by clamps or collars attached to the pipework which shall be fixed to rigid steel brackets secured to the building structure in a manner in which lateral pipe movement is restrained.

Pipework and all peripheral services shall be restrained according to the requirements of NZS 4219

### 4.12.5 Expansion, contraction

Pipework shall be designed and constructed with provision for controlled expansion and contraction.

When the inherent flexibility of existing pipework is inadequate, expansion joints, loops or bellows shall be provided.

### 4.12.6 Sleeves

Refer to *Section 10 Passive Fire Guides 1 to 3* of *Property Services Design Standards and Guidelines*.

### 4.12.7 Refrigeration piping

Refrigerant pipework that runs external to the building shall be mounted on trunking containment, cable tray or similar. All external refrigerant pipework and insulation shall be totally concealed for protection from UV exposure.

A minimum number of joints shall be made in the refrigerant piping systems. Silver soldered capillary joints shall be used throughout.

Joints in small soft copper tube may be made with flare compression fittings such as Starkie type. Crox fittings shall not be used.

All pipes and peripheral items shall be supported by clips and hangers 'anchored' to the structure at minimum intervals not exceeding manufacturer's recommendations. All anchors shall be selected according to the gravitational acceleration associated with a seismic event. Where anchors are used, these shall be selected in accordance with a Structural Engineer's input.

Where out of balance forces are present (associated with pumps, etc.) the seismic design of the fixings shall incorporate any necessary vibration measures to minimise transmission to the structure.

Where chilled water is being supported any fixings shall be insulated to minimise condensation formation.

All refrigerant pipework penetrating through walls or floors shall be sleeved.

Sleeves penetrating fire-rated floors and walls shall be to a fire engineer's or fire specialist's approved detail.

### 4.12.8 Valves

Valves shall be of a high commercial standard, suitably rated for the temperature and pressure for the intended service and fluid to be reticulated.

Sample valves shall be submitted to the University prior to procurement and installation.

A complete valve schedule pertaining to the project works shall be provided within the contract O&M Manual. Refer to 4.6 Identification and Labelling on page *18* for valve identification requirements.

Valves must be installed in easily accessible locations to facilitate correct, safe, and complete system operating purposes. Valve installation must facilitate separation of pipework and valve assemblies without requiring cutting or other modification of the pipework installation.

Where valves are used for control or balancing purposes, the valve shall be installed so the operating lever is side mounted wherever possible with the dial numbers clearly visible.

### 4.12.9 Valve design requirements

These valve design requirements shall be followed:

**Table 11: Valve design requirements**

| Type | Size | Design Requirement |
|---|---|---|
| Isolating (IV) | All | • Must be provided to all equipment, tanks, meters, control valves, check valves, strainers, header connections, risers, and on-floor riser branches to ensure equipment and groups of equipment can be effectively isolated without causing system disruption.<br>• Shall be used in 'closed' or 'fully open' positions only.<br>• All existing isolation valves within existing buildings should not be assumed to be in good working order. Similarly, all existing isolation valves which appear to be in poor condition or greater than 20 years old, should be replaced with new as part of the project works where replacement opportunity arises. |
| | ≤50mm | • Ball type (stainless steel). |
| | ≥65mm | • Lugged butterfly type.<br>• Stainless steel shaft.<br>• Handwheel operated where valves ≥ 150mm. |

| Type | Size | Design Requirement |
|---|---|---|
| Isolating-Regulating (IRV) | All | • Shall be used for the provision of balancing a water circuit or piece of equipment between the 'closed' and 'fully open' position. May be used for the dual purpose of circuit or equipment isolation except where IRVs are not capable of tight shut-off isolation of the system at the rated design pressure – additional IV(s) shall be installed upstream in this case.<br>• Must be provided to all risers, on-floor riser branches, and all equipment with a design flowrate requirement<br>• Valves must be installed in accordance with the manufacturer's recommendations (e.g. allow for the recommended length of straight section of pipe before and after the valve).<br>• Must incorporate built-in pressure measurement tappings to facilitate water flow measurement. Tappings shall be self-sealing.<br>• Shall be appropriately selected for the design flowrate and for maximum 5-10kPa at full design flow.<br>• IRV hand wheels must incorporate graduated adjustment dial complete with number indication and locking facility.<br>• All IRV commissioned settings must be recorded within the commissioning results (i.e. record the numbered setting made during commissioning). Lock hand wheels after system is balanced. |
| Check (NRV) | All | • Check valves shall be installed wherever any item of equipment may be affected by reverse flow or backflow, e.g.:<br>  ◦ Contamination protection of potable water supplies<br>  ◦ Protection and prevention of potential system flow reversal during shutdown<br>  ◦ Pump protection<br>  ◦ Boiler protection for multiple boiler installations<br>  ◦ Prevention of flow under gravity<br>  ◦ Prevention of flooding.<br>• Check valves for backflow prevention must be double check type |
| | ≤50mm | • Spring type.<br>• Swing type. |
| | ≥65mm | • Wafer type (80mm and above).<br>• Flap type.<br>• Silent type (65mm and above). |
| Automatic flow control valves | All | • Automatic flow control valves ('flowcons') such as Frese ALPHA may be used under these situations:<br>  ◦ Where IRVs cannot be readily and easily accessed or installed to IRV manufacturers requirements<br>  ◦ Where there is no potential for future additions to the existing circuit<br>  ◦ Where an excessive amount of IRVs would be required for an installation.<br>• Flowcons may be used in conjunction with IRVs such as sub-branch reticulation connections to ensure water flows are balanced within pressure fluctuating systems.<br>• Flowcons shall have replaceable orifice plates within balancing cartridges so that flows may be altered. Provide IVs so that cartridges can be accessed without drain down or disruption of the pipework system.<br>• Flowcons shall be stainless steel body with built-in tappings for commissioning measurement. |

| Type | Size | Design Requirement |
|---|---|---|
| Pressure relief valves | | • Pressure relief valves, which for these design guidelines also includes safety relief valves, must be used for over pressure protection of any installed equipment.<br>• Pressure relief valve discharges must be piped to nearest open tundishes or floor wastes.<br>• Refrigerant relief valve applications must be piped to the building exterior. |
| Differential pressure control valves | | • Differential pressure control valves such as Tour and Anderson may be used on variable flow systems to enable accurate and stable control in large variable pressure dependent circuits.<br>• Differential pressure control valves shall be selected in coordination with the Controls Engineer. |
| Motorised control valves | Refer to *Section 7 Building Management System (BMS)* of *Property Services Design Standards and Guidelines.* | |

### 4.12.10 Strainers

Strainers must be installed upstream of all water and steam equipment to ensure the effective arrest of pipework scale and debris for equipment protection.

Strainers shall be 'Y' types fitted with perforated 304 stainless steel baskets removable via screwed plug or bolted flange ends. Strainers must be installed in fully accessible locations complete with ceiling access provisions where relevant, to facilitate strainer basket removal.

Strainers shall be generally pipework line size, with maximum full flow resistance to 10kPa.

Due to the vast and varying extent of installed reticulation systems across the University built environment, the University does not have a firm requirement with regard to provision of tertiary strainers such as strainers to each individual piece of on-floor equipment. Generally, tertiary strainers shall be reviewed on a case-by-case basis, with the exception of these situations whereby tertiary strainers shall be provided:

- Where centrally located strainers are of a large pipe size and subsequent course strainer basket hole sizes; therefore, necessitating the requirement for smaller strainers of finer basket hole sizes to accommodate the reduction in pipework reticulation diameter(s)
- The installed system is the existing system which is believed to be of sub-standard or unknown condition and/or water quality
- Critical equipment such as equipment serving IT and Server rooms, special laboratories, etc.

### 4.12.11 Flexible pipework connections

All pumps, chillers, air handling units, fan coil units and other vibrating and rotating machinery must be isolated from their respective pipework connections.

### 4.12.12 Binder test points

Binder test points shall be provided each side of all pumps, coils, control valves, vessels and the like to facilitate both temperature and pressure measurement. Test points shall be self-sealing type.

# 4.13 Insulation

## 4.13.1 General

Insulation shall only be installed by skilled and experienced specialists in accordance with the manufacturer's recommendations.

These requirements shall be deemed as minimum requirements:

**Table 12: Insulation design requirements**

| Systems | Design Requirement |
| --- | --- |
| General pipework<br>An approved type is "Thermobreak" | • Pipework insulation shall be applied to all pipework where either condensation occurs on cold surfaces, or where surface temperatures exceed 50°C.<br>• Pipework insulation shall achieve a Material Group Number 1S or 2S when tested in accordance with the requirements of C/VM2 / ISO5660.1.<br>• Insulation materials shall be non-hydroscopic and meet these requirements:<br>  • Water Vapour Permeability to be ≤ 8.19x10-15 kg/Pa.s.m<br>  • Water Vapour Permeance to be ≤ 3.3 x 10-4 g/MN.s<br>  • Permeability Resistance Factor to be ≥ 20,000<br>  • Water Absorption by volume to be ≤ 0.1% v/v<br>• Have maximum thermal conductivity of 0.032 W/mK @23°C.<br>• Insulation shall be continuously glued to the pipework including all joints and overlaps. Suitable adhesives must only be applied to the pipework in its neutral state and following pressure testing of the installation.<br>• Pipework hangers shall be provided with high density mounting blocks.<br>• Pipework hangers shall be pre insulated to minimise thermal bridges, such as 'Thermaloc'<br>• Pipework insulation shall be sheathed with aluminium sheet metal cladding in these conditions:<br>  • Within all mechanical services plantrooms<br>  • Wherever exposed to view<br>  • Wherever exposed to weather.<br>• Insulation sheathing shall be secured in place using pop rivets and swaged joints. All sheathing exposed to weather must have all laps and joints sealed water-tight.<br>• All strainer and valve 'jackets' shall be installed in a manner of which regular service and maintenance is not impeded or will cause disruption to the installed insulation. Provide saddle clips and hinges to facilitate this requirement.<br>• Provide suitable access for binder tappings and the like.<br>• All valves and low points shall be installed in a manner to reduce condensation forming. |

| Systems | Design Requirement |
|---|---|
| CHW pipework | • Closed cell elastomeric material such as Armaflex shall only be used on copper pipework.<br>• Insulation to have a factory-applied external foil vapour barrier<br>• Thermal conductivity to be ≤ 0.032W/mK @23°C<br>• Water Vapour Permeability to be ≤ 8.19x10-15 kg/Pa.s.m<br>• Water Vapour Permeance to be ≤ 3.3 x 10-4 g/MN.s<br>• Permeability Resistance Factor to be ≥ 20,000<br>• Water Absorption by volume to be ≤ 0.1% v/v<br>• Fire Properties; Pipework insulation shall achieve a Material Group Number 1S or 2S when tested in accordance with the requirements of C/VM2 / ISO5660.1<br>• An example of a conforming insulation product is Thermobreak manufactured by Nexus Foams<br>• Pump casings shall generally be insulated wherever practical; however this should not impede motor cooling. Where uninsulated, provide drip trays.<br>• All valve bodies and fittings shall be insulated wherever practical. Where uninsulated, install over extended drip trays. |
| HHW pipework | • Foil faced fibreglass to a glass fibre density of no less than 80kg/m$^3$.<br>• Tape all laps and joints with aluminium foil tape so free of any gaps or potential separation over time. |
| Condenser water pipework | • No insulation requirement |
| Condensate pipework from CHW or refrigerant systems | • Closed cell elastomeric material such as 'Armaflex'. |
| Ductwork insulation | • Ductwork insulation shall be fibreglass, polyester or closed-cell, polyolefin foam, having a maximum thermal conductivity of 0.036 W/mK at mean temperature of 20°C.<br>• All air conditioning supply and return air ductwork shall be thermally insulated in accordance with the manufacturer's recommendations.<br>• For internal insulation, insulation shall be foil faced. Where fibreglass is used, special care must be taken to ensure there are no exposed glass fibres. Any ductwork insulation found to have exposed fibres shall be rejected and the University shall reserve the right to request spot checks of other existing sections which have already been installed.<br>• All supply diffuser cushion heads shall be insulated. Internal face shall be black felt faced, or painted black<br>• All internal insulation shall be pinned, with joints close-butted and taped. Exposed ends shall be capped.<br>• All external insulation must be supported with aluminium foil tape and intermittent banding. Insulation must be free from sagging |

# 4.14 Water Treatment

## 4.14.1 General

Effective water treatment must be provided to ensure the longevity and efficiency of mechanical services systems. Effective water treatment ensures prevention of scale, corrosion, sludge accumulation and microbial growth within pipework systems. In the case of open systems, effective water treatment is required in accordance with, and for full compliance with, the NZ Building Code. The prevention of Legionella bacteria is vital to the University environment.

Water treatment of University mechanical service water reticulation systems site wide is managed and maintained under the guidance of a contracted water treatment specialist.

It shall be the responsibility of the contractor to obtain written requirements and recommendations specific to the project application from the water treatment specialist. The water treatment specialist's requirements and recommendations for both the water treatment methodology and chemical dosing requirements must be followed. Allowances shall be made under the project/contract for the water treatment specialist to visit site and take water samples as appropriate before, during, and upon completion of water treatment procedures.

## 4.14.2 Responsibilities

Use this table of responsibilities as a guide:

**Table 13: Water treatment responsibilities**

| Who | Responsibility |
|---|---|
| Consultant / Designer | • Makes system design provisions for the dosing and dumping of chemicals, flushing bypasses, fresh water introduction, corrosion racks, etc.<br>• Makes provision for automated dosing equipment for all cooling tower and open system applications presenting a possible bio-hazard.<br>• Specifies engagement of University water treatment specialist.<br>• Specifies and/or reviews detailed methodology associated with flushing, cleaning, and dosing of systems appropriate to the project application.<br>• Verifies/witnesses water treatment methodology and water quality samples as appropriate.<br>• Assists Contractor in strategising system flushing and cleaning methodology appropriate to the application.<br>• Communicates with FM on extent of modifications to existing systems to establish extent of required water treatment procedure. |
| Contractor | • Coordinates with the University water treatment specialist and obtains their written requirements and recommendations specific to the project application.<br>• Prior to commissioning phase, supplies the specialist with the system water volume and any other information they may require, coordinates water sampling, etc.<br>• Installs all necessary provisions for flushing, dosing and dumping of chemicals, e.g. mobile pumping stations, flushing bypasses, dumping points, dosing pots.<br>• Flushes, cleans, and chemically doses water reticulation systems to a detailed written methodology.<br>• In the absence of specified requirements, applies water flushing velocities and procedures in accordance with BSRIA application guide 1/2001.1; Pre-commissioning cleaning of pipework systems<br>• Handles all chemicals.<br>• Appropriately disposes of any discharged treated water. |

| Who | Responsibility |
|---|---|
| | • Coordinates with University of Auckland FM and advises any potential implications resulting from the planned activity.<br>• Adjusts pump speeds, adjusts valves, etc. and coordinates with the University FM BMS Technician as required. |
| Water Treatment Specialist | • Designs and submits required water treatment methodology specific to the project application.<br>• Conducts water sampling.<br>• Calculates and supplies required chemicals.<br>• Site presence and advice as required. |
| University of Auckland FM | • Assists with respect to site water supply and drainage provisions.<br>• Assists with respect to any system control modifications required to facilitate flushing and dosing procedures.<br>• Assists in determining extent of water treatment procedures required on installations connecting to existing systems. |

### 4.14.3 Chemicals and handling

Environmentally sensitive chemicals shall be used wherever possible.

Chemicals must be handled with extreme caution and only by experienced personnel with the appropriate personal protection.

Dumping of any treated water must be into the sanitary drainage network.

### 4.14.4 Modifications and/or connections onto existing systems

It is generally recommended that, prior to any new equipment or installation connecting onto an existing system, the current water quality condition for the service is known. This is to be obtained from the University of Auckland FM maintenance records, or from the water treatment specialist taking samples under the project/contract.

These guidelines for any new or modified installation which is to connect onto an existing network shall be applied:

- New or modified installation resulting in 'new' water introduction >10% of the existing system total water volume provided the 'new' water volume is >1000L:
    1. New or modified installation is isolated from the existing network. New installation shall be dynamically flushed, water dumped, and new water introduced.
    2. New water from the above step shall be sampled to determine whether chemical cleaning required.
    3. Chemical clean as appropriate. Take water samples.
    4. Introduce final new water once water treatment specialist is satisfied from samples.
    5. Open up new or modified system to existing network and re-circulate. Add additional inhibitor chemicals (as calculated and supplied by water treatment specialist) to entire network as required.

- New or modified installation resulting in 'new' water introduction <10% of the existing system total water volume provided the 'new' water volume is <1000L:
    1. Dynamically flush new or modified installation where possible.
    2. New or modified system may be opened up to the existing installation without steps 2 to 4 above being applied.

3. Open up new or modified system to existing network and re-circulate. Take water samples. Add additional inhibitor chemicals to entire network where deemed necessary.
4. Consideration shall be given to the use of combined air and dirt separators when connecting onto an existing reticulation system.

### 4.14.5 Design provisions

These design provisions must be made for new installations:

- Automated dosing systems – for open systems only
- Dosing pots. Make connection to flow and return to ensure siphonic mixing
- Flushing bypasses
- Drain cocks at dirt collection points
- Corrosion racks.

# Appendix A 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:<br>(in case we need clarification) | | | |
| **Complete this section if you have found a typo / formatting error.**<br>(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:<br>(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 B Index