

SECTION 20

MECHANICAL SERVICES

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20.0 MECHANICAL SERVICES

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

20.1 Design Process Requirements

The consultant shall be held responsible / liable for ensuring that all works necessary for the complete installation and successful operation are included in the design and specifications. Specific deliverables are required at the end of each project stage, namely:

20.1.1 Approvals Required during Design

Approval shall be obtained from the Estate Directorate, Deputy Director, Planning and Development in SD for:

- Any non-compliances with the table in 20.1.7,
- Use of direct expansion systems for any campus application,
- Separate metering of miscellaneous ventilation systems etc. on the MSSB,
- Internal design conditions for special process areas, laboratories, physical activity areas, etc.,
- Differing hours of operation for special projects,
- Use of Air Transfer System door grilles, and the
- Colour of exposed ductwork within spaces, any fabric duct, spiral wound circular or oval duct,
- Use of condensate pumps,
- Installation of fans in ceiling spaces, and the
- Use of recirculating fume cupboards.

Approval shall be obtained from the Estate Directorate, Deputy Director, Planning and Development in DD for the:

- Room occupancies and loads with the room sheets,
- Overall strategy for vibration isolation to all equipment with moving parts,
- Plant numbering sequence, and the
- Use of external Bradford duct blanket in lieu of Thermobreak for pipe insulation.

Approval shall be obtained from the JCU Manager, Infrastructure Services for:

- Chilled Water (CHW) CDC system and building connections as detailed in 20.1.2
- Pump manufacturer if different from companies in 20.2.3,

- Fan manufacturer if different from companies in 20.2.4,
- CHW treatment chemicals during DD to ensure alignment with the products used by the incumbent maintenance contractor.

20.1.2 Site Infrastructure Connection Approvals

Connections to the CDC system are generally in two stages. The initial connection from the existing CHW pit to the in-ground CHW piping followed later by the connection of the in-ground piping to the TCHWPs and the new building.

Each of these request(s) are to be sent to the Manager, Infrastructure Services, at least 3 working days before the connection is required. The approval for the initial connection of in-ground CHW piping to the CDC CHW pit requires the following supporting documentation (in draft if appropriate or as available);

- Form 15 or statement from designer that design meets code requirements,
- Form 16 or statement from installer that installation has been done in accordance with design,
- As built drawing of surveyed CHW in ground pipework, pit and connection point,
- Updated CHW in-ground layout drawing for the campus in CAD format,
- Updated CHW schematic for the campus in CAD format,
- Agreed sections of the Mechanical Services Commissioning Plan addressing as a minimum:
 - Agreed location of bypass between supply and return CHW piping and bleed valves,
 - TCHWP(s) and VSD installation checks and commissioning procedure,
 - Confirmation of process to identify amount of inorganic or organic fouling present in the in-ground piping – and results/camera footage,
 - Agreed location of sewer for flush water discharge,
 - Calculated amount of flush water and flushing velocity,
 - Agreed location of water meter to measure flushed water for each line,
 - Actual amount of chemicals introduced for passivation post flushing, and
 - Dates and proposals for building commissioning and connection.

For the connection of the building and TCHWPs to the in-ground piping, the following supporting documentation (in draft if appropriate or as available) is required;

- Form 15 or statement from designer that design meets code requirements
- Form 16 or statement from installer that installation has been done in accordance with design
- Any changes to the certificate of Design Compliance as per 20.1.4 completed by the CD RPEQ Design Engineer.
- Agreed sections of the Mechanical Services Commissioning Plan addressing as a minimum:
 - In-ground CHW piping water pressure test result,
 - In-ground CHW piping water quality test result (post clean and passivation)
 - TCHWP(s) commissioning results,
 - BMS connection points connected/not yet connected,

- Agreed location of bypasses between supply and return CHW piping and bleed valves at each separate commissioning branch,
- Confirmation of process to identify amount of inorganic or organic fouling present in the building piping – and results/camera footage,
- Agreed location of sewer for flush water discharge,
- Calculated amount of flush water and flushing velocity for each line size,
- Agreed location of water meter to measure flushed water for each line, and
- Actual amount of chemicals introduced for passivation post flushing.
- Certificate of Installation Compliance

20.1.3 Schematic Design (SD) Report / Design Review

Report Content in addition to requirements of Section 30:

- Concept P&IDs, schematic, etc. drawings including proposed in-ground piping routes and dimensions
- A high level description of the method of servicing the various spaces in the project
- Equipment List with estimated sizes/specifications
- Estimated services consumptions (chilled water, etc.)
- Calculations and plotted psychometric charts
- Outcomes and recommendations for safety in design, and design risk assessment workshops particularly responding to (or addressing) design elements which will limit liability under mould issues in HVAC systems, temperature control and upper limit humidity control.

20.1.4 Developed Design (DD) Report / Design Review

Report Content in addition to requirements of Section 30:

- Detail on existing CDC system site infrastructure locations with proposed connections for this project, including in-ground pipe material, size, route and CHW maximum loads and consumptions.
- Detail on any central plant being provided
- Detail on mechanical design approach for each type of system / area etc. including calculations and plotted psychometric charts
- Detail on special services such as laboratory / piped gases
- Final Equipment List with sizes/specifications and location
- Notification should the new building become the system index building and any consequences for CDC system operation
- Updated JCU chilled water schematic

The Developed Design JCU RPEQ Certification Schedule below shall be completed by the DD Design Engineer and submitted for confirmation.

Project Name		_____
Project Number		_____
Date		_____
Company		_____
RPEQ Design Engineer Name		_____
RPEQ Licence Number		_____
Building Area (GFA)	sqm	_____
Building Area (UFA)	sqm	_____
Total HVAC Plant Cooling Capacity	kW(t)	_____
Building Peak Load Chilled Water Flow Demand	l/s	_____
Building Peak Load Chilled Water Flow Design ΔT	°C	_____
Calculated Summer Day, Thermal Energy Consumption	kWh(t)	_____
24 hour System Peak Load Chilled Water Flow Demand	l/s	_____
24 hour System Peak Load Chilled Water Flow Design ΔT	°C	_____
Mechanical Services Estimated Capital Investment (ex GST)	\$(ex GST)	_____
Total number of Tertiary Chilled Water Pumps	No. Off	_____
Total number of Heat Exchangers	No. Off	_____
Manager Infrastructure Services		
All specific design elements are included in the design	YES / NO	_____
Does the design comply with 20.1.8 “Campus District Cooling (CDC)” in full	YES / NO	_____
Does the SD Report include a target NABERS Rating	YES / NO	_____
Does the SD Report include Life Cycle Costing	YES / NO	_____

20.1.5 Construction Contract Document Requirements

In addition to requirements of Section 30, include an updated Certification Schedule as per 20.1.4 completed by the CD RPEQ Design Engineer.

20.1.6 Handover Requirements

Following commissioning, undertake a witness inspection of the operation. Ensure that the Consulting Engineer and JCU Manager, Asset Strategy and Maintenance and/or JCU Manager, Infrastructure Services (or representatives) are present.

As a minimum, prove to their satisfaction:

- Air flows. A sample of 10-20% of registers and duct air flows shall be witnessed as agreed in the mechanical services commissioning plan. For small systems or critical systems all airflows shall be witnessed.
- Laboratory containment requirements: for any PC2, PC3, SPF or other pressure or airflow directional space, all related aspects shall be witnessed (room pressure, room airflow in or out, air flows are registers and grilles, control and alarm operation)
- Fume hoods: Air flow and sash operation
- Laboratory Shutdown

- Fire mode operation of systems. Undertake end to end testing from tripping a field device to the correct response of the mechanical services
- Chilled water balance and flows
- Duty / Standby operation and changeover.
- Controls operation. Prove operation by amending set-points etc. and observing operation. Prove alarm functionality. Provide end to end testing from field

Rectify any defects identified. Should re-inspection be required, the cost of consultants reinspections will be deleted from the contract sum.

20.1.7 Specific Design Requirements

JCU owns, operates and maintains all infrastructure services and all academic buildings on and within the campuses. The RPEQ consulting engineer shall take a long term (whole of life) investment and maintenance decision strategy when designing the systems.

The design standards are provided with the intent that the default energy rating would be in the order of 4.5 star NABERS rating and previous maintenance or performance issues experienced with existing HVAC installations onsite are not repeated.

The following shall be adopted in all new HVAC design solutions and where feasible on all refurbishment solutions, unless approved by the Estate Directorate, Deputy Director, Planning and Development during SD.

Scope	Reason
All systems shall have pre-conditioner plant included in the design to remove moisture content from the outdoor air before it is delivered to the building air handling units or room direct. PCU are to be ducted to the AHU's they supply. The use of plate heat exchangers is preferred over enthalpy wheels. Control of the PCU is to use an adjustable dew point control referencing the outside air temperature and humidity.	Condensation and Mould Control
HVAC plant rooms shall not be naturally ventilated or draw outdoor air through the plant areas. All outdoor air systems shall be ducted to external grilles. Outdoor air duct routes to filter plenums shall be kept to a minimum and include access panels.	Condensation and Mould Control
All air conditioning plant supplied with chilled water from the campus district cooling system shall have high temperature split cooling coils and pressure independent flow control valves. These can be at each air handling unit or a pressure flow regulating valve for the building.	Ensure no building is disadvantaged or takes more flow than designed.
AHU's supplying entry foyer and office areas shall have humidity monitoring.	
Air handling unit filter plenums shall be fabricated from the same material and form part of the AHU manufacturers' scope.	Ability to clean filter plenums. Longevity of system.
Multizone air handling units are not accepted.	Inherent low return water issues which impact on the CDC plant.
Contact JCU PM for required manufactures of :- <ul style="list-style-type: none"> • Compressed Air Fume Cupboards • Fume Cupboards • Laminar Flow Cabinets • Specialist Ventilation Systems • Filters 	Standing Maintenance agreements
BMS requirements are covered in Section 23.	

20.1.8 Campus District Cooling (CDC)

Both Townsville and Cairns campuses have a CDC network where chillers in a central energy plant (CEP) generate chilled water (CHW) during low electrical load periods and then store the thermal energy in a storage tank or system (TEST/S) for distribution to campus buildings through the chilled water piping reticulation during periods of high electrical use.

To maximise the benefits of the CDC systems, these provisions shall be complied with;

- All air conditioning systems used in campus buildings shall be chilled water type.
- Direct expansion systems shall not be used for any campus application unless specifically approved by the Estate Directorate, Deputy Director, Planning and Development during SD.
- Chilled water cooling coil selections shall be based on the parameters scheduled in 20.1.8.1 below.
- "Duty" plus "100% Standby" variable speed tertiary pumping, operating in response to building chilled water flow and return differential pressure shall be provided. Selection shall be in accordance with the parameters scheduled below.

- Individual building CHW energy consumption (kWh(t)) metering shall be provided using magnetic flow meters and flow and return chilled water temperature monitoring. At each temperature sensor thermometer pocket (well), provide an adjacent binder fitting for testing and calibration purposes. A second set of thermometer pockets shall be provided for interface with the campus BMS.
- JCU standard for chilled water energy metering shall be as specified in Section 25 of these design guidelines. This meter measures CHW mass flow rate plus flow and return water temperatures and has dual outputs, 4-20mA to the campus BMS and pulsed energy output to the campus energy metering system (EMS). The electrical trade shall connect the pulse input signal into the Energy Management controller and provide all necessary programming. The mechanical services trade shall ensure the pulse output from the energy calculator is accurate.
- Provide dedicated electrical power consumption metering (kWh(e)) of the MSSB to capture only tertiary chilled water pumps and air conditioning air handling units serving each building or group of buildings. Separate metering of miscellaneous ventilation systems etc. shall be at the discretion of the JCU brief and/or Estate Directorate, Deputy Director, Planning and Development and shall be additional to that mentioned above.
- A dedicated pump room shall be provided to accommodate tertiary pump/s, heat exchangers and quaternary chilled water pumps (if required) control equipment and flow meters. Two (2) pairs of double data points shall be provided for interface to the campus EMS (1pair) and campus BMS (1 pair) inside the MSSB and DB for each service.
- Two way chilled water control valves shall be used throughout. Three way valves or fixed or motorised flow/return bypass connections shall not be used under any circumstances.
- Coil control systems employing constant coil air off temperature (AOCT) control or similar control strategies which can result in fully open control valves at part load conditions shall not be used. AOCT control shall only be used in combination with set-point reset strategies to ensure that chilled water control valves respond to building load.
- Where identified as a requirement, tertiary chilled water pumping systems are to be arranged to accommodate the temporary connection of JCU’s mobile chiller - by provision of accessible 150NB valved connections.
- Where identified as a requirement, plate heat exchangers with additional pumps as required will be required to separate the chilled water system in the building from the campus CDC system. These systems are to have a modulating valve to ensure the efficient operation of the building and CDC chilled water loops.
- Install air/dirt separators on the chilled water supply to the building, before the TCHWP arrangement.

20.1.8.1 Design Parameters

The following design parameters apply to the CDC interface and shall be used for purposes of selecting pumps, pipework and fittings.

Parameter	Design Criteria
Available Flow/Return Differential Pressure	0 kPa
Available Flow Rate	As nominated by Building Designer

Delivery Temperature	6°C
Static Pressure	300 kPa

It is important to maintain high building chilled water ΔT s during full and part load conditions to reduce pumping power and maximise TES capacities. Designers shall recognise this requirement and avoid any unnecessary system elements which compromise building ΔT . In particular, control systems shall be arranged to ensure that control valve positions respond to building load and flow/return bypasses shall be avoided.

Cooling coils shall be specified to achieve high ΔT s and designers should scrutinise manufacturer's technical data for cooling coils prior to accepting tenders.

Select all cooling coils using the following criteria.

Chilled Water Entering/Leaving Temperatures	7.0°C /17.0°C
Max Coil Air Pressure Drop	80 Pa
Max Coil Water Pressure drop	40 kPa
Maximum Coil Height	950mm

Use the following coil construction.

General Air Handling Units	Copper tube aluminium fin
Outside Air Pre-Conditioners	Copper tube and copper fins electro-plated in brass frames

Cooling coils shall be fitted with drip trays. Drip trays shall be stainless steel and shall extend a minimum of 450mm beyond pre-cooling coils and chilled water coils on the downstream side of the coil and have sides and underside insulated with 12mm closed cell rubber. Install coils with sufficient space under for cleaning and fully flash around to prevent by-pass.

20.1.9 HVAC Zoning

Heaters shall not be incorporated in VAV boxes on either campus.

Air conditioning zones shall be carefully arranged to permit accurate control of conditions and to avoid reheat, excessive zone throttling and such. Zoning shall permit functionally separate systems to be turned off individually.

- Generally thermal / control zones on air handlers shall not exceed 150 m² for internal zones and 100 m² for perimeter zones (Guide). The zoning is acknowledged to have flexibility based on the RPEQ design engineer's experience.
- Zones displaying different usage patterns, solar aspects or load profiles shall be served separately if a temperature swing of 1°Cdb outside of normal temperature proportional control range is likely.
- Zones with different operating times shall be served by separate plant
- Specific Zones requiring specialised humidity controls vs comfort conditioning shall be by served separate plant
- Lecture theatres and intermittently loaded spaces shall be served by separate plant.
-

- Areas with constant or 24/7 loads shall be served by separate plant
- Laboratories requiring separate plant etc.

20.1.10 Internal Design Parameters

Generally for comfort

Summer: 23.5° C to 24.5 ° C (at 55% relative nominal humidity – refer below)

Winter: 22° C to 23.5 ° C (no humidity)

For special process areas, laboratories, physical activity areas, confirm the internal design conditions with the Estate Directorate, Deputy Director, Planning and Development.

20.1.11 Humidity Control / Requirements

JCU campuses are generally located in Tropical environments, in addition to which teaching and laboratory environments often include large fresh requirements. General comfort design required to produce approximately 55% RH @ 23.5 degrees internal temperature and external design conditions. Systems shall be designed to inherently limit space RH to below 65% under all conditions. The SD and DD reports shall specifically cover how space RH will be controlled.

For particular areas, close humidity control may be required (e.g. Library spaces, laboratory spaces etc.)

Designers are required to produce energy efficient designs with inherently “improved” dehumidification over commercial norms. The use of additional energy to perform reheat dehumidification is to be avoided, and generally direct electric reheat will not be permitted for comfort dehumidification.

Dehumidification plant design shall accommodate part load conditions. Calculations should be verified by plotted psychometric charts (included in SD and DD reports).

Generally, humidification is not required. Where required for specific projects, ensure that the method is energy efficient, suitable for sustained operation, and suitable for the water supply available.

20.1.12 Heat load calculations

Formal heat load calculations are to be undertaken for all air conditioned spaces. The heat load shall be calculated using software recognised by NCC (e.g. CAMEL)

Occupancy rates are to be taken from the project brief if provided, otherwise from the occupancy information provided in the NCC. If occupancy rates are not provided, the consulting engineer shall complete a return client brief for approval.

Activity levels used for heat loads shall match the usage of the space.

Initial calculations may be based on the allowances for lighting, equipment etc. provided in the brief or in this guide but shall be checked / amended before final design using information relevant to the specific project (e.g. specialist lighting etc.).

A modest safety factor should be applied (typically 5-15% at the discretion of the designer), however particular care shall be exercised not to significantly oversize plant. Safety factors should be advised in SD and DD reports.

20.1.13 Population Densities

All room occupancies and loads are to be confirmed in writing with the room sheets to the Deputy Director – Planning and Development before Developed Design.

20.1.14 Hours of Operation

Normal operating hours for the campuses are as follows:

Townsville: Standard Operating hours 8:00am – 6:00pm, 5 to 7 days per week

Cairns: Standard Operating Hours 7:30am – 6:00pm Monday to Friday

Data Centres: 24 hours per day, 7 days per week

Certain projects / areas may have special operating hour requirements. Confirm with the Estate Directorate, Deputy Director, Planning and Development via return brief.

20.1.15 Ventilation of Areas

Shower areas shall always be mechanically vented.

Wherever practical toilets and ablution facilities shall be naturally vented. Natural ventilation openings etc. shall be a minimum of 200% of legislated requirements; otherwise mechanical ventilation should be applied.

20.1.16 Plant room and Plant Locations and Platforms

All air handling plant rooms shall be fully enclosed and included within the building vapour barrier/insulation systems. Plant rooms shall be designed to limit internal temperature to under 26.0°C, and this may require air conditioning of the plant room space.

Generally plant rooms and the like shall not be located immediately bordering noise sensitive spaces (e.g. plant room backing on conference rooms and the like). Wherever possible, plant rooms shall be stacked above one another in multistorey buildings. AHU's to be a minimum of 600mm from the walls to allow for maintenance. The plant rooms shall be painted and floors finished with two part epoxy paint.

Plant rooms shall be carefully planned to facilitate all service and maintenance activities including (for example) motor changes, drive changes, filter access, coil and AHU cleaning, fan changes, and so on. The space between equipment shall be sufficient to allow all works to be completed without blocking paths of egress e.g. doors to AHU when open shall not block walkways.

AHU's shall not be stacked on top of each other and unit with an upper and lower operating sections shall have service access e.g. an attached ladder.

Safe permanent access is paramount. Where plant is located on external decks at height, permanent stairs, handrails etc. should be provided. Where ladders are used, these should only be for minor service items and shall be less than 2.5m in height.

Plant rooms should be tanked / banded and provided with drainage to address any free water (e.g. roof leakage, tray overflow etc.) Provide access panels to ducts immediately below roof penetrations to allow inspection for water ingress.

These rooms should be located in such positions that workers need not enter any secure area to access plant rooms. This could require the plant rooms to be located on the perimeter of the building. Internal walls should extend slab to slab and grilles should be provided over any ducting which penetrates the floor, walls or ceiling.

Plant rooms should be designed without windows.

Doors should be solid core and locked in accordance with Section 14 Doors, Hardware and Locks Section and fitted with blocked plates over the lock and striker plate.

20.1.17 Noise & Vibration Control

Prior to finalising the design, provide an overall strategy for vibration isolation to all equipment with moving parts to the Estate Directorate, Deputy Director, Planning and Development for review and approval.

Noise level limits from Mechanical Services plant etc. shall be comply with the requirements of Section 18 of these Design Guidelines.

Pipework shall not be rigidly mounted to building structure. Ensure that hangers are arranged to accommodate thermal expansion, transient loads and conditions whilst maintaining isolation.

Take particular care to avoid tonal components, whistles, rattles etc. Avoid intrusive noises such as machinery start and stop characteristics. Generally allow VSD or soft starting.

Equipment such as heat exchangers and ventilation units should not be located in the ceiling above any videoconferencing facilities or the surrounding areas. These devices will transfer mechanical vibrations into the space, adding to the overall noise floor. HVAC diffusers, returns, and associated ducts should be designed to allow air to flow through them at minimal velocities and with minimal disruption of the airflow.

20.1.18 Duct Design

Duct systems shall be designed with velocity and pressure drop characteristics that permit full design flow to all points, do not create excess noise, do not contribute to noise bridges between areas and do not adversely affect comfort (e.g. draughts, stagnant areas etc.)

General design parameters:

Type	Velocity [m/s] (max)	Pressure [Pa/m] (max)
Supply Air Duct	8	0.8
Return air duct	5	0.8
Exhaust Ducts	7.5	0.8
Flexible duct	2.5	
Exposed Duct	4.0	0.8

Supply air duct risers may run at higher velocities than set out above.

Return Air Transfer System door grilles shall not be used without the approval of the Deputy Director – Planning and Development. Typically air conditioned rooms and toilets shall be provided with acoustic return air transfer systems sized to limit pressure drop to 10 Pa. Cascaded return air transfer systems shall not be used.

20.1.19 Ductwork

All air handling ductwork design and construction methods shall comply with AS4254 / SMACNA and shall be minimum 500Pa pressure rating Class B, generally with external insulation as per clause 20.2.8.3.

Ductwork materials:

- Within concealed and plant spaces: Galvanised sheet metal
- Externally to buildings: stainless steel (including all fixings etc.)

- Exposed within spaces: fabric duct, spiral wound circular or oval duct, coloured to Estate Directorate, Deputy Director, Planning and Development's direction
- For fume exhaust or in corrosive environments: Stainless steel
- Fibreglass duct is not permitted
- All duct materials, sealants etc. shall meet the requirements of AS1530

20.2 Mechanical Equipment Requirements

JCU owns, operates and maintains all infrastructure services and all academic buildings on and within the campuses. The RPEQ consulting engineer shall take a long term investment and maintenance decision strategy when designing the mechanical systems.

20.2.1 Identification of Equipment

Confirm the plant numbering sequence with JCU Estate Directorate, Deputy Director, Planning and Development prior to Contract Documentation. Prefix equipment with building number (xxx) for Townsville, the Cairns building number is an integral part of the sequence.

All items of equipment shall be suitably identified with Traffolyte labels.

Generally all plant is to be numbered as follows:

- Chilled water entering building temperature sensor "xxx-T-1" Townsville or "T-xxx-1" Cairns
- Chilled water leaving building temperature sensor "xxx-T-2" Townsville or "T-xxx-2" Cairns
- Primary chilled water pumps "PCHWP-1"
- Secondary chilled water pumps "SCHWP-1"
- Tertiary chilled water pumps "xxx-TCHWP-1" Townsville or "TCHWP-xxx-1" Cairns
- Quad chilled water pumps "QCHWP-1"
- Fan coil unit ground floor "xxx-FCU 0-01" Townsville or "FCU-xxx 0-01" Cairns
- Fan coil unit 1st floor "FCU 1-01", "FCU 1-02"
- Fan coil unit 2nd floor "FCU 2-01", "FCU 2-02"
- Air handling unit ground floor "AHU 0-01", "AHU 0-02"
- Air handling unit 1st floor "AHU 1-01", "AHU 1-02"
- Air handling unit 2nd floor "AHU 2-01", "AHU 2-02"
- Multi level AHU for VAV "AHU-1", "AHU-2"
- VAV; AHU number plus VAV number "1-01"
- Preconditioner "PCU-1"
- Exhaust fan "EF-1"
- Toilet exhaust fan "TEF-1"

20.2.2 Air handlers

All air handling equipment should be floor or plant room mounted ducted equipment, readily serviceable without use of special platforms, lifting equipment etc.

All air handling equipment shall be non-cold tracking TB2 thermal rating.

In ceiling air handling equipment will not be allowed.

Air intake should be high up on the building with access for servicing. The exhausts can be at ground level if required

AHU equipment shall be built up sandwich panel or proprietary equipment manufactured by Modutherm, Carrier, GJ Walker or approved equivalent.

Drain trays in all instances shall be stainless steel and full width, depth condensate trays.

Air handling equipment shall be designed to inherently provide enhanced dehumidification at low loads. Refer to 20.1.8.1 for coil requirements.

Fin spacing shall not exceed 472 fins per meter. Water carryover from the cooling coil is not permitted.

In general, coils are to be aluminium fin, copper tube, mechanically bonded construction. Where additional corrosion resistance is required or for particular applications, coils may be copper/copper or stainless steel.

Provide isolation switches on power supply for AHU chilled water valve actuators.

All AHU's serving Animal Facilities, PC2/PC3 laboratories and pre-conditioner plant shall be fitted with UV lamps for coil sterilization e.g. Sterile Aire.

Air handlers and fan coil units shall be sandwich panel construction complying (at minimum) with NCC Section J Insulation and leakage requirements, displaying no cold tracking at supply air temperature of 12 degrees with ambient wet bulb of 28 degrees.

Cabinets shall be of sheet steel (external sheet minimum thickness 1.6mm, internal sheet minimum thickness 1.2mm), reinforced to prevent drumming. Casings shall be painted or powder coated internally and externally.

Where necessary for corrosion resistance or other requirements, casings may be Aluminium or Stainless Steel.

Condensate drainage is to be gravity driven. The use of condensate pumps is not permitted without written acceptance from the Estate Directorate, Deputy Director, Planning and Development.

20.2.3 Tertiary CHW Pumps

Building chilled water pumps shall be provided in Duty and Standby arrangement (n+1), with independent VSDs. VSDs are to be powered at all times (do not remove control power on standby).

Pumps shall be Ajax or Wilo or other manufacturer approved by the Manager, Infrastructure Services.

Pumps shall be non-overloading and deliver required flow over all operating conditions and be free from cavitation. Generally pumps shall be provided with Variable Speed Drives.

VSD and electrical supply components are to be sized to suit full speed operation on full size impellor.

Each new pump set connected to any building / precinct / area shall be provided with Air/dirt separator.

Provide pumps and ancillaries as follows:

- Single stage, in-line or end-suction pumps.
- Casings shall be spheroidal graphite cast iron with integral mounting feet (if appropriate). Bronze impellor, fitted to shaft with Stainless Steel or bronze nut, fine metric threaded.
- Stainless steel (316) shaft, with mechanical long life seals
- Deep groove long life bearings (>100,000 hours). Rear bearings shall be double row, and suitable for all thrust and load conditions.
- Provide suction diffusers or clear straight entry to pump in accordance with manufacturer's recommendations.

- Stainless steel drain tray, drained to condensate waste.
- Couplings suitable for continuous operation, guarded and capable of absorbing operational misalignment
- Pumps subject to high twisting (e.g. DOL) loads shall be provided with concrete filled inertia bases. Provide spring mounts for all pumps
- Pumps shall be vibration isolation mounted with flexible connections to pipe networks on inlet and discharge.

20.2.4 Fans

Ventilation fans shall be of Fantech, Fans Direct or other manufacturer approved by the Manager, Infrastructure Services, and shall be carefully selected to match the system requirements.

- Fans handling moisture laden air or exposed to weather shall be minimum IP55.
- Significant fans (generally fans above 1.1kW or where required for critical applications or control) are to be provided as three phase with VSD, however smaller fans may be three phase VSD if necessary.
- Fans are generally to be located within plant rooms etc. Avoid the installation of fans in ceiling spaces etc. unless specifically approved by the Deputy Director – Planning and Development.

Fan motors of 750Watts and below may be single phase direct drive with manual speed controllers (unless required to be variable speed or three phase to suit other requirements). Larger fans are to be multiple belt drives with adjustable pulleys or Variable Speed Drive.

Where air handlers serve systems with variable air flows, provide Variable Speed drive, Danfoss is the preferred supplier unless approved in writing by the Manager, Infrastructure Services.

20.2.5 Filters

Plant rooms shall be provided with filters at the fresh air entry point. High efficiency filters minimum rating F5 shall protect all air handling equipment. These filters in turn shall be protected by pre-filters rated G4.

HEPA filters shall be carefully specified for the requirements of the space. For these systems ensure sufficient fan capacity and control. Fan assisted HEPA units may be used. As installed DOP testing and certification shall be provided with each HEPA / NEPA install.

Provide Magnehelic gauges to all filters.

Where filters are of a critical nature to the operation or safety of a space (e.g. PC3 etc), provide filter differential pressure switches or air flow measurement and provide alarm function to alert users at the BMS front end and occupants within the building.

20.2.6 Fire Dampers

Fire Dampers shall be fully compliant to NCC, Australian standards (in particular AS1668.1) and the like in all aspects. Fire dampers shall be inspected and certified prior to practical completion.

Ensure that fire dampers are arranged to permit maintenance and inspection.

Fire dampers shall be carefully selected so that they do not adversely affect system air flows, pressure drops or noise levels. Avoid bends hard onto fire dampers.

Duct sections connected to fire dampers shall be carefully constructed to be “drop away” as required

by AS1668. Hangers, services etc. shall not interfere with the dropping away of duct from the fire damper connection

Provide permanent identification to all fire dampers. Where fire dampers are concealed, provide visible labelling to indicate their location. Ensure all installation, test and inspection records are provided to JCU Project Manager within 1 week of test.

20.2.7 Water Treatment

Pre-cleaning shall be provided on all pipe systems, and only after successful pressure testing which has been signed off by JCU's Commissioning Representative for witnessing purposes of building pipework before the building system can be opened to the sitewide CDC system.

Circulate non-foaming alkaline detergent solution for minimum 2 hours before removing this solution and flushing. The corrosion inhibitor dosage shall limit the corrosion to less than 3 mils per year (0.0762 mm) for steel and 1 mil per year (0.0254 mm) for copper.

Ensure all chemical treatments are suitable for use with those chemicals used in the CDC loop and have no detrimental effect on systems. Recommendations are to be submitted to the Manager, Infrastructure Services for approval, during DD to ensure alignment with the products used by the incumbent maintenance contractor.

20.2.8 Chilled Water Pipework

Where headers are provided, provide at least one spare pair of take offs for future use complete with isolation valves. Provide valves bypass line to avoid "dead-legs".

Provide full galvanic separation between dissimilar metals.

OPTIVENT OVA-D air-dirt separators are to be provided to every new system installed. These are to be fully accessible for servicing, identified/numbered and valved for service isolation by providing a bypass line and valving arrangement to allow the unit to be taken out of circulation without impacting the entire system.

20.2.8.1 Pipe Materials – Above Ground

Chilled water pipework above ground and/or within buildings shall be AS1432 Type B Copper and shall be phosphorus de-oxidised non-arsenical copper.

Larger diameter pipe shall be stainless steel, spiral butt welded from minimum 2mm thick, grade 316 stainless steel sheet. Provide TIG full butt weld joints. Passivate weld areas following welding stainless steel pipe

20.2.8.2 Pipe Materials – Below Ground

Chilled water pipework below ground shall be HDPE or MDPE PE100 PN10 generally uninsulated and buried at 1200 fill and embedded in sand. Where thermal losses are considered an issue (shallow depth or creek crossing) pre-insulated system such as Insapipe (TM) is required.

20.2.8.3 Pipe Insulation

Provide insulation blocks of high density polyurethane foam at all hangers, except for pipes up to 25mm diameter where zinc annealed saddles may be used. For pipes larger than 25mm two rolled half sections of 1.2mm zincanneal shall be installed at the hanger to avoid damage to the phenol foam block. Where necessary to prevent crushing, provide extended saddle sections to support the pipe.

Compartmentalise insulation every 5m or at insulation blocks and adjacent to fittings and take-offs to prevent longitudinal moisture transfer along the pipe. Insulation shall be sealed to the pipes at these points.

Pipework from floor level to 2,100 mm above floor in plantrooms shall be metal sheathed, with

colourbond or painted steel sheathing.

Where exposed to view, and where exposed to weather or the possibility of physical damage, all pipes shall be sheathed.

Valves and strainers adjacent to fan coil units, air handlers, pumps are not be insulated but provided with drained insulated stainless steel safety tray. The condensate tray shall be insulated with minimum 25mm Thermobreak applied to the base and sides.

Arrange for all such valves to be installed in the horizontal.

Insulation for other valves, flanges and fittings shall be arranged for easy removal for maintenance purposes, and shall have hinged and clipped (not screw fixed) casings. Pack penetrations for valve spindles etc. with white petroleum grease to provide a continuous vapour barrier.

20.2.8.4 Pipe Pits

Underground pipe transitions from one material to another, connections to CDC etc. shall be made within formed concrete pits with Gatic pit lids. Pits shall be drained and arranged to be fully accessible for service work on valves etc.

All bolts washers and fittings in pits shall be stainless steel. Thrust or mounting brackets shall be stainless steel or fully hot dip galvanised.

20.2.8.5 Valves: Balancing Valves

Option 1: Control valves for air handlers are generally pressure independent flow regulating self-balancing valves equal to Belimo PICCV or T&A Autoflow. Provide double regulating valves at each major branch take-off or take off to each floor, building etc., to allow balancing and measurement of respective branches equal to Tour and Andersson Sta-d / Sta-f type valves.

Option 2: Each AHU shall have double regulating valves equal to Tour and Andersson Sta-d / Sta-f type valves. If this option is adopted, the building CDC pipe connection shall have a pressure independent flow regulating device to ensure the building does not receive more flow than the design value at any time of the year.

20.2.8.6 Valves: Isolation Valves

Provide isolation valves to all air handling plant to enable service work / replacement of control valves, coils and the like.

Provide isolation valves at each major branch take-off, or take off to each floor etc. Provide isolation valves at each duty/standby piece of equipment to allow servicing etc.

Provide isolation valves at the CDC connection point.

Provide blanked isolation valves (150mm diameter) at suitable location adjacent the building chilled water connection point to allow connection of JCU's portable chiller.

Up to 50mm: Ball valve, Screwed BSP Bronze body, Stainless steel ball and stem

Over 50mm: Butterfly Valve (Gear type over 80mm), Lugged body to Table E

20.2.8.7 Binder points

Provide binder test/measurement points across all operating elements of plant, including but not limited to:

- Each air handler cooling coil
- Every pump

- Any strainers or filters in the system
- Flow meters
- Adjacent any BMS sensing point (Pressure, temperature, sensing etc.) to allow calibration and verification
- CDC connection point
- Temporary chiller connection point

20.2.8.8 Sensor Wells

For Townsville campus Sigma controls are to be provided with Telescopic STP660 type temperature sensors for chilled water; sensor wells to be fitted 30° below horizontal (120° from vertical). For Cairns Campus, pipe sensors shall be thermowell with thermal contact with the bottom e.g. Invensys well-mounted temperature sensors TS-5721-853. Energy Calculator wells may be fitted in the vertical position

20.2.8.9 Air Venting

Provide an Automatic air bleed at the top of each vertical riser and at all high points within the system. The automatic air bleed shall be fitted with an isolation valve and a permanent connection to a drain point complete with a section of clear hose. These shall be in easily accessible locations such as plantrooms, to allow for servicing and maintenance.

20.2.9 Condensate Pipework

Provide insulated PVC condensate drains to all air handling equipment, pumps etc. The minimum pipe diameter is to be 32mm. Insulation shall be minimum 19mm wall thickness Thermobreak, or thicker as required to prevent condensation forming.

The insulation shall be carried vapour tight to within the air handler casing.

Provide a removable section of clear PVC pipe to inspect and service the drain

Safetrays are to be separately drained.

Condensate is to discharge to an approved tundish. Provide sufficient height to the unit to ensure satisfactory operation of the trap. Traps shall

20.2.10 Duct Insulation

External insulation shall be Thermobreak, securely glued to the clean external surface of the duct. Where necessary apply multiple layers. Each layer shall be vapour taped and sealed fully.

Only where permitted by the Estate Directorate, Deputy Director, Planning and Development, external Bradford duct blanket may be used in lieu of Thermobreak. The duct-blanket shall meet or exceed all thermal property requirements, installed strictly to the Manufacturer's requirement.

Where required for acoustic purposes, insulation shall be evaluated for the required performance. The mechanical engineer is required to undertake simple acoustic selection, however where an acoustic engineer is appointed, refer to the acoustic engineer for guidance.

Internal insulation should not be used to prevent mould growth in impossible to access/clean areas.

20.2.11 Exhaust Systems

Ventilation systems shall be suitable for the duty required. In particular, exhausts likely to handle contaminated air, moist air etc. shall be specifically suitable. For moisture laden air or where

condensation may occur within the duct, duct should be fully waterproof and appropriately drained. Install removable drain to allow service and inspection.

All exhaust stacks shall be fully drained with removable section to facilitate cleaning etc. They shall have a large diameter access i.e. 100-150mm to allow for the easy removal of debris and dirt at the lowest point of the vertical stack to the roof.

Exhausts shall be arranged to avoid adverse effects on intakes, other buildings, surfaces etc. For example, ensure kitchen exhausts are arranged so as not to cause excessive deposits of grease etc. on roofs.

Exhaust ductwork, fans and the like shall be concealed from view as practically possible. Fans from specialist exhaust systems (i.e. fume cupboards) shall be located in a separated ventilated plant room and not on the roof. Plant room shall have a roof and walls with adequate access for servicing.

Kitchen exhaust shall be fully compliant to codes and regulations. Ensure kitchen exhaust systems in excess of 1000l/s are provided with user VSD control to NCC section J.

Kitchen exhaust hoods shall be 316 stainless steel.

Honeycomb (similar to Email GW) filters shall be provided with a full set of spares to allow cyclic cleaning.

High efficiency, low air volume hoods of self-cleaning type shall be Stoddart or similar.

Provide access panels to AS1668 for full cleaning access. Where discharges can admit water / weather, ensure that waterproof duct construction with accessible drain is provided.

An independent laboratory exhaust is typically to be provided with intakes in each laboratory, independent of the building / laboratory room ventilation. Generally this system shall be 100mm PVC minimum diameter, terminated in PVC ball valves and stubs at accessible locations

20.2.12 Fume Cupboards / Systems

Fume cupboards shall be of Lab Systems or equal manufacture.

Recirculating fume cupboards are not the preferred solution and can only be used with the approval of the Deputy Director – Planning and Development.

The fume cupboards shall be either constructed from unplasticised UPVC or corrosion resistant Fibreglass (GRP) to AS1530 Part 3, depending on the client requirements. Provide infill panels above each fume cupboard to the ceiling line and cove the floor up the base to a minimum of 25mm.

Investigate the possibility of using energy saving automatic sash closing systems in all multiple fume cupboard set ups.

20.2.13 Flammable Materials Storage Cabinets

Pratt Safety systems are preferred.

20.2.14 Laboratory & Piped Services

Gases Store Broen products are preferred.

Terminations / Taps Manufacturers: Broen, Enware or Galvin Engineering (confirm user requirements)

Compressed Air Preferred Manufacture: Atlas Copco

Vacuum Pumps / Plant Preferred manufacture: Dynavac or Nash.

Piped Services isolation shall be provided at

- all infrastructure connection points (e.g. main lines, main branches, plant),

- at the bottom (or top for top fed) of risers
- At each floor take-off
- At each major branch junction (example > 10 connected points)