

# ***Summary File ONLY***

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**IT IS BROWSABLE ON-SCREEN ONLY AND IS PROVIDED  
FOR YOUR INFORMATION TO DECIDE WHETHER TO  
BECOME A PROSPECTIVE TENDERER ONLY**

Note: This file may contain a brief scope statement, or an extract from the RFT documents, or a full exhibited copy – depending on the specific circumstances.

To participate in this tender process you **MUST** first download or order a full copy of the Request for Tender (RFT) documents, including the responsible components, and any addenda issued to date.

To do this return to the RFT web page on this web site and copy the RFT documents to your own computer or network – the blue “**DOWNLOAD A SOFT COPY**” link at the bottom provides access to the page from which you can do this.

# **Tender Document**

**for**

## **Broken Hill Government Office Block Air Conditioning Upgrade**

**Contract No: 800327**

**March 2008**

**Department of Commerce**

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# TENDERING



# CONDITIONS OF TENDERING

[THERE ARE 8 PAGES IN THIS SECTION](#)

This section includes notices to tenderers.

The Conditions of Tendering section does not form part of the Contract.

## 1 GENERAL

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### 1.1 CONTACT PERSON

Refer requests for information about the Tender to:

Name: Jacek Wocial

Telephone number: (02) 9372 8118

Facsimile number: (02) 9372 8144

E-mail address: [jacek.wocial@commerce.nsw.gov.au](mailto:jacek.wocial@commerce.nsw.gov.au)

### 1.2 NSW GOVERNMENT CODE OF PRACTICE FOR PROCUREMENT

Tenderers must comply with the NSW Government *Code of Practice for Procurement*, which is available at:

[www.treasury.nsw.gov.au/procurement/cpfp\\_ig](http://www.treasury.nsw.gov.au/procurement/cpfp_ig)

Lodgement of a tender is evidence of the Tenderer's agreement to comply with the Code for the duration of any contract awarded as a result of the tender process. If a tenderer fails to comply with the Code, the Principal may take the failure into account when considering this or any subsequent tender from the tenderer, and may pass over such the tender.

## 2 TENDERER ELIGIBILITY

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### 2.1 ACCEPTABLE LEGAL ENTITIES

The Principal contracts only with recognised and acceptable legal entities. The Principal does not contract with firms under any form of external administration. Any tender submitted by an unincorporated business such as a sole trader, partnership, or business name must identify the legal entity that proposes to enter the contract.

If the Tenderer is a trustee, the Principal may require:

- an unconditional undertaking in accordance with Preliminaries Clause - **Additional security and obligations for trustees**; and
- a signed statement from the Tenderer, provided before the Contract is awarded, making the following undertaking:

‘If (insert the legal name of the Tenderer) is awarded Contract No (insert the contract number) for (insert the contract description) it will provide security in the amount of (insert the amount of security advised by the Principal) in accordance with Preliminaries clause - **Additional security and obligations for trustees**, and it undertakes to ensure that, for the duration of the Contract, the total value of the trust beneficiaries' loans to the trustee is always greater than the total value of trust beneficiaries' loans from the trustee.’

Failure to provide the signed statement may result in the Tender being passed over.

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*Broken Hill Government Office Block - Air Conditioning Upgrade*



## 2.2 QUALITY MANAGEMENT

The Principal may elect to pass over a tender from a tenderer that does not demonstrate the capacity to systematically plan and manage the quality of its work in accordance with the NSW Government *Quality Management Systems Guidelines*, which are available at:

[www.managingprocurement.commerce.nsw.gov.au/system/index\\_procurement\\_guideline\\_documents.doc](http://www.managingprocurement.commerce.nsw.gov.au/system/index_procurement_guideline_documents.doc)

Submit with the Tender the information identified in Tender Schedules - **Schedule of Quality Management Information.**

## 2.3 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

Tenderers must demonstrate their capacity to manage occupational health and safety in accordance with the NSW Government *Occupational Health and Safety Management Systems Guidelines 4<sup>th</sup> Edition (OHSM Guidelines)*. The *OHSM Guidelines* are available at:

[www.managingprocurement.commerce.nsw.gov.au/system/index\\_procurement\\_guideline\\_documents.doc](http://www.managingprocurement.commerce.nsw.gov.au/system/index_procurement_guideline_documents.doc)

Submit with the Tender the information identified in Tender Schedules - **Schedule of Occupational Health and Safety Management Information.**

## 2.4 ENVIRONMENTAL MANAGEMENT

Tenderers must demonstrate their capacity to manage environmental matters in accordance with the NSW Government *Environmental Management Systems Guidelines (EMS Guidelines)* available at:

[www.managingprocurement.commerce.nsw.gov.au/system/index\\_procurement\\_guideline\\_documents.doc](http://www.managingprocurement.commerce.nsw.gov.au/system/index_procurement_guideline_documents.doc)

Submit the information identified in Tender Schedules - **Schedule of Environmental Management Information.**

## 2.5 FINANCIAL ASSESSMENT CRITERIA

The main criteria considered in financial assessment of tenderers are:

- Net Worth (total assets, excluding any assets of company directors, less total liabilities less intangible assets);
- Current Ratio (ratio of current assets to current liabilities); and
- Working Capital (current assets less current liabilities).

The Principal considers tenders with the following financial capacity, and no other significant detrimental financial characteristics to be financially satisfactory in respect of tenders:

- Net Worth exceeds 5% of the Contract Sum or initial Contract Price;
- Current Ratio exceeds 1; and
- Working Capital exceeds 10% of the Contract Sum or initial Contract Price.
- Where a tenderer is a trustee the total value of trust beneficiaries' loans to the trustee must be greater than the total value of trust beneficiaries' loans from the trustee.

Deviations below these indicative criteria will not necessarily prevent the Principal from considering any tender.

### 3 CONTRACT DETAILS

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#### 3.1 INSURANCE

##### Works and public liability insurance

The Contractor must arrange insurance of the Works (and any temporary works) and public liability and pay all premiums in accordance with General Conditions of Contract clause **Insurance**.

##### Asbestos liability insurance

The Contractor must arrange any asbestos related insurance required by law. Any other asbestos related insurance is at the discretion of the Contractor. The Contractor is not entitled to any additional payments for asbestos related insurance. The Principal does not require the Contractor to hold any particular Asbestos Liability Insurance under General Conditions of Contract clause **Insurance**.

##### Other Insurance

The Contractor must arrange and pay all premiums for all other insurance required under General Conditions of Contract clause – **Insurance**.

For professional indemnity insurance, a Certificate of Currency or evidence of the ability to obtain the required insurance, such as a letter from a broker or insurer, may be required as a condition of acceptance of tender.

### 4 CURRENT POLICIES

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#### 4.1 GOODS AND SERVICES TAX

The tendered lump sum and/or rates must include GST if it is payable.

#### 4.2 NSW GOVERNMENT PREFERENCE SCHEME

##### Preference

The Principal will give a preference advantage to goods of Australian and New Zealand origin over imported goods supplied under the Contract. NSW country manufacturers may be eligible for an additional preference under the Country Industries Preference Scheme (CIPS). Details of these schemes may be obtained from the Department of State and Regional Development, telephone (02) 9338-6780; facsimile (02) 9338-6676.

The Industry Capability Network Office has been established to provide assistance in planning for, purchasing and using Australian and New Zealand made products. The office can provide professional advice on local industry capability and on the availability and efficiency of local supplies suited to Australian conditions, while retaining commercial confidentiality. The Industry Capability Network Office may be contacted on: telephone (02) 9819 7200; facsimile (02) 9181 3321; e-mail [enquiry@icnsw.org.au](mailto:enquiry@icnsw.org.au); internet [www.icnsw.org.au](http://www.icnsw.org.au).

##### Imported Goods

Where imported goods are proposed, complete the Tender Schedules - **Schedule of Imported Materials and Equipment**. Provide details of alternatives to such goods which are of Australian or New Zealand origin, or give reasons why such alternatives cannot be supplied by completing the Tender Schedules - **Schedule of Alternatives to Imported Goods**.

The Principal may, but is not bound to, negotiate a reduction in price to accept the imported goods, but the reduction will be not less than 20% of the Principal's estimate of the imported value of the goods.

Refer to Preliminaries clause - **Australian and New Zealand Goods**.

### **NSW Country Manufactured Goods**

If the tenderer wishes to seek preference under the NSW Country Industries Preference Scheme, submit Tender Schedules – **Schedule of NSW country manufactured goods** with the tender.

## **4.3 DISCLOSURE OF TENDER AND CONTRACT INFORMATION**

Details of this tender and contract awarded as a result of this tender process must be disclosed in accordance with the *Freedom of Information Act 1989* (NSW), Premier's Memorandum 2007-01 and the NSW Government Tendering Guidelines which are available at:

[www.managingprocurement.commerce.nsw.gov.au/system/index\\_procurement\\_guideline\\_documents.doc](http://www.managingprocurement.commerce.nsw.gov.au/system/index_procurement_guideline_documents.doc)

## **4.4 EXCHANGE OF INFORMATION BETWEEN GOVERNMENT AGENCIES**

By submitting a tender, the Tenderer authorises the Principal to gather, monitor, assess, and communicate to other NSW Government agencies or local government authorities information about the Tenderer's financial position and its performance in respect of any contract awarded as a result of the tender process. Such information may be used by those agencies or authorities in considering whether to offer the Tenderer future opportunities for work.

## **4.5 FINANCIAL ASSESSMENT**

By tendering for this Contract, the Tenderer agrees that the Principal may engage private sector consultants to financially assess tenderers. Financial details of tenderers may be obtained by an external Financial Assessor for assessment. Financial Assessors have a contract with the Principal to safeguard the financial details obtained. Financial Assessors must not disclose such details, either in whole or in part to any party other than NSW Government departments or agencies without the express written permission of the tenderer.

The Financial Assessor is Kingsway Financial Assessments Pty Ltd

Submit, when requested by the Financial Assessor or Principal, the Financial Assessment information shown in Tender Schedules - **Schedule of Financial Assessment Information**.

## **4.6 UNCONDITIONAL UNDERTAKINGS - APPROVED INSTITUTIONS**

For the purpose of giving unconditional undertakings, the Principal has approved banks, building societies, credit unions and insurance companies listed by the Australian Prudential Regulation Authority (APRA) as being regulated by the APRA. Lists appear at the APRA website at:

[www.apra.gov.au/](http://www.apra.gov.au/)

The Principal is prepared to consider proposals from tenderers for the approval of Unconditional Undertakings by substantial financial institutions, not registered by APRA, which lawfully carry on business in Australia. The Principal may require the submission of evidence demonstrating the substance and status of any proposed financial institution without cost to the Principal.

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## **5 FURTHER INFORMATION**

### **5.1 ADDENDA TO TENDER DOCUMENTS**

If, as a result of a request for clarification from a tenderer or for any other reason, the Principal issues an instruction amending the tender documents, the instruction will be issued in writing

to all tenderers in the form of an Addendum, which becomes part of the tender documents. Written Addenda issued by the Principal are the only recognised explanations of, or amendments to, the tender documents.

## 5.2 SITE ACCESS RESTRICTIONS

Tenderers and their agents or representatives must:

- obtain permission to inspect the Site from the Client's Representative at least 48 hours before access to the Site is required;
- upon arrival, at the pre-arranged time, introduce themselves at the Client Representative's office prior to undertaking their inspection of the Site.

The Client's Representative's details are:

Name:	Jenny Kappe
Telephone number:	0418 644 609
Facsimile Number:	(08) 8087 1201
e-mail address:	<a href="mailto:jenny.kappe@fived.com.au">jenny.kappe@fived.com.au</a>

The Client's Representative may be contacted:

on the following days:	Monday to Friday
between the hours of:	8.30 am to 12.00 pm

Tenderers should telephone the Contact Person if they experience difficulty in securing an appointment with the Client's Representative for a site inspection.

## 6 PREPARATION OF TENDERS

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### 6.1 ALTERNATIVE TENDERS

Submit a conforming tender, in full compliance with the work as specified without any conditions or qualifications attached. Alternative tenders will not be considered.

## 7 SUBMISSION OF TENDERS

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### 7.1 DOCUMENTS TO BE SUBMITTED

The following documents must be completed and submitted by the Tenderer:

- Tender Form
- All schedules marked "Submit with Tender Form"

Where applicable, refer to each Addendum and state that the Tender allows for the instructions given in the Addendum.

### 7.2 SUBMISSION PROCEDURE

Submit the Tender Form, Tender Schedules marked 'Submit with the Tender Form' and other required documents or information by the date and time given in the advertisement or invitation, by any of the following methods:

- eTendering Web site,

- Tender Box,
- Facsimile.

If more than one tender submission is made, mark each submission clearly as to whether it is a copy, an alternative tender, or whether the submission supersedes another submission.

Submit when requested, by the date, time and method stipulated in the request, Tender Schedules marked 'Submit when requested' and any other information required to allow further consideration of the Tender. Failure to meet this requirement may result in the Tender being passed over.

### 7.3 ETENDERING

Tenderers are encouraged to obtain Requests for Tenders (RFT) and submit tenders through NSW Government online eTendering at:

<https://tenders.nsw.gov.au/commerce>

#### Legal status

Tenders submitted electronically will be treated in accordance with the *Electronic Transactions Act 2000* (NSW), and given no lesser level of confidentiality, probity and attention than tenders submitted by other means.

Tenderers, by electronically submitting a tender, are taken to have accepted any conditions shown on the NSW Government eTendering web site.

The Principal may decline to consider for acceptance, tenders that cannot be effectively evaluated because they are incomplete or corrupt.

#### Electronic Format for Submissions

Tenders submitted electronically must be in a file format that can be read, formatted, displayed and printed by Microsoft Word 97, or any format required by the RFT.

#### File Compression

Tenderers may compress electronic tenders in any format that can be decompressed by WinZip. Tenderers must not submit self-extracting (\*.exe) zip files.

#### Change of Tender Form Text

Tenderers must not change existing text in electronic tender forms other than to insert required information.

### 7.4 TENDER BOX

The Tender may be submitted in the Tender Box at:

Level 3, McKell Building  
2-24 Rawson Place  
SYDNEY NSW 2000

Submit the Tender in a sealed envelope addressed to the Secretary of the Tender Opening Committee and marked with 'Tender for Broken Hill Government Office Block – Air Conditioning Upgrade' and the closing date and time.

### 7.5 FACSIMILE

The Tender may be submitted to the following facsimile number:

(02) 9372 8974

Address the Tender to the Secretary of the Tender Opening Committee and mark the first page of the facsimile with 'Tender for Broken Hill Government Office Block – Air Conditioning Upgrade' and the closing date and time.

Tenders sent by facsimile and not completely received by the close of tenders may be excluded from consideration for acceptance even if transmission or receipt is delayed due to the receiving facsimile machine being engaged, faulty or otherwise inoperative.

## 7.6 LATE TENDERS

In accordance with the NSW Government *Code of Practice for Procurement*, available at:

[www.treasury.nsw.gov.au/procurement/cpfp\\_ig](http://www.treasury.nsw.gov.au/procurement/cpfp_ig)

late tenders will not be accepted, except where the integrity and competitiveness of the tendering process will not be compromised.

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## 8 PROCEDURES AFTER CLOSING OF TENDERS

### 8.1 EVALUATION OF TENDERS

In evaluating tenders, the Principal may take into consideration factors including, but not limited to: whole of life costs; ability to meet requirements of the NSW Government *Code of Practice for Procurement*; innovation; delivery time; quality offered; previous performance; experience; capability; occupational health and safety performance; industrial relations performance; environmental management performance; community relations; value adding including economic, social and environmental initiatives; and conformity.

In addition to prices tendered, the Principal will take into consideration the tenderer's experience:

#### **Tenderer's Experience**

Tenderers must demonstrate that they have the knowledge, experience and capacity to successfully complete the work. Tenderers must have completed projects within the last 3 years, which meet the following criteria.

1. At least 3 air conditioning projects with a contract value greater than \$250,000.
2. At least one project involving the provision and commissioning of a chiller.

Provide details of experience on the tender schedules.

The Principal may treat any detail required by the tender documents which is omitted, illegible or unintelligible as failing to fulfil the relevant requirement.

### 8.2 ACCEPTANCE OF TENDER

The Principal may accept tenders that do not conform strictly with all requirements of the tender documents.

The Principal is not bound to accept the lowest or any tender. Tenders which do not comply with any requirement of, or which contain conditions or qualifications not required or allowed by, the tender document may be passed over.

No tender, or qualification or departure from a contract condition or specification, is accepted unless the Principal gives an acceptance or formal agreement in writing.

### **8.3 PROTECTION OF PRIVACY**

The Tenderer warrants, in respect of any personal information provided in this Tender or any contract arising from this Tender, that the information is accurate, up to date and complete, and that nominated individuals authorise its collection and are aware:

- that the information is being collected for the purpose of evaluating tenders and administering any contracts arising from those tenders and may be made available to other NSW government agencies or local government authorities for those purposes;
- whether the supply of the information by the individual is required by law or is voluntary, and any consequences for the individual if the information (or any part of it) is not provided; and
- of the existence of any right of access to, and correction of, the information.

**END OF SECTION – CONDITIONS OF TENDERING**

## TENDER SCHEDULES



**1 TENDER FORM**

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Location

Tender Closing Office: McKell Building , Sydney, NSW

Name of Tenderer  
(in block letters): .....

A.B.N.

(if applicable): .....

Address: .....

Telephone number: .....

Facsimile number: .....

e-mail address: .....

hereby tender(s) to perform the work for

**BROKEN HILL GOVERNMENT OFFICE BLOCK****AIR CONDITIONING UPGRADE**

(Contract No. 0000000)

in accordance with the following documents:

TENDER DOCUMENT VOL. 1 SPECIFICATION

TENDER DOCUMENT VOL. 2 DRAWINGS

and Addenda Numbers: .....

At the (GST inclusive) rates and lump sums in the attached Schedules  
of Rates and Lump Sum Items as follows:

- Schedule 2
- Schedule 3
- Schedule 4
- Schedule 5

Optional Works:

- Schedule 6
- Schedule 7

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

## 2 SCHEDULE OF LUMP SUM ITEMS

(SUBMIT WITH TENDER FORM)

Complete this Schedule by inserting the tendered lump sum for the items of work under **Amount**.

**The lump sums tendered shall form part of the Contract.**

**All lump sums must include GST.**

Item No.	Description	Lump Sum Amount
1	All work and obligations under the Contract NOT INCLUDED ELSEWHERE in this Schedule.	\$.....
2	Decommission and removal of the redundant equipment.	\$.....
3	Provision of a chiller with a remote, air cooled condenser.	\$.....
4.	Provision of a new chilled water coil.	\$.....
5.	Provision of a new chilled water pump and pipework.	\$.....
6.	Provision of a new outside air intake and motorised damper.	\$.....
7	Modification to the existing ductwork including new VAV boxes.	\$.....
8.	Provision of variable speed drives to existing supply air and return fans.	\$.....
9.	Upgrade of existing BMCS.	\$.....
10.	Balancing, Testing and Commissioning.	\$.....
11.	Electrical work.	\$.....
12.	Building work.	\$.....
13.	Programmed preventive maintenance of all existing mechanical services during the construction period and for all reused mechanical service during the defects liability period, from possession of site until completion of DLP, including labour and materials.	\$.....
14.	12 months comprehensive maintenance of all new equipment and controls (includes preventive and breakdown maintenance) concurrent with 12 months defect liability period.	\$.....
<b>Total of Lump Sum Items (Items 1 to 14)</b>		<b>\$.....</b>

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

### 3 SCHEDULE OF LUMP SUM ITEMS - PROGRAMMED PREVENTIVE MAINTENANCE (FOR FIRST AND SECOND YEARS AFTER DEFECT LIABILITY PERIOD)

(SUBMIT WITH TENDER FORM)

The contract includes ongoing maintenance after completion the Defects Liability Period. The rates will be used for progress payments.

Complete this Schedule by inserting the tendered rates. Insert under **Amount** the amount arrived at by multiplying the tendered rate by the quantity.

**The lump sums tendered shall form part of the Contract.**

**All rates must include GST.**

Description	Quantity (Per Year)	Rate	Amount
FIRST YEAR (after contract defects liability period)			
Monthly Service	8	\$	\$
3-Monthly Service	2	\$	\$
6-Monthly Service	2	\$	\$
FIRST YEAR (after contract defects liability period)		SUB-TOTAL	\$
SECOND YEAR (after contract defects liability period)			
Monthly Service	8	\$	\$
3-Monthly Service	2	\$	\$
6-Monthly Service	2	\$	\$
SECOND YEAR (after contract defects liability period)		SUB-TOTAL	\$
<b>TOTAL LUMP SUM AMOUNT</b> (for first and second years after defects liability period)			\$

Preventive maintenance rates are to include all labour costs, lubricants, chemicals and all materials used in the routine preventive maintenance.

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

#### 4 SCHEDULE OF RATES - BREAKDOWN MAINTENANCE OF EXISTING MECHANICAL SERVICES DURING CONSTRUCTION PERIOD AND REUSED SERVICES DURING DEFECTS LIABILITY PERIOD

(SUBMIT WITH TENDER FORM)

The following rates will be used for breakdown call outs and repairs for existing plant only during the construction period.

Complete this Schedule by inserting the tendered rates.

**The rates tendered shall form part of the Contract.**

**All rates must include GST.**

Item	Description	Rate
Call out during normal working hours		
1.	On-site labour charge for breakdown call-out service (including travelling time, all travelling costs and setup charges) and first hour on site	\$..... per call-out
2	Additional hours	\$..... per hour
Call out outside normal working hours (after hours, public holidays, weekends)		
3.	On-site labour charge for breakdown call-out service (including travelling time, all travelling costs and setup charges) and first hour on site	\$..... per call-out
4	Additional hours	\$..... per hour

Note: Normal hours are Monday to Friday, from 7 am to 5 pm.

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

## 5 SCHEDULE OF RATES - BREAKDOWN MAINTENANCE (FOR FIRST AND SECOND YEARS AFTER DEFECT LIABILITY PERIOD)

(SUBMIT WITH TENDER FORM)

The following rates will be used for breakdown repairs.

Complete this Schedule by inserting the tendered rates.

**The rates tendered shall form part of the Contract.**

**All rates must include GST.**

FIRST YEAR (after contract defects liability period)		
Item	Description	Rate
Call out during normal working hours		
1.	On-site labour charge for breakdown call-out service (including travelling time, all travelling costs and setup charges) and first hour on site	\$..... per call-out
2	Additional hours	\$..... per hour
Call out outside normal working hours (after hours, public holidays, weekends)		
3.	On-site labour charge for breakdown call-out service (including travelling time, all travelling costs and setup charges) and first hour on site	\$..... per call-out
4	Additional hours	\$..... per hour
SECOND YEAR (after contract defects liability period)		
Call out during normal working hours		
5	On-site labour charge for breakdown call-out service (including travelling time, all travelling costs and setup charges) and first hour on site	\$..... per call-out
6	Additional hours	\$..... per hour
Call out outside normal working hours (after hours, public holidays, weekends)		
7	On-site labour charge for breakdown call-out service (including travelling time, all travelling costs and setup charges) and first hour on site	\$..... per call-out
8	Additional hours	\$..... per hour

Note: Normal hours are Monday to Friday, from 7am to 5pm

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

## 6 SCHEDULE OF LUMP SUM ITEMS – OPTIONAL PROGRAMMED PREVENTIVE MAINTENANCE (FOR THIRD AND FOURTH YEARS AFTER DEFECT LIABILITY PERIOD)

(SUBMIT WITH TENDER FORM)

The contract includes the option to extend maintenance for the third and fourth years after completion of the Defects Liability Period.

Complete this Schedule by inserting the tendered rates. Insert under **Amount** the amount arrived at by multiplying the tendered rate by the quantity.

**The lump sums tendered shall form part of the Contract if the option is accepted.**

**All rates must include GST.**

Description	Quantity (Per Year)	Rate	Amount
OPTIONAL THIRD YEAR (after contract defects liability period)			
Monthly Service	8	\$	\$
3-Monthly Service	2	\$	\$
6-Monthly Service	2	\$	\$
OPTIONAL THIRD YEAR (after contract defects liability period)		SUB TOTAL	\$
OPTIONAL FOURTH YEAR (after contract defects liability period)			
Monthly Service	8	\$	\$
3-Monthly Service	2	\$	\$
6-Monthly Service	2	\$	\$
OPTIONAL FOURTH YEAR (after contract defects liability period)		SUB TOTAL	\$
TOTAL (for third and fourth years after defects liability period)			\$

Note: "Optional" means the State Property Authority or its agent may or may not extend the maintenance contract for the third or fourth year after the defect liability period. If the Authority decides to extend the maintenance contract, these rates will be applied.

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

## 7 SCHEDULE OF RATES - OPTIONAL BREAKDOWN MAINTENANCE (FOR THIRD AND FORTH YEARS AFTER DEFECT LIABILITY PERIOD)

(SUBMIT WITH TENDER FORM)

The contract includes the option to extend maintenance for the third and forth years after completion of the Defects Liability Period.

Complete this Schedule by inserting the tendered rates.

**The rates tendered shall form part of the Contract if the option is accepted.**

**All rates must include GST.**

THIRD YEAR (after contract defects liability period)		
Item	Description	Rate
Call out during normal working hours		
1.	On-site labour charge for breakdown call-out service (including travelling time, all travelling costs and setup charges) and first hour on site	\$..... per call-out
2	Additional hours	\$..... per hour
Call out outside normal working hours (after hours, public holidays, weekends)		
3.	On-site labour charge for breakdown call-out service (including travelling time, all travelling costs and setup charges) and first hour on site	\$..... per call-out
4	Additional hours	\$..... per hour
FOURTH YEAR (after contract defects liability period)		
Call out during normal working hours		
5	On-site labour charge for breakdown call-out service (including travelling time, all travelling costs and setup charges) and first hour on site	\$..... per call-out
6	Additional hours	\$..... per hour
Call out outside normal working hours (after hours, public holidays, weekends)		
7	On-site labour charge for breakdown call-out service (including travelling time, all travelling costs and setup charges) and first hour on site	\$..... per call-out
8	Additional hours	\$..... per hour

Notes:

1. Normal hours are Monday to Friday, from 7 am to 5 pm.
2. "Optional" means the State Property Authority or its agent may or may not extend the maintenance contract for the third or fourth year after the defect liability period. If the Authority decides to extend the maintenance contract, these rates will be applied.

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

## 8 SCHEDULE OF IMPORTED MATERIALS AND EQUIPMENT

(SUBMIT WITH TENDER FORM)

Provide brief details of all imported materials and equipment to be supplied or incorporated into the Works, and country of manufacture or origin. Do not include goods manufactured in New Zealand.

The value of the imported content must be the estimated duty paid value inclusive of the value of any services (eg. overseas freight and insurance, software in computer tenders, consultancy or engineering fees) or any charges of overseas origin, together with customs clearing charges.

This is not a Schedule of Rates within the meaning of the Construction Contract Conditions. See also Preliminaries Clause - **Australian and New Zealand goods**.

Description	Country of Origin	Value A\$
.....	.....	\$ .....
.....	.....	\$ .....
.....	.....	\$ .....
.....	.....	\$ .....
.....	.....	\$ .....
.....	.....	\$ .....
.....	.....	\$ .....

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....



## 9 SCHEDULE OF ALTERNATIVES TO IMPORTED GOODS

(SUBMIT WITH TENDER FORM)

Provide brief details of materials and equipment of Australian and/or New Zealand manufacture as alternatives to imported materials and equipment as listed in the SCHEDULE OF IMPORTED MATERIALS AND EQUIPMENT, or give reasons why such alternatives cannot be provided.

The Principal may accept a tender specifying all or any of the items listed below, with an adjustment to the contract price based on the difference between the prices listed in this Schedule and the SCHEDULE OF IMPORTED MATERIALS AND EQUIPMENT.

Description of Australian and/or New Zealand manufactured Alternatives	Value A\$
.....	\$ .....
.....	\$ .....
.....	\$ .....
.....	\$ .....
.....	\$ .....
.....	\$ .....
.....	\$ .....
.....	\$ .....

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

**10 SCHEDULE OF NSW COUNTRY MANUFACTURED GOODS**

(SUBMIT WITH TENDER FORM)

Complete the Schedule if you wish to seek preference under the NSW Country Industry Preference Scheme (CIPS.). The preference may be given only to a Tenderer who is a NSW manufacturer registered under the scheme.

State your CIPS. registration number. Give details of the materials and equipment to be supplied or incorporated into the Works, the place of manufacture, the percentage(s) applicable for preference purposes and the value added content at the Tenderer's works for the material or equipment manufactured by the Tenderer for incorporation in the Works.

This is not a Schedule of Rates within the meaning of the Construction Contract Conditions.

**C.I.P.S. Registration No.:** .....

Description	Place of Manufacture	% Applicable	Value Added Content \$
.....	.....	.....	\$ .....
.....	.....	.....	\$ .....
.....	.....	.....	\$ .....
.....	.....	.....	\$ .....
.....	.....	.....	\$ .....

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

## 11 SCHEDULE OF QUALITY MANAGEMENT INFORMATION

---

(SUBMIT WITH TENDER FORM)

Submit one of the following, to demonstrate the capacity to plan and manage the quality of work:

- evidence of current full certification of the Tenderer's Quality Management System to AS/NZS ISO 9001:2000 by a certifying body registered with the Joint Accreditation System - Australia and New Zealand (JAS-ANZ); **or**
- evidence that the Tenderer's Quality Management System complies with the NSW Government *Quality Management Systems Guidelines (QMS Guidelines)*; **or**
- a minimum of three (3) completed examples of Inspection and Test Plans used on recent past projects and complying with the requirements of the *QMS Guidelines*.

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

**12 SCHEDULE OF EXPERIENCE**

(SUBMIT WITH TENDER FORM)

Provide documents and information indicated below in accordance with Conditions of Tendering clause – **Evaluation of Tenders**

**Evidence of satisfactory Completion of Projects**

Nominate at least three contracts/projects completed within the last three years that demonstrate satisfactory completion of a project of this size and scope each with mechanical services value larger than \$250,000.

<b>Client</b>	<b>Name &amp; location of contract</b> <i>E.g. Sutherland Hospital Carpark; Dubbo Water Treatment Plant; Tamworth Coles shopping Centre; 3 Storey Unit Block, Penrith.</i>	<b>Contract Price/ Project Value</b>	<b>Start Date</b>	<b>Completion Date</b>

**Evidence of satisfactory completion and commissioning of a chiller**

Nominate at least one project completed within the last three years that demonstrate satisfactory installation and commissioning of a chilled water system.

<b>Client</b>	<b>Name &amp; location of contract</b>	<b>Total Cooling Capacity kW</b>	<b>Start Date</b>	<b>Completion Date</b>

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

### 13 SCHEDULE OF OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT INFORMATION

(SUBMIT WITH TENDER FORM)

Provide documents and information indicated below in accordance with Conditions of Tendering clause – **Occupational health and safety management.**

Evidence of satisfactory OHS management

Nominate at least three contracts/projects completed within the last two years that demonstrate successful management of occupational health and safety by the Tenderer:

Client	Name & location of contract <i>E.g. Sutherland Hospital Carpark; Dubbo Water Treatment Plant; Tamworth Coles shopping Centre; 3 Storey Unit Block, Penrith.</i>	Contract Price/ Project Value	Start Date	Completion Date

**WHEN REQUESTED**, submit the following additional information for each of three contracts/projects selected from the above list:

- a client referee report (which may be a NSW Government agency Contractor Performance Report) commenting on the Tenderer's performance in relation to occupational health and safety management, identifying the referee's name, position, organisation and telephone and email contact details; **or**
- a third party audit report or internal audit report; **or**
- a site safety inspection report; **or**
- a Safety Management Plan; **or**
- three Safe Work Method Statements; **or**
- minutes of three Toolbox meetings.

Recent OHS prosecutions and fines

Provide:

- a statement confirming that the Tenderer is not in default of any fine issued for a breach of the OHS legislation; **AND**
- details of every OHS prosecution and fine imposed on the Tenderer in Australia during the last two years, together with a description of actions taken by the Tenderer in response to each prosecution and fine; **or**
- a statement that the Tenderer incurred no prosecutions or fines during the last two years.

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

**13 SCHEDULE OF OCCUPATIONAL HEALTH AND SAFETY  
MANAGEMENT INFORMATION (CONT)**

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Hazardous substances

**WHEN REQUESTED**, submit details of proposed:

- i) methods for surveying for hazardous materials;
- ii) methods for handling and removal from the Site of hazardous materials; and
- iii) Consultants and Subcontractors and licence details.

Occupational Health and Safety Management Monthly Report

The Tenderer undertakes, if awarded the Contract, to provide Monthly OHS Management Reports as described in Preliminaries clause – **Occupational Health and Safety Management**.

Independent certification of formwork

The Tenderer undertakes, if awarded the Contract, to provide evidence of independent certification of formwork as required by Preliminaries clause – **Occupational Health and Safety Management**.

Signed for the Tenderer by: ..... Date:.....  
Name (in block letters): ..... (Authorised Officer)  
In the Office Bearer capacity of: .....

## 14 SCHEDULE OF FINANCIAL ASSESSMENT INFORMATION

(SUBMIT WHEN REQUESTED BY PRINCIPAL OR FINANCIAL ASSESSOR)

Provide documents and information listed below in accordance with Clause Conditions of Tendering - **Financial assessment.**

1. Financial Statements for last three years for the entity under consideration, including:
  - i) Balance Sheets;
  - ii) Profit and Loss Statement;
  - iii) detailed Profit and Loss Statement;
  - iv) statement of Cash Flows;
  - v) notes to and Forming Part of the Accounts;
  - vi) an Accountant's Report; and
  - vii) where existing, Auditor's Reports.

Consolidated accounts of a parent organisation or group to which the entity belongs are not acceptable.
2. Where latest financial statement is more than 6 months old, the latest management report showing:
  - i) a trading statement;
  - ii) a profit and loss statement; and
  - iii) a trial balance.
3. Where the company is required to lodge audited financial statements with ASIC, copies of these statements for the last three years.
4. Where any financial statement supplied is not audited, copies of the entity's tax returns for last three years.
5. A letter from the Tenderer's banker providing details of overdraft and guarantee facilities including:
  - i) Bank, Branch, and Account Names,
  - ii) type and limit of bank overdraft facility,
  - iii) type and limit of bank guarantee facility,
  - iv) current bank overdraft balance,
  - v) number and amount of bank guarantees outstanding; and
  - vi) details of other bank funding facilities available to the Tenderer, such as term loans, lines of credit, commercial bills and other debt instruments.
6. Current and projected cash flows for all work on hand.
7. Forecast budget for forthcoming financial year including Revenue and Profit and Loss.
8. Names and contact numbers of:
  - i) major suppliers; and
  - ii) major subcontractors.
9. Details relating to the Tenderer's history and Directors Profiles.

Signed for the Tenderer by: ..... Date:.....

Name (in block letters): ..... (Authorised Officer)

In the Office Bearer capacity of: .....

**15      UNDERTAKING TO COMPLY WITH THE NSW GOVERNMENT  
CODE OF PRACTICE FOR PROCUREMENT .**

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(SUBMIT WHEN REQUESTED)

The Tenderer, if awarded the Contract, will comply with the NSW Government *Code of Practice for Procurement*.

Signed for the Tenderer by: ..... Date:.....  
Name (in block letters): ..... (Authorised Officer)  
In the Office Bearer capacity of: .....



*TENDER SCHEDULES*

**END OF SECTION –TENDER SCHEDULES**

# SPECIFICATION



# 1 GENERAL CONDITIONS OF CONTRACT AND ANNEXURE

*THERE ARE 24 PAGES IN THIS SECTION*

## GENERAL CONDITIONS OF CONTRACT - MINOR WORKS

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### 1 DEFINITIONS

- 1.1** The Principal is as stated in the Annexure.
- 1.2** The Principal's Representative is as stated in the Annexure and is the person appointed by the Principal to act with its full authority in all matters relating to the Contract.
- 1.3** The Principal's Agent is as stated in the Annexure.
- 1.4** The Works means the whole of the work to be carried out and materials and services to be provided under the Contract.
- 1.5** The Contract Sum means:
- (a) where the Principal accepted a lump sum, the lump sum;
  - (b) where the Principal accepted rates, the amount calculated by firstly multiplying the rates by their respective quantities in the schedule of rates and then adding those products;
- but excluding any additions or deductions which are made under the Contract.
- 1.6** day means calendar day.
- 1.7** Site means the lands and other places made available to the Contractor by the Principal for the purpose of the Contract.
- 1.8** Text within the following format denotes a definition:

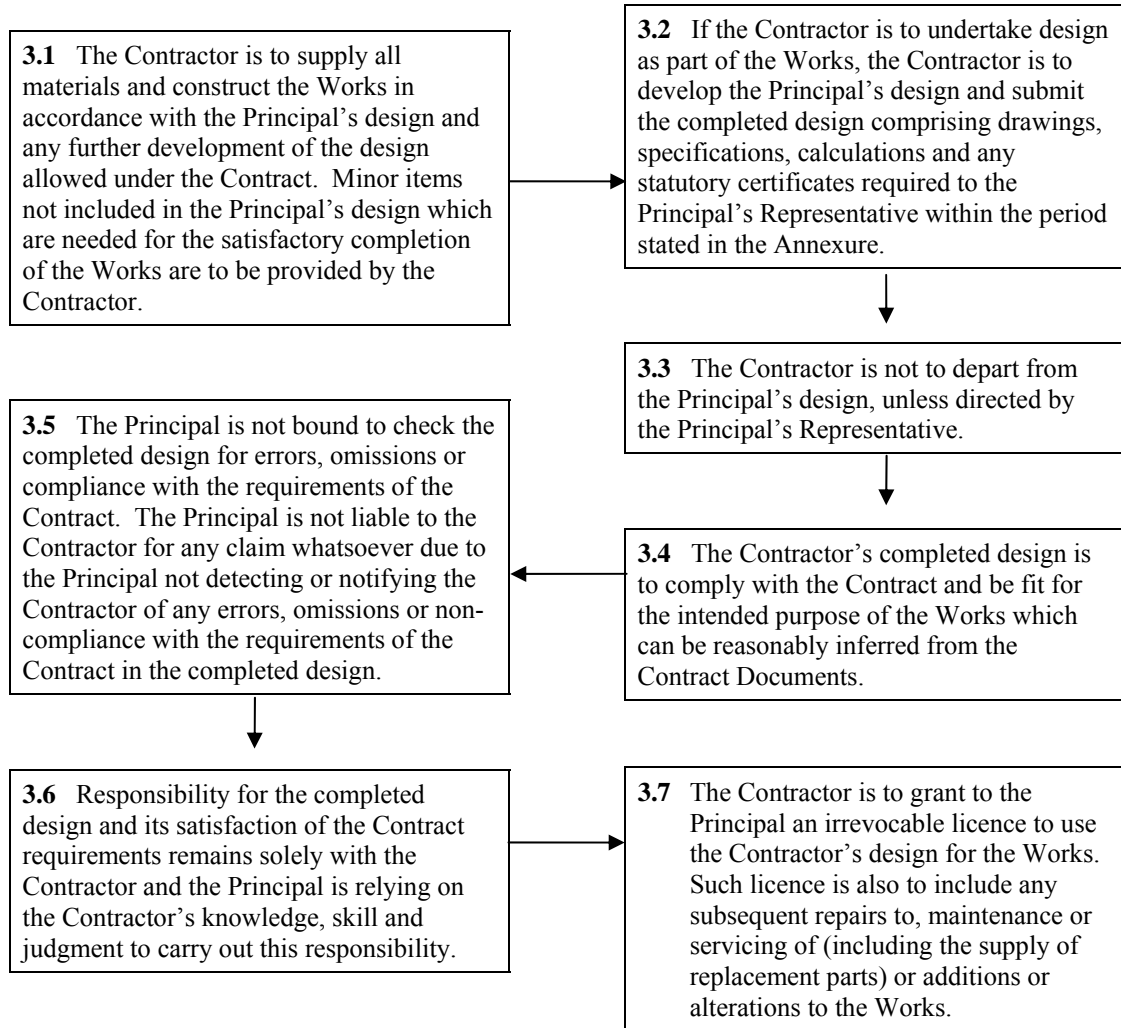


### 2 CONTRACT

**2.1** The written agreement between the Principal and the Contractor for the performance of the Works, including all documents and parts of documents to which reference may properly be made to determine the rights and obligations of the parties (the Contract Documents) shall evidence the Contract.

**2.2** The Contract Documents shall be taken as mutually explanatory and anything contained in one but not in another shall be treated as if contained in all.

**2.3** If the Contractor finds any discrepancy, error or ambiguity in or between the Contract Documents, the Contractor is to inform the Principal's Representative before starting such work and follow the directions given by the Principal's Representative.

**3 DESIGN AND CONSTRUCTION**

#### 4. CARE OF THE WORKS AND OTHER PROPERTY

**4.1** From and including the date the Site is made available to the Contractor to the date of Completion of the Works, the Contractor is responsible for the care of the Works, constructional plant and things entrusted to the Contractor by the Principal for the purpose of the Works.

The Contractor is to make good at the Contractor's expense any damage which occurs to the Works while responsible for their care.

The Contractor is also liable for damage caused by the Contractor during the Defects Liability Period.

**4.2** The Contractor is to indemnify and keep the Principal indemnified against any loss or damage to the property of the Principal (including existing property in, about or adjacent to the Works) and against any legal liability for injury, death or damage to property of others arising from the performance of the Works.

**4.3** Nothing in Clause 4 relieves the Principal from liability for the Principal's own default and defaults of others for whom the Principal is liable.

**5. INSURANCE**

**5.1** On acceptance of the tender, the Contractor is to hold or take out an insurance policy covering Workers Compensation in the State of NSW and shall also ensure that every subcontractor, who is not taken to be a worker employed by the Contractor in accordance with the *Workplace Injury Management and Workers Compensation 1998* (NSW) Schedule 1, must hold or take out insurance covering Workers Compensation.

If insurance of the Works and public liability is to be arranged by:  
the Principal, go to **5.2**  
the Contractor, go to **5.3**

**5.2** If insurance of the Works and public liability is to be arranged by the Principal (see the Annexure) the Principal must effect insurance of the Works and public liability.

The Principal must make a copy of the policy for insurance of the Works and public liability available to the Contractor.

Go to **5.4**

**5.3** If insurance of the Works and public liability is to be arranged by the Contractor, (see the Annexure) then, before commencing work on the Site, the Contractor is to hold or take out policies of insurance covering the Contractor, Principal and subcontractors for:

- (a) public liability to an amount of not less than \$5,000,000 for any single occurrence; and
- (b) loss or damage to the Works, any temporary works and all materials, constructional plant and other things that are brought onto the Site by or on behalf of the Contractor or are entrusted to the Contractor by the Principal. The amount insured is not to be less than the Contract Sum.

The Principal is to be named as an insured in the policies.

The policies must include cross liability and waiver of subrogation clauses under which the insurer, in respect of liability, agrees that the term 'insured' applies to each of the persons covered as if a separate insurance policy had been issued to each of them and generally agrees to waive all rights of subrogation or action against any of the persons covered.

Go to **5.4**

**5.4** If the Works include work described in (a) or (b) below, the Contractor is to take out the following additional insurance policies before starting such work:

- (a) For the use of water-borne craft in excess of 8 metres in length: marine liability insurance;
- (b) For design of the Works undertaken by the Contractor: professional indemnity insurance.

The policy under (a) is to be in the name of the Contractor with the Principal as an additional name insured and is to cover the Contractor, the Principal, and all subcontractors employed from time to time in relation to the Works for their respective rights and interests and cover their liabilities to third parties. The policy is to be for an amount not less than \$5,000,000 for any one occurrence and shall include cross-liability and waiver of subrogation clauses under which the insurer, in respect of liability, agrees that the term 'insured' applies to each of the persons covered as if a separate insurance policy had been issued to each of them and generally agrees to waive all rights of subrogation or action against any of the persons covered.

The policy under (b) is to cover the Contractor for liability to the Principal for a minimum amount of \$500,000 or 20% of the Contract Sum, whichever is greater, to a maximum of \$5,000,000 for loss (whether economic loss only or other loss) in a single occurrence arising from errors or omissions in design of the Works carried out by the Contractor or any subcontractor.

Go to **5.5**



**5.5** The required policies are to be with insurers and in terms approved by the Principal's Representative. Approvals will not be withheld unreasonably.



**5.6** The Contractor is responsible for making and managing claims and meeting the costs of any deductibles.



**5.7** The Contractor is to maintain all required insurance policies until the end of the Defects Liability Period, or Completion if there is no Defects Liability Period.



**5.8** If, when required in writing by the Principal to do so, the Contractor fails to produce evidence of having paid insurance premiums and other compliance with insurance obligations under General Conditions of Contract Clause 5, to the satisfaction of the Principal, the Principal may effect or maintain the insurance and pay any premiums. The Contractor is to pay the Principal the amount of any premiums paid by the Principal plus an amount of \$250 to cover the Principal's costs.



## 6. SITE AND POSSESSION

**6.1** The Principal is to give the Contractor possession of the Site by the time stated in the Annexure.



**6.2** The Principal is to give the Contractor sufficient possession to allow the Contractor to perform the Works but is not required to give the Contractor sole or uninterrupted possession of or access to the Site.



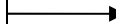
**6.3** The Contractor is to begin work on the Site as soon as practicable after being given possession of the Site by the Principal.



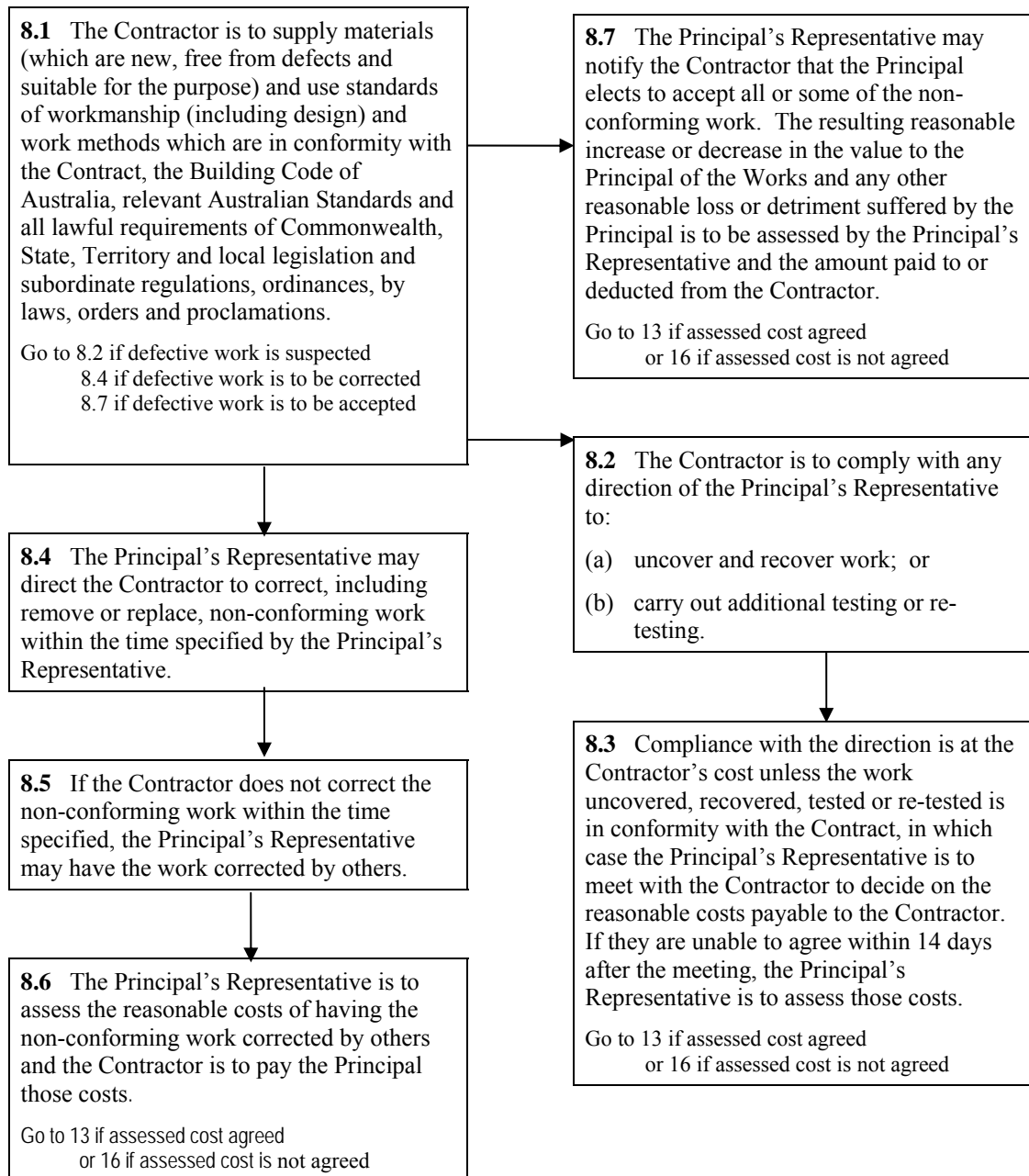
**6.4** The Contractor is to give the Principal's Representative, agents and contractors reasonable access to the Site for any purpose.

## 7. SITE CONDITIONS

**7.1** If the Contractor discovers that the conditions on, about or below the Site differ from what ought to have reasonably been anticipated at Tender time the Contractor is to inform the Principal's Representative immediately and, where possible, before the conditions are disturbed.



**7.2** The Contractor is not entitled to any extra payment for the different Site conditions. If the different conditions are such that the Principal's Representative directs the Contractor to carry out a variation, the procedure in Clause 9 is then to be followed.

**8. NON-CONFORMING WORK**

## 9. VARIATIONS

**9.1** The Principal's Representative may direct the Contractor to carry out a variation and the Contractor is to carry out the direction.

**9.3** A variation is any change to the character, form, quality and extent of the Works directed in writing by the Principal's Representative. A variation shall not invalidate the Contract.

**9.2** The Principal's Representative and Contractor are to meet to agree on the reasonable amount payable to or deducted from the Contractor for the variation. If they do not agree within 14 days after the meeting, the Principal's Representative is to assess that amount.

Go to 13 if assessed amount agreed  
or 16 if assessed amount is not agreed

## 10. SUSPENSION

**10.1** The Principal's Representative may direct the Contractor to suspend all or part of the Works and the Contractor is to carry out the direction.

**10.2** If the direction to suspend the work is due to any act or omission of the Principal, the Principal's Representative and Contractor are to meet to agree on the reasonable extra costs payable to the Contractor which resulted from the suspension. If they do not agree within 14 days after the meeting, the Principal's Representative is to assess those extra costs.

Go to 13 if assessed cost agreed  
or 16 if assessed cost is not agreed

**10.3** The Contractor is to recommence the Works as soon as practicable after being directed to do so by the Principal's Representative.

## 11. COMPLETION OF THE WORKS

**11.1** The Contractor is to Complete the Works within the period stated in the Annexure which starts on the date of being given possession of the Site.

**11.2** The Contractor is to inform the Principal's Representative when, in the Contractor's opinion the Works have reached Completion.

**11.3** The Principal's Representative is to:

- (a) determine if the Works have reached Completion, and if so, the date of Completion; and
- (b) give the Contractor written notice of the determination.

**11.4** The Works have reached Completion and are Complete when the Works are capable of use for their intended purpose, and should be free from any omissions or defects, and the Contractor has made good the Site and its surroundings.

## 12. DELAY IN COMPLETION

**12.1** If the Contractor is delayed in reaching Completion then the Contractor is to notify the Principal's Representative within 14 days after the commencement of the delay and to meet with the Principal's Representative to determine the cause of delay. Where such a delay is caused by:

- (a) a direction given by the Principal's Representative except under:
  - Clause 8; or
  - Clause 10 where the event giving rise to the direction was not beyond the control of the Contractor; or
- (b) a breach of the Contract by the Principal; or
- (c) any event beyond the control of the Contractor,

the period for Completion is to be extended.

**12.2** If the Principal's Representative and the Contractor do not agree on an extension to the period for Completion within 14 days of the meeting to determine the cause of delay, the Principal's Representative is to assess a reasonable extension of time. The Principal's Representative may for any reason and at any time extend the period for Completion.

Go to 16 if assessed extension of time is not agreed.

**12.3** If the Contractor does not Complete the Works by the last day of the period for Completion then the Contractor is to pay to the Principal liquidated damages from, but excluding that date, to and including the date the Works are Complete at the rate stated in the Annexure.

### 13. PAYMENT AND RETENTION

**13.1** *If the Contract has substantial Demolition and the 'Amount of Security' in the Annexure is >\$0:*

Before commencing any work on the Site, the Contractor is to provide security in the amount stated in the Annexure and in the form as detailed in Schedule - Unconditional Undertaking.

**13.2** *If the Contract requires the Contractor to pay the Contract Sum to the Principal:*

Before commencing any work on the Site, the Contractor is to pay the Principal the Contract Sum.

**13.3** *If the Contract requires the Principal to pay the Contract Sum to the Contractor:*

The Contractor is to give the Principal's Representative a written claim for payment when a Milestone stated in the Annexure is reached. The claim is to identify the Milestone, the amount claimed, how the amount is calculated, deductions to which the Principal is entitled and, when additions are claimed, the legal and factual basis of the claim. Additions are extra costs or other amounts to which the Contractor is entitled under or in connection with the subject matter of the Contract.

When a Milestone is reached the amount which the Contractor is entitled to claim, and be paid, is the sum of:

- for work for which the Principal accepted rates, an amount calculated by applying the rates to the quantities of work carried out to that date;
- for work for which the Principal accepted a lump sum, the percentage stated in the Annexure for the Milestone;
- for any additions for which the Principal has approved an amount in writing or for which an amount has been finally determined by an Expert under Clause 16, the amount approved or determined;

less payments previously made (including under Clause 16), costs payable by the Contractor to the Principal and deductions to which the Principal is entitled under or in connection with the subject matter of the Contract, including but not limited to retention moneys, liquidated damages and other damages whether liquidated or unliquidated.

With each claim for payment, and at any other time as requested by the Principal's Representative, the Contractor is to give the Principal's Representative a completed statutory declaration, as detailed in Schedule - Statutory Declaration.

Within 10 business days after receipt of the Contractor's payment claim, the Principal is to provide to the Contractor a payment schedule identifying the progress claim to which it relates and stating the payment, if any, which the Principal will be making. If the payment is to be less than the amount claimed by the Contractor the payment schedule is to indicate why it is less. For the purposes of this clause a business day is any day other than a Saturday, Sunday, public holiday or 27, 28, 29, 30 or 31 December.

**13.3 (Continued)**

Payment is to be made:

- within 20 business days after receipt of the Contractor's written payment claim; or
- within 5 business days after the statutory declaration is received; or
- by the specified time after any action required prior to payment has been carried out,

whichever is the latest. If the Contractor breaches the requirement to submit a completed statutory declaration the Principal is not obliged to make any payment to the Contractor while the breach continues.

Any claim by the Contractor on the Principal is to be made within 28 days after the date of the Principal's Representative's written notice of Completion under Clause 11.3. All claims whatsoever by the Contractor against the Principal made after that time are barred. However, if the contract includes a Defects Liability Period, and the Contractor has a claim against the Principal under Clause 14.4 or because of an event which occurred during the Defects Liability Period, the Contractor may make that claim up to 28 days after the end of the Defects Liability Period. If the claim is made after that time it is barred.

Unless stated otherwise, all payments by the Principal to the Contractor are to be made by Electronic Funds Transfer to a bank, building society or credit union account nominated by the Contractor. No payment is due to the Contractor until details of the nominated account (name of financial institution, account name and account number) are notified in writing to the Principal's Representative. The Contractor is to promptly notify the Principal's Representative in writing of any changes to the nominated account and the Principal is not responsible for any payments made into a previously nominated account before notification of such change is received by the Principal's Representative.

Payment is not evidence of the value of work or an admission of liability or that the work is satisfactory but is a payment on account only.

**13.4** *When the Works are Complete and the Contract requires Security:*

When the Contractor has provided an Unconditional Undertaking for Security (Annexure 13.1) the Principal is to return the Unconditional Undertaking, less any amounts the Contractor is to pay the Principal, within 14 days of Completion.

**13.5** *When the Works are Complete and the Contract has a Defects Liability Period:*

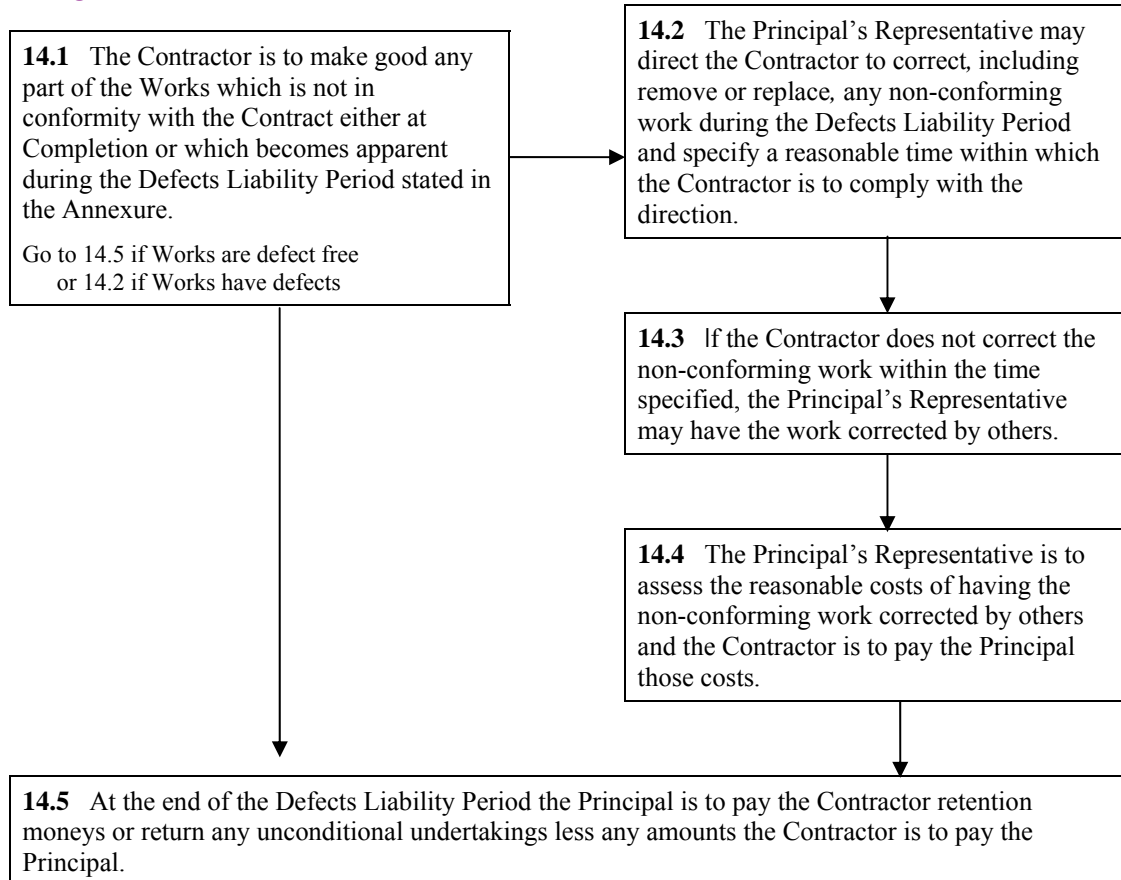
An amount of 2.5% of the Contract Sum is to be retained by the Principal against the due and proper performance of the Contract, except when there is no Defects Liability Period.

The Contractor may, instead of the retention, provide security in the amount of the retention in the form as detailed in Schedule – Unconditional Undertaking.

**13.6** *If an Unconditional Undertaking is required:*

All Undertakings must be provided by a financial institution acceptable to the Principal.

#### 14. DEFECTS LIABILITY PERIOD



**15. DEFAULT AND INSOLVENCY**

**15.1** Without prejudice to any other rights which the Principal has, if the Contractor commits a substantial breach of the Contract, including:

- (a) failing to carry out a direction of the Principal's Representative within the time specified or if no time is specified, within a reasonable time;
- (b) not progressing Works at a reasonable rate,

the Principal may, in writing, specify the breach and ask the Contractor to give reasons why the Principal should not take further action.

**15.3** If the Contractor either fails to give a written response within 7 days of receiving the Principal's notice, or fails to give reasons satisfactory to the Principal, then:

Go to 15.5 for Termination option  
or 15.4 for Takeover option

**15.5** The Principal, may immediately terminate the Contract by notice in writing to the Contractor, in which case the respective rights and liabilities of the parties shall be the same as they would be at common law if the Contractor had wrongfully repudiated the Contract.

**15.7** If the calculation results in a shortfall to the Principal, the Contractor is to pay the amount of the shortfall to the Principal within seven days of a written demand for payment.

**15.2** If the Contractor is wound up or declared insolvent then:

**15.4**

- (a) The Principal may immediately take over the uncompleted Works by notice in writing; and
- (b) suspend payments due or which would become due under Clause 13; and
- (c) have the Works Completed by others.

**15.6** The Principal's Representative is to calculate the difference between:

- (a) the costs of having the Works Completed by others; and
- (b) the amount of suspended payments and retention moneys held by the Principal.

Go to 15.7 Contractor to pay  
or 15.8 Principal to pay

**15.8** If the calculation results in an excess to the Principal, the Principal is to pay the amount of the excess to the Contractor.



**16. DISPUTES**

**16.1** If either party is dissatisfied with an act or omission of the other party in connection with the Contract, including assessment of a claim, failure to agree, or an instruction, that party is to notify the Principal's Agent and the other party in writing of a dispute within 14 days of the act or omission. The notifying party is to provide particulars, including the factual and legal basis of any claimed entitlement.

If a party gives notice of a dispute but not within the time provided by this Clause 16.1, then it is not entitled to interest for the period before the party gave notice.

**16.2** Within 7 days of the giving of the notice, the Contractor and Principal's Agent are to meet to attempt to resolve the dispute.

**16.3** If the dispute is not resolved within 14 days after the notice providing particulars of the dispute, the parties are to appoint an independent Expert.

If the parties fail to agree upon an Expert, either may request the Chief Executive Officer of the Australian Commercial Disputes Centre Ltd Sydney to nominate an Expert. If there is no Chief Executive Officer or the Chief Executive Officer fails to make a nomination within a reasonable time, the Principal is to nominate an Expert.

**16.4** The person nominating the Expert is not to nominate:

- an employee of the Principal or Contractor,
- a person who has been connected with the Contract, or
- a person upon whose appointment the Principal and the Contractor have previously failed to agree.

**16.5** When the person to be the Expert has been agreed on or nominated, the Principal, on behalf of both parties is to appoint the expert in writing, with a copy to the Contractor, setting out:

- the dispute being referred to the Expert for a decision,
- the Expert's fees,
- the procedures detailed in this Clause 16, and
- any other matters which are relevant to the engagement.

**16.6** The Principal and the Contractor are to share equally the Expert's fees and out-of-pocket expenses, including security deposit if required. Each party is to otherwise bear their own costs and share equally any other costs of the process.



**16.7** Each party is to make written submissions to the Expert and provide a copy to the other party as follows:

- (a) Within 7 days after the appointment of the Expert, the notifying party is to submit details of the claimed act or omission.
- (b) Within 14 days after receiving a copy of that submission, the other party is to submit a written response. That response can include cross-claims.

**16.8** The Expert is to decide whether the claimed event, act or omission did occur and, if so:

- when it occurred,
- what term of the Contract or other obligation in law, if any, requires the other party to pay the claimant money in respect of it, and
- the merits in law of any defence or cross-claim raised by the other party.

The Expert then decides the amount, if any, which one party is legally bound to pay the other on account of the event, act or omission.

The Expert is also to decide any other questions required by the parties, as set out in the dispute referred to the Expert at Clause 16.5.

**16.9** In making the decision, the Expert acts as an expert and not as an arbitrator and is:

- (a) not liable for acts, omissions or negligence;
- (b) to make the decision on the basis of the written submissions from the parties and without formalities such as a hearing;
- (c) required within 35 days of appointment to give the decision in writing, with brief reasons, to each party; and
- (d) bound by the rules of natural justice.

**16.10** If the Expert decides that one party is to pay the other an amount exceeding \$250,000 (calculating the amount without including interest on it), and within 14 days of receiving the decision of the Expert, either party gives notice in writing to the other that the party is dissatisfied, the decision is of no effect and either party may then commence litigation.

**16.11** Unless a party has a right to commence litigation under Clause 16.10:

- (a) The parties are to treat each determination of the Expert as final and binding and give effect to it.
- (b) If the Expert decides that one party owes the other party money, that party is to pay the money within 14 days of the receiving the decision of the Expert.

## 17. TERMINATION FOR THE PRINCIPAL'S CONVENIENCE

**17.1** The Principal may terminate the Contract by giving notice with effect from the date stated in the notice, for its convenience and without the need to give reasons. The Contractor must leave the Site by the date stated in the termination notice and remove all plant, equipment and amenities it has brought onto the Site for the construction of the Works.

If the Contract is terminated for the Principal's convenience, the Principal must pay the Contractor:

- the value of all work carried out (as determined in clause 13) up to the date of the termination notice takes effect; plus
- 2% of the difference between the Contract Sum, adjusted by any amounts agreed or assessed under clause 9.2 or finally determined under clause 16, and the total of all amounts paid and payable to the contractor for payment claims.

The payments referred to in this Clause are full compensation under this Clause, and the Contractor has no claim for damages or other entitlement whether under the Contract or otherwise.

The Contractor must, wherever possible, include in all subcontracts and supply agreements an equivalent provision to this Clause.

**SCHEDULE 1**

**APPROVED FORM OF UNCONDITIONAL UNDERTAKING**

*[To be submitted on a Financial Institution's letterhead and show, at a minimum, the Financial Institution's name and address]*

At the request of ..... ('the Contractor')  
and in consideration of ..... ('the Principal')  
accepting this undertaking in respect of the contract for  
..... ('the Contract'),  
..... ('the Financial Institution')  
unconditionally undertakes to pay on demand any sum or sums which may from time to time be  
demanded by the Principal to a maximum aggregate sum of  
.....(\$.....)('the Sum').

*The undertaking is to continue until notification has been received from the Principal that the Sum is no longer required by the Principal or until this undertaking is returned to the Financial Institution or until payment to the Principal by the Financial Institution of the Sum or such part as the Principal may require. The Principal must not assign the unconditional undertaking without the prior **written** agreement of the Financial Institution, which must not be unreasonably withheld.*

*Should the Financial Institution be notified in writing, purporting to be signed by or for and on behalf of the Principal that the Principal requires payment to be made of the whole or any part or parts of the Sum, it is unconditionally agreed that the Financial Institution will make the payment or payments to the Principal forthwith without reference to the Contractor and notwithstanding any notice given by the Contractor not to pay same.*

*Provided always that the Financial Institution may at any time without being required so to do pay to the Principal the Sum less any amount or amounts it may previously have paid under this undertaking or such lesser sum as may be required and specified by the Principal and thereupon the liability of the Financial Institution hereunder shall immediately cease.*

DATED at ..... this ..... day  
of ..... 20 .....

[Signature]  
.....

[Print name of person signing the Undertaking]  
.....

[Position / Title]

**SCHEDULE 2****Statutory Declaration****Definitions***Oaths Act 1900*  
(NSW)

*The Principal is* .....

*The Contractor is* .....

*The Contract is* ACN/ABN.....

Contract No. ....

Contract Title.....

dated .....(Date of Contract) between the party identified as the Principal and the party identified as the Contractor.

**Declaration**

*Full name* **I,** .....

*Address* of .....

do hereby solemnly declare and affirm that:

*Insert position title of the Declarant* **1** I am the representative of the Contractor in the Office Bearer capacity of .....

**2** I am in a position to make this statutory declaration about the facts attested to.

**REMUNERATION OF CONTRACTOR'S EMPLOYEES ENGAGED TO CARRY OUT WORK IN CONNECTION WITH THE CONTRACT**

- 3** All remuneration payable to the Contractor's relevant employees for work done in connection with the Contract to the date of this statutory declaration has been paid and the Contractor has made provision for all other benefits accrued in respect of the employees.
- Relevant employees are those engaged in carrying out the work done in connection with the Contract.

Remuneration means remuneration or other amounts payable to relevant employees by legislation, or under an industrial instrument, in connection with work done by the employees [s127(6) of the *Industrial Relations Act 1996* (NSW)].

**REMUNERATION OF THE EMPLOYEES OF SUBCONTRACTORS ENGAGED TO CARRY OUT WORK IN CONNECTION WITH THE CONTRACT**

- 4** The Contractor *is/is not* a principal contractor for the work done in connection with the Contract, as defined in section 127 of the *Industrial Relations Act 1996* (NSW).
- 5** Where the Contractor is also a principal contractor for work done in connection with the Contract, the Contractor has been given a written statement in its capacity of principal contractor under section 127(2) of the *Industrial Relations Act 1996* (NSW) by each subcontractor in connection with that work stating that all remuneration payable by each subcontractor to the subcontractor's relevant employees for work done in connection with the Contract to the date of this declaration has been paid, and each subcontractor has made provision for all other benefits accrued in respect of each subcontractor's employees.
- 6** I am aware that the *Industrial Relations Act 1996* (NSW) requires any written statement provided by subcontractors must be retained for at least 6 years after it was given and declare that the Contractor has accordingly made arrangements for the secure retention of the written statements.

Delete the words  
*in italics* that are  
not applicable.

**WORKERS COMPENSATION INSURANCE OF THE CONTRACTOR'S WORKERS**

- 7 All workers compensation insurance premiums payable by the Contractor to the date of this statutory declaration in respect of the work done in connection with the Contract have been paid. This statutory declaration is accompanied by a copy of any relevant certificate of currency in respect of that insurance.

**WORKERS COMPENSATION INSURANCE FOR WORKERS OF SUBCONTRACTORS**

- 8 The Contractor *is / is not* a principal contractor for work done in connection with the Contract, as defined in section 175B of the *Workers Compensation Act 1987* (NSW).
- 9 Where the Contractor is also a principal contractor for work done in connection with the Contract, the Contractor has been given a written statement under section 175B of the *Workers Compensation Act 1987* (NSW) in the capacity of principal contractor in connection with that work to the intent that all workers compensation insurance premiums payable by each subcontractor in respect of that work done to the date of this statutory declaration have been paid, accompanied by a copy of any relevant certificate of currency in respect of that insurance.
- 10 I am aware that the *Workers Compensation Act 1987* (NSW) requires any written statement provided by subcontractors and any related certificate of currency must be retained for at least 7 years after it was given and declare that the Contractor has accordingly made arrangements for the secure retention of the written statements.

Delete the words *in italics* that are not applicable.

**EMPLOYER UNDER THE PAYROLL TAX ACT**

- 11 The Contractor *is registered as / is not required to be registered as* an employer under the *Payroll Tax Act 2007* (NSW).
- 12 All payroll tax payable by the Contractor in respect of wages paid or payable to the relevant employees for work done in connection with the Contract to the date of this statutory declaration has been paid.
- 13 The Contractor *is / is not* a principal contractor for work done in connection with the Contract, as defined in section 17 of Schedule 2 to the *Payroll Tax Act 2007* (NSW).
- 14 Where the Contractor is also a principal contractor for work done in connection with the Contract, the Contractor has been given a written statement under section 18 of Schedule 2 to the *Payroll Tax Act 2007* (NSW) in the capacity of principal contractor in connection with that work to the intent that all payroll tax payable by each subcontractor in respect of the wages paid or payable to the relevant employees for that work done to the date of this statutory declaration has been paid.
- 15 I am aware that the *Payroll Tax Act 2007* (NSW) requires any written statement provided by subcontractors must be retained for at least 5 years after it was given and declare that the Contractor has accordingly made arrangements for the secure retention of the written statements.

Delete the words *in italics* that are not applicable.

Delete the words *in italics* that are not applicable.

**PAYMENTS TO SUBCONTRACTORS**

- 16 The Contractor has paid every subcontractor, supplier and consultant all amounts payable to each of them by the Contractor as at the date of this statutory declaration with respect to engagement of each of them for the performance of work or the supply of materials for or in connection with the Contract.
- 17 The provisions of clause "SECURITY OF PAYMENT", if included in the Contract, have been complied with by the Contractor.
- 18 The Contractor has been informed by each subcontractor and consultant to the Contractor (except for subcontracts and agreements not exceeding \$25,000 at their commencement) by written statement in equivalent terms to this declaration (made no earlier than the date 14 days before the date of this declaration):
- .1 that their subcontracts with their subcontractors, consultants and suppliers comply with the requirements of clause "SECURITY OF PAYMENT", if included in the Contract, as they apply to them; and
- .2 that all of their employees, subcontractors, consultants and suppliers, as at

*1. GENERAL CONDITIONS OF CONTRACT AND ANNEXURE*

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the date of the making of such a statement have been paid all remuneration and benefits due and payable to them by, and had accrued to their account all benefits to which they are entitled from, the subcontractor or consultant of the Contractor or from any other of their subcontractors or consultants (except for their subcontracts and agreements not exceeding \$25,000 at their commencement) in respect of any work for or in connection with the Contract.

**19** I am not aware of anything to the contrary of any statutory declaration referred to in paragraph 18 of this declaration and on the basis of the statements provided, I believe the matters set out in paragraph 18 to be true.

**20** And I make this solemn declaration, as to the matters aforesaid, according to the law in this behalf made, and subject to the punishment by law provided for any wilfully false statement in any such declaration.

*Signature of  
Declarant*

.....

declared at

*Place*

.....

*Date*

on.....

before me

*Signature of legally  
authorised person\*  
before whom the  
declaration is made*

.....

*Name and title of  
person\* before  
whom the declaration  
is made*

.....

.....

**Notes:**

1. In this declaration:

- (a) the words “principal contractor”, “employee”, “employees” and “relevant employees” have the meanings applicable under the relevant Acts;
- (b) the word “subcontractor” in paragraphs 5, 6, 9, 10, 14 and 15 has the meaning applicable under the relevant Act; and
- (c) otherwise the words “Contractor”, “subcontractor”, “supplier” and “consultant” have the meanings given in or applicable under the Contract.

2. \* The declaration must be made before one of the following persons:

(a) where the declaration is sworn within the State of New South Wales:

- (i) a justice of the peace of the State of New South Wales;
- (ii) a solicitor of the Supreme Court of New South Wales with a current practising certificate;
- (iii) a notary public; or
- (iv) another prescribed person legally authorised to administer an oath under the *Oaths Act 1900* (NSW);

or

(b) where the declaration is sworn in a place outside the State of New South Wales:

- (i) a notary public; or
- (ii) any person having authority to administer an oath in that place.





## **ANNEXURE TO GENERAL CONDITIONS OF CONTRACT - MINOR WORKS**

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### **Clause**

#### **1.1**

The Principal is **The Chief Executive of NSW State Property Authority**.

### **Notices and Submissions to the Principal**

Notices and Submissions to the Principal must go to the Principal's Representative.

#### **1.2**

The Principal's Representative is : Jack Wocial

and is located at:

Level 17, McKell Building  
2-24 Rawson Place  
SYDNEY NSW 2000  
Facsimile: (02) 9372 8144

If no name is stated the Principal is to name the person in writing within 7 days after accepting the tender. The Principal may at any time change the person for any reason whatsoever by giving written notice.

#### **1.3**

The Principal's Agent is :

and is located at:

If no name is stated the Principal is to name the person in writing within 2 days of the Contractor giving written notice of a dispute under Clause 16. The Principal may at any time change the person for any reason whatsoever by giving written notice.

#### **3.2**

The period to submit the completed design is: Not applicable

#### **5.3**

The Contractor must arrange insurance of the Works and public liability.

#### **6.1**

The time to give possession of Site is: 7 days after the Principal accepted the tender.

#### **11.1**

The period for Completion is: 24 calendar weeks.

#### **12.3**

The rate per day of liquidated damages is: \$

If no rate is stated common law damages are to apply.

### 13.1

The amount of Security is: 2 x 2.5% of the contract sum  
1<sup>st</sup> is released at practical completion of the construction work,  
2<sup>nd</sup> at completion of defects liability period for construction.

### 13.3

The Milestones and Percentages are as below:

Milestone	Percentage
-----------	------------

**Payments will be made monthly based on  
the assessed value of work completed.**

### 14.1

The following Defects Liability Period apply:

1. For the construction works commencing at completion of construction works: **52 weeks**
2. For the programmed preventive maintenance works, for each repair the contractor is liable for (due to inadequate preventive maintenance), on completion of the repair is: **30 days**
3. For the programmed preventive maintenance works, for each ordinary breakdown repair, on completion of the breakdown repair: **26 weeks**

**END OF SECTION – GENERAL CONDITIONS OF CONTRACT AND ANNEXURE**

## 2 PRELIMINARIES

*THERE ARE 22 PAGES IN THIS SECTION*

### 1 ADMINISTRATION AND CONTRACTING

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#### 1.1 ELECTRONIC COMMUNICATIONS

The parties agree and consent that notices and communications may be by electronic communication in accordance with the *Electronic Transactions Act 2000* (NSW).

#### 1.2 USE OF QUALIFIED TRADEPERSONS

Use qualified tradepersons when completing the Works. The use of such persons shall not relieve the Contractor of liability for the fitness of the Works for the purposes required by the Contract.

#### 1.3 LONG SERVICE LEVY

Before commencing the works, the Contractor must:

- pay to the Building and Construction Industry Long Service Payments Corporation or the Corporation's agent the amount of the long service levy payable under the *Building and Construction Industry Long Service Payments Act 1986* (NSW); and
- produce to the Principal the document evidencing payment of the levy.

Additional information and the Levy Payment Form are available at: [www.lspc.nsw.gov.au](http://www.lspc.nsw.gov.au)

#### 1.4 COLLUSIVE ARRANGEMENTS

The Contractor must comply with the NSW Government *Code of Practice for Procurement*, which is available at:

[www.treasury.nsw.gov.au/procurement/cpfp\\_ig](http://www.treasury.nsw.gov.au/procurement/cpfp_ig)

#### 1.5 CONTRACTOR PERFORMANCE REPORTING

During the course of the Contract, the Contractor's performance may be monitored and assessed in accordance with the *Performance management system guidelines* at:

[www.managingprocurement.commerce.nsw.gov.au/system/index\\_performance\\_management.doc](http://www.managingprocurement.commerce.nsw.gov.au/system/index_performance_management.doc)

#### 1.6 EXCHANGE OF INFORMATION BETWEEN GOVERNMENT AGENCIES

The Contractor authorises the Principal and its employees and agents to make information concerning the Contractor and its performance available to other NSW government agencies and local government authorities, which may take such information into account in considering whether to offer the Contractor future opportunities for work.

The Principal regards the provision of information about the Contractor to any NSW government agency or local government authority as privileged under the *Defamation Act 2005*. The Contractor agrees that it will have no entitlement to make any claim against the Principal in respect of any matter arising out of the provision or receipt of such information.

### 1.7 NATSPEC SUBSCRIPTION

If any of the Contractor's Documents are based on NATSPEC, then the Contractor must provide to the Principal proof of the Contractor's current NATSPEC subscription.

### 1.8 GOODS AND SERVICES TAX

All prices, rates and other amounts referred to under the Contract must include GST if it is payable.

The Principal will issue payment schedules in the form of Recipient Created Tax Invoices. The Contractor must not issue Tax Invoices in respect of the Contract.

The Principal will issue Adjustment Notes in respect of adjustment events known to the Principal. The Contractor must notify the Principal of details of any adjustment event not known to the Principal.

Each party warrants it is registered for GST at the time of entering into the Contract, and must notify the other party if it ceases to be registered for GST or to satisfy any requirements for the issue of Recipient Created Tax Invoices.

### 1.9 PASSING OF PROPERTY AND RISK

Unless otherwise provided, items supplied by the Contractor become the property of the Principal when unloaded as required in the Contract. Such items remain at the risk of the Contractor until property therein passes to the Principal.

### 1.10 PAYMENT CLAIMS FOR LUMP SUM ITEMS

A claim for payment of any proportion of a lump sum, including any lump sum in a *Schedule of Rates* or *Schedule of Prices*, must be expressed as a percentage.

### 1.11 AUSTRALIAN AND NEW ZEALAND GOODS

Do not supply or incorporate into the Works any items imported into Australia except:

- items manufactured in New Zealand;
- items included in Tender Schedules - **Schedule of Imported Materials and Equipment** lodged with the Tender and accepted by the Principal;
- a single item with an imported content valued at less than 2% of the Contract Sum or \$20,000, whichever is the lesser. If an item is one of a group of similar items, the group shall be considered as one single item.

The Principal will not pay for imported goods supplied or incorporated into the Works in breach of the provisions of this clause.

### 1.12 QUALITY MANAGEMENT REQUIREMENTS

#### Design Plan

Prior to commencing design work, prepare and implement a Design Plan complying with the NSW Government *Quality Management Systems Guidelines (QMS Guidelines)*, covering each phase of design and addressing the key activities.

The *QMS Guidelines* are available at:

[www.managingprocurement.commerce.nsw.gov.au/system/index\\_procurement\\_guideline\\_documents.doc](http://www.managingprocurement.commerce.nsw.gov.au/system/index_procurement_guideline_documents.doc)

### Inspection and Test Plans

Prepare and implement Inspection and Test Plans, complying with the *QMS Guidelines*, incorporating the Hold and Witness points specified in the Contract.

Submit copies of Inspection and Test Plans and checklists not less than 7 days before commencing the work to which they apply. Also submit certification that the relevant Inspection and Test Plans of Subcontractors and Consultants meet the requirements of the *QMS Guidelines*. Do not start any work before this documentation is submitted.

Give at least 24 hours notice prior to reaching a Hold or Witness point.

The Contractor must not proceed beyond a Hold point without endorsement by the Principal or its authorised representative.

The Principal, at its discretion, may inspect the work at a Witness point, but work may proceed without endorsement.

Endorsement by the Principal at a Hold or Witness point does not release the Contractor from its obligations to achieve the specified requirements of the Contract.

Surveillance (monitoring) by the Principal will apply to all work associated with the Contract.

### Conformance records

Submit copies of conformance records as specified, including:

Conformance records	Time when records are required
Completed Inspection & Test Plans and associated checklists	With each Payment Claim
Commissioning of works	At completion
Maintenance reports	After each scheduled preventative maintenance

### Failure to Comply

If the Contractor fails to comply with the requirements of this clause, the Principal may implement such inspections and tests as the Principal determines and the cost incurred by the Principal shall be a debt due from the Contractor.

## 1.13 SECURITY OF PAYMENT

### General

In this clause “subcontract” includes an agreement for supply of goods or services (including professional services and plant hire) or both and “subcontractor” includes a supplier of goods or services (including professional services and plant hire) or both.

The Contractor shall ensure that each subcontract, whether written or oral, entered into by the Contractor or any subcontractor in respect of the work under the Contract and which has a value of \$25,000 or more at the commencement of the subcontract, includes provisions in the form or to the effect of the form, as the case may be, of those contained in this clause, including the provisions of this subclause.

### Options as to Form of Security

Each subcontract which -

- requires the subcontractor to provide a cash security to its principal;
- allows the subcontractor’s principal to deduct retention moneys from any payment made by it to the subcontractor; or

- provides for both of the above

shall allow the subcontractor the option at any time to provide an unconditional undertaking or unconditional undertakings in lieu of a cash security or retention moneys. To the extent that the subcontractor provides an unconditional undertaking or undertakings, the subcontractor's principal shall not deduct retention moneys and shall forthwith release to the subcontractor any retention moneys or cash security then held.

### Trust for Cash Security and Retention Moneys

Each subcontract shall include a provision having the effect that:

- When a party receives or retains security in cash or converts security to cash, that security is held in trust by the security holder from the time of receipt, retention or conversion, as the case may be, and the security holder must forthwith deposit the money into a trust account in a bank selected by that party;
- the moneys shall be held in trust for whichever party is entitled to receive them until they are paid in favour of that party and the security holder shall maintain proper records to account for such moneys; and
- any interest earned by the trust account shall not be held in trust, and shall be owned by the party holding the security.

If the party holding security has a policy of insurance protecting subcontract payments due to the other party which is equivalent to the HIA Security of Payment Bond, then compliance with the above of this subclause is not required.

Whenever requested by the Principal to provide evidence verifying that the Contractor is holding in trust an amount which the Contractor should be holding in trust, the Contractor shall provide evidence to the reasonable satisfaction of the Principal that the amount is held in trust. If the Contractor fails to do so then, in addition to any other remedy which the Principal may have against the Contractor, the Principal may withhold an equivalent amount from payments to the Contractor.

### Payments

Each subcontract shall include:

- an obligation, which takes precedence over any inconsistent provision of the subcontract, for the subcontractor's principal to pay the subcontractor regular progress payments of 100% of the value of work, goods or services provided by the subcontractor less only retention moneys, if any, paid into the trust account referred to in subclause - **Trust for cash security and retention moneys**;
- an entitlement to progress payments within the following periods after the date upon which a progress claim is lodged by the Contractor with the Principal's Representative:
  - in the case of the Contractor's subcontractors, 28 days;
  - in the case of all other subcontractors, 35 days,

Compliance with this subclause shall not prevent the Contractor from paying a subcontractor an amount in excess of that claimed from the Principal, or paying before the time stipulated in this subclause.

### Alternative Dispute Resolution

Each subcontract shall include provisions incorporating the dispute resolution procedures outlined in the Contract except that, in each case, it shall not be mandatory for the subcontractor to pursue the contractual dispute resolution mechanism if the only remedy sought by the subcontractor is an order that the subcontractor's principal pay to it an amount which is not disputed to be due and payable under the subcontract.

### Documents to be Provided to Subcontractors

Each subcontract shall include a provision which requires the subcontractor's principal to provide to the subcontractor, before the subcontractor commences work under the subcontract, a copy of the following provisions of the contract between the subcontractor's principal and its principal:

- the provision equivalent to this Preliminaries clause - **Security of Payment**; and
- the clauses relating to proof of payment of subcontractors, times for payment claims and payment and alternative dispute resolution.

### Register of Subcontracts

Maintain a register of all subcontracts which have a value of \$25,000 or greater showing brief details of the subcontract work, the name, address and telephone number of the subcontractor, and provide an up to date copy of the register when requested by the Principal's Representative.

If further requested by the Principal's Representative, provide an unpriced copy of the subcontract agreement within 14 days of such request.

## 1.14 ADDITIONAL SECURITY AND OBLIGATIONS FOR TRUSTEES

If the Contractor is a trustee:

- before commencing the Works, the Contractor must give the Principal an unconditional undertaking as security for any amount previously agreed in writing by the parties. The unconditional undertaking must be in the form detailed in Schedule 1- **Approved Form of Unconditional Undertaking** and from a financial institution acceptable to the Principal.
- The security will be retained by the Principal against the due and proper performance of the Contract by the Contractor. Unless the Principal has made or intends to make a demand against the unconditional undertaking, the Principal will return the unconditional undertaking within 14 days after the date of Completion of the Works determined or agreed by the Principal.
- The Contractor must not prevent the Principal making any demand against the unconditional undertaking, or prevent the provider of an unconditional undertaking complying with the unconditional undertaking or any demand by the Principal, but the Contractor may seek damages if the Principal makes a demand in breach of the Contract.
- The Contractor must ensure that, for the duration of the Contract, the total value of the trust beneficiaries' loans to the trustee is always greater than the total value of trust beneficiaries' loans from the company.

## 1.15 INDUSTRIAL RELATIONS MANAGEMENT

### Requirement

The Contractor must comply with the NSW Government *Industrial Relations Management Guidelines*.

Submit, before beginning work on the Site, confirmation that the Contractor will comply with the industrial relations aspects of the NSW Government *Code of Practice for Procurement* and the associated Implementation Guidelines.

### Failure to comply

If at any time the Contractor has not carried out its obligations under this clause - **Industrial Relations Management**, then notwithstanding any other provision of the Contract, no payment is due to the Contractor until the 7<sup>th</sup> day after the required action has been carried out.



### 1.16 AUDIT AND REVIEW

Make available, on request, all records, including those of or relating to Subcontractors or suppliers, relevant to compliance with requirements of the Contract, for the purposes of audit, review or surveillance. Provide all reasonable assistance during the audits or reviews including attendance by the Contractor.

Promptly implement effective corrective action on matters disclosed by audit or review.

## 2 SITE AND WORKS

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### 2.1 WORKING HOURS AND WORKING DAYS

Unless the Contract provides otherwise the Site is available to the Contractor to perform the Works between 7 am and 5 pm Monday to Friday but excluding public holidays.

The Principal's Representative may approve additional working hours or working days, subject to conditions which may include, but are not limited to:

- restrictions on the performance of work which requires supervision; and
- a requirement that the Contractor meet the costs of supervision, by or on behalf of the Principal, of work performed during the additional working hours or working days.

### 2.2 EXISTING SERVICES

#### Locating Existing Services – Dial Before You Dig

The Contractor is responsible for locating services and in doing so, must comply with the WorkCover Work Near Underground Assets Guideline, which is available at:

[www.workcover.nsw.gov.au/NR/rdonlyres/96ACDD20-8FC0-4583-A6F4-97292055A954/0/work\\_near\\_underground\\_asset\\_1419.pdf](http://www.workcover.nsw.gov.au/NR/rdonlyres/96ACDD20-8FC0-4583-A6F4-97292055A954/0/work_near_underground_asset_1419.pdf)

Before commencing excavation the Contractor must obtain, from the Dial Before You Dig information service or relevant public authorities or owners of underground services, written confirmation of the exact positions of all underground services at and around the Site, and verify and prominently mark the locations of the underground services on the Site.

#### Dealing with Existing Services

Existing services (such as drains, watercourses, public utilities, telecommunications and other services) obstructing the Works or if damaged in the course of the Contract, must be dealt with as follows:

- if the service is to be continued: repair, divert, relocate as required;
- if the service is to be abandoned: cut and seal or disconnect and make safe as required;

#### Cost and Delay

Where an existing service is damaged by the Contractor for any reason whatsoever, the Contractor shall bear all costs and any delays for repairing or disconnecting the service.

#### Notification

Notify the Principal's Representative immediately upon the discovery of services obstructing the Works not shown in the Contract documents.

## 2.3 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

### Specification and Statutory Requirements

The Contractor must comply with the NSW Government *Occupational Health and Safety Management Systems Guidelines 4<sup>th</sup> Edition* (OHSM Guidelines) and all statutory requirements including, but not limited to, the *Occupational Health and Safety Act 2000* (NSW) and *Occupational Health and Safety Regulation 2001* (NSW). In the event of any inconsistency, the Contractor must comply with the statutory provisions.

### Appointment as principal contractor

The Contractor, having responsibility for the construction work at all times until the work is completed under the Contract, is appointed principal contractor and controller of the premises for the construction work under Clause 210 of the *Occupational Health and Safety Regulation 2001* (NSW), and is authorised to exercise such authority of the owner as is necessary to enable it to discharge the responsibilities of principal contractor and controller of premises imposed by the *Occupational Health and Safety Act 2000* (NSW) and Chapter 8 of the *Occupational Health and Safety Regulation 2001* (NSW).

### Design

The Contractor must ensure that systematic assessments are undertaken in carrying out any design required, that:

- identify hazards and analyse the associated risks, probability and consequences of injury or illness;
- involve consultation with appropriate people on the safe construction, use and maintenance of the designed asset;
- establish a Design Hazard Register for the designed asset to record any hazards not eliminated in the design that may impose a risk to those constructing, using or maintaining the asset.

An up to date copy of the Design Hazard Register must be provided to the Principal at the date of Completion of the Works or the date the Works are occupied or taken over, whichever is earlier.

### Site-specific Safety Management Plan

Develop and implement a Site-specific Safety Management Plan that complies with the *OHSM Guidelines*.

Submit the Site-specific Safety Management Plan no later than 14 days before construction work commences. Do not start construction work before a complying Site-specific Safety Management Plan has been submitted.

Ensure all risks are covered in the Site-Specific Management Plan

The Contractor must undertake its own detailed analysis of all occupational health and safety risks under the Contract.

### Site Safety Rules

Develop site safety rules that are equal to or better than the following minimum set of site safety rules, include them in the Site-specific Safety Management Plan and ensure implementation.

Site safety rules must make it a condition of entry to the applicable work site that all employees and visitors comply with their provisions, including:

- **Construction OHS Induction.** All persons must display evidence of completing OHS Induction training prior to being inducted to commence work on the Site.

- **Site Induction.** All persons working on the Site must attend a Site Induction prior to entering it. Visitors may enter a work site if, either, they first attend a Site Induction, or if they are accompanied by a person who has attended a Site Induction. All persons each day must sign in and out on the Site Register.
- **Safe Work Method Statements.** Safe Work Method Statements must be prepared and used for all work activities assessed as having a safety risk.
- **Toolbox Talks.** Weekly or more regular discussions must be held with workers to consult on site safety matters.
- **Safety Helmets, Safety Footwear and Safety Vests.** Safety helmets and steel-capped safety footwear must be worn by all supervisors, employees, and visitors in the construction area at all times. The footwear must comply with AS 2210. Safety vests must be worn when moving plant is present or work is undertaken near traffic.
- **Personal Protective Equipment (PPE).** PPE, such as safety eye protection, hearing protection, safety gloves and masks and the like, must be worn when welding, drilling and with all other tasks with similar risks.
- **Accidents and Incidents.** Accidents, incidents and injuries must be reported immediately to the Contractor's and applicable subcontractor's site representative in charge.
- **Alcohol and Drugs.** The consumption of, or being under the influence of, alcohol and illegal drugs on the Site is prohibited.
- **Amenities.** Access to clean toilets and meal facilities, cool, clean drinking water, and the other requirements of the WorkCover *Code of practice: Amenities for construction work* must be provided for all persons.
- **Electrical.** All electrical work and electrical plant must comply with the WorkCover *Code of practice: Electrical practices for construction work*.
- **Emergency evacuation.** Arrangements must be included in the Site Induction and clearly identified.
- **Excavations.** Barricading and signage for all excavations must be provided, with excavations 1.5 metres or more deep also to be benched, battered or shored. See the WorkCover *Code of practice: Excavation*.
- **Fire Prevention.** Fire prevention must be used by all persons on the Site. An appropriate fire extinguisher must be on hand for all welding sets and oxy acetylene work.
- **First Aid.** All persons requiring first aid treatment must contact the first aid officer who will administer the treatment and record the injury in the WorkCover Register of Injuries, including the person's name and the nature of the injury.
- **Hazardous Substances.** Chemicals and hazardous substances must be used and stored in compliance with up to date Material Safety Data Sheets (MSDS) and details recorded in the Register of Hazardous Substances.
- **Housekeeping.** Work areas must be kept clean and tidy, with rubbish and other safety hazards cleaned up promptly. All protruding nails must be removed immediately from timber.
- **Leads and Power Tools.** All leads, power tools and electrical equipment must be inspected and tagged by a qualified person prior to their use and then at monthly

intervals. See the WorkCover *Code of practice: Electrical practices for construction work*.

- **Mobile Plant.** Every owner of plant must ensure plant is registered with WorkCover when required and operators are appropriately qualified. Plant must be fitted with working hazard lights/reversing lights and beepers. See the WorkCover *Code of Practice for Moving Plant on Construction Sites*.
- **Overhead Power Lines.** The requirements of the WorkCover *Code of Practice – Work near Overhead Power Lines* must be complied with.
- **Site Security and Public Access.** Security measures, including perimeter fencing, must be used to prevent unauthorised access to construction areas and ensure safe access and passage for all those on and adjacent to the Site. Security must comply with Clause 235 of the OHS Regulation 2001 and the WorkCover *Position paper: The requirements for fencing*.
- **Underground Services.** Prior to any underground work being carried out, services must be located using Dial Before You Dig, a services locator, potholing and the other precautions identified in the WorkCover *Work Near Underground Assets Guideline*.
- **Working at Height.** Working at heights must be in accordance with WorkCover requirements, including certification of formwork and scaffolding. See the WorkCover *Guide to Safe Working at Heights*.

### OHS Management Monthly Report

Submit, no later than the seventh (7<sup>th</sup>) day of each month, an OHS Management Monthly Report, detailing *Inspection, testing and servicing* activities, *Internal reviews* and *Incident management and corrective action*, and including the information listed below, as evidence of the implementation of the Site-specific Safety Management Plan during the previous month.

#### Contract Details

- Contract
- Contractor
- Contractor's representative
- Signature and Date
- Period Covered

#### Implementation of Risk management (OHSM Guidelines Section 5, element 1)

Summary of OHS inspections and reviews carried out to identify risks and hazards and ensure risk management controls are being implemented for:

- plant and equipment
- incoming products
- work site conditions
- adherence to and completeness of Risk Assessments, Safe Work Method Statements and Site Safety Rules
- work site access and exits
- personal protective equipment

**Implementation of OHS training** (*OHSM Guidelines* Section 5, element 3)

An up to date copy of the Induction Register and details of OHS training carried out.

**Implementation of Incident management** (*OHSM Guidelines* Section 5, element 4)

Details of:

- any OHS incidents or OHS issues, including non-compliance with OHS procedures and near misses
- implementation of incident management
- implementation of corrective action
- OHS statistics for entire the Contract including:

	This Month	Total Cumulative
Number of Lost Time Injuries		
Number of Hours Worked		
Number of Hours Lost Due to Injury		
Lost Time Injury Frequency Rate LTIFR		
Number of OHS Management Audits		
Number of OHS Inspections		

**Implementation of Safe Work Method Statements** (*OHSM Guidelines* Section 5, element 6)

An up to date copy of the register of Safe Work Method Statements, including confirmation that the principal contractor has ensured that all Safe Work Method Statements comply with the *OHS Regulation 2001* and that their implementation is being monitored.

## Incident Reports

Ensure compliance with the notification and other requirements of *OHS Regulation 2001* Clauses 341 and 344 for accidents, incidents and non-disturbance occurrences, including immediate notification of WorkCover where required.

Immediately notify the Principal of any accident or incident defined in *OHS Regulation 2001* Clauses 341 and 344.

Provide a written report to the Principal within twenty-four hours of the incident, giving details of the incident and evidence that notification requirements have been met.

When requested, provide an incident investigation report, including identification of the cause of the incident and corrective actions taken, in the form directed.

## Prohibition and Improvement Notices and On-The-Spot Fines

Immediately notify the Principal of any Prohibition and Improvement Notice (PIN) or on-the-spot fine issued by WorkCover. Provide the Principal with a copy of the PIN or fine notice and written details of the corrective action taken by the Contractor and/or the applicable subcontractor to rectify the breach and to prevent recurrence.

## Electrical work on electrical installations

In compliance with section 207 of the *OHS Regulation 2001*, ensure that electrical work on an electrical installation is not carried out while the circuits and apparatus of the part of the installation that is being worked on are energised, unless it is necessary to do so in the interests of safety and the risk of harm would be greater if the circuits and apparatus were de-energised before work commenced.

### Independent Certification of Formwork

In this clause, the terms “qualified engineer” and “formwork” have the meanings given in Clause 209 of the *OHS Regulation 2001*. “Related Entities” means businesses, one of which is owned wholly or in part by the other or that have proprietors, directors, officers, shareholders or employees in common.

Inspection and certification of formwork, if required by Clause 233 of the *OHS Regulation 2001*, must be carried out by a qualified engineer who is not a proprietor, director, officer, or employee either of the entity carrying out the formwork erection or a Related Entity to that entity. In addition, if the Contractor carries out the design of the formwork, then the qualified engineer must not be a proprietor, director, officer or employee either of the Contractor or a Related Entity to the Contractor.

If such inspection and certification are required, the Contractor and any subcontractors involved must include the inspection and certification as actions in Safe Work Method Statements for the erection and use of formwork, and they must be hold points in the Contractor’s and subcontractors’ Inspection and Test Plans.

Submit formwork certification before commencing the use of the formwork. Do not use the formwork before this certification is submitted.

### Failure to Comply

If at any time the Contractor has not carried out its obligations under the Contract in relation to occupational health and safety management, then notwithstanding any other provisions of the Contract, no payment will be due to the Contractor until the 7<sup>th</sup> day after the required action has been carried out.

## 2.4 HAZARDOUS SUBSTANCES

### Definition

Hazardous Substance means a substance that is listed in the document entitled *List of Designated Hazardous Substances* published by Worksafe Australia; or a substance that fits the criteria for a hazardous substance set out in the document entitled *Approved Criteria for Classifying Hazardous Substances* published by Worksafe Australia.

Asbestos, material containing asbestos, polychlorinated biphenyl (PCB) and lead based paints are recognised as hazardous substances. Other substances in certain situations are also considered hazardous and therefore require controlled handling. Examples are glues, solvents, cleaning agents, paints, and water treatment chemicals.

Work involving stone, rock, concrete, masonry and such materials containing silica, is work under the Contract whether explicitly identified in the Specification or not. The Contractor is responsible for the control of any hazard which may arise from the presence of silica.

### Response to Unexpected Discovery

If any hazardous substance not specified in work under the Contract is discovered on the Site the Contractor must suspend all work which may result in exposure to such hazardous substance and notify the Principal’s Representative immediately of the type of substance and its location.

With the initial notification, or as soon as practicable thereafter, submit details, including:

- the additional work and additional resources the Contractor estimates to be necessary to deal with the substance so that work and subsequent use of the Works may proceed safely and without risk to health
- the time the Contractor anticipates will be required to deal with the substance and the expected delay in achieving Completion;

- the Contractor's estimate of the cost of the measures necessary to deal with the substance; and
- other details reasonably required by the Principal's Representative

The Contractor must, in planning and carrying out any work dealing with the substance take all reasonable steps:

- to carry out the work concurrently with other work wherever possible; and
- to otherwise minimise effects of the work on the Contractual Completion Date.

### Responsibility For Decontamination

Control and decontamination of any hazardous substances is the responsibility of:

- the Principal, in respect of any such substances not identified in the Contract Documents, which are discovered on the Site; and
- the Contractor, in respect of any such substances identified in the Contract Documents.

### Decontamination By Principal

Where the Principal is responsible for the control and decontamination of any hazardous substances, the Principal's Representative may suspend the whole or any part of the Works until the hazardous substances are isolated or removed.

### Decontamination By Contractor

Where the Contractor is responsible for the control and decontamination of the Site following the discovery of hazardous substances, handle, use, isolate, remove and dispose of such substances in accordance with statutory requirements.

The Environment Protection Authority or Waste Service NSW may advise of suitable disposal sites.

### Working Hours

When the Contractor is required to decontaminate hazardous substances on occupied Sites, all such decontamination shall be carried out outside normal hours of occupation, unless otherwise approved in writing by the Principal's Representative. Normal hours of occupation are:

- 7am to 5pm Monday to Friday

## 2.5 ASBESTOS REMOVAL

### Requirement

Where the Contractor is responsible for asbestos removal work, comply with the relevant statutory requirements, standards, codes and guidelines, including but not limited to the:

- *Occupational Health and Safety Act 2000* (NSW)
- *Occupational Health and Safety Regulation 2001* (NSW)
- WorkCover Authority of NSW requirements
- Australian Safety and Compensation Council *Code of Practice for the Safe Removal of Asbestos 2<sup>nd</sup> Edition* (2005)
- Australian Safety and Compensation Council *Code of Practice for the Management and Control of Asbestos in Workplaces* (2005)



- Australian Safety and Compensation Council *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2<sup>nd</sup> Edition* (2005)
- *Environmentally Hazardous Chemicals Act 1985* (NSW)
- *Waste Avoidance and Resource Recovery Act 2001* (NSW)

### Notification and Permit

Not less than seven days prior to commencing any asbestos removal work, notify the local office of WorkCover and the Principal of the intention to carry out that work.

Where the regulations require a licence for asbestos removal work, before the work commences, submit a copy of the current licence held by the entity that will undertake the work and a copy of any WorkCover permit required for the work.

### Monitoring

Provide air monitoring by an independent testing authority on each day during asbestos removal and on completion of each area where removal has been undertaken.

### Clearance Certificate

Submit to the Principal a clearance certificate from an independent testing authority at the completion of the asbestos removal work.

## 2.6 ENVIRONMENTAL MANAGEMENT

### Requirement

The Contractor must comply with the NSW Government *Environmental Management Systems Guidelines* available at: [www.managingprocurement.commerce.nsw.gov.au/system/index\\_procurement\\_guideline\\_documents.doc](http://www.managingprocurement.commerce.nsw.gov.au/system/index_procurement_guideline_documents.doc)

### Environmental Management Plan

Develop and implement an Environmental Management Plan that complies with the *EMS Guidelines*.

The Contractor may elect to complete Schedule to Preliminaries - **Environmental Management Plan**, adding objectives and actions as required to suit the risks/hazards associated with the work under the Contract, and implement the completed version as the Environmental Management Plan.

Submit the Environmental Management Plan no later than 7 days before construction work commences. Do not start construction work before a complying Environmental Management Plan has been submitted.

The Environmental Management Plan must address all environmental risks on site.

The Contractor must undertake its own detailed analysis of all environmental risks under the Contract.

### Incident reports

Ensure compliance with the notification and other requirements of the *Protection of the Environment Operations Act 1997 (POEO Act)*.

Immediately notify the Principal of any pollution incident that may cause material harm to the environment, providing evidence that notification requirements of the POEO Act have been met, where applicable.

Report immediately the details of any waste removed from the Site and not disposed of at a lawful facility.



When requested, provide an incident investigation report, including identification of the cause of the incident and corrective actions taken, in the form directed.

### Failure to comply

If at any time the Contractor has not carried out its environmental management obligations under the Contract, then notwithstanding any other provisions of the Contract, no payment is due to the Contractor until the 7<sup>th</sup> day after the required action has been carried out.

## 2.7 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

### Requirement

Apply strategies to maximise the achievement of ecologically sustainable development in the design, construction and operation of the Works, including reducing pollutants, greenhouse gas emissions and demand on non-renewable resources such as energy sources and water.

### Restricted timbers

Do not use the following timbers or their products for work under the Contract:

- rainforest timbers, unless certification is provided that they are plantation grown;
- timber from Australian high conservation forests.

## 2.8 WASTE MANAGEMENT

### Requirement

Implement waste minimisation and management measures, including:

- recycling and diverting from landfill surplus soil, rock, and other excavated or demolition materials, wherever practical;
- separately collecting and streaming quantities of waste concrete, bricks, blocks, timber, metals, plasterboard, paper and packaging, glass and plastics, and offering them for recycling where practical.

Ensure that no waste from the Site is conveyed to or deposited at any place that cannot lawfully be used as a waste facility for that waste.

### Monitoring

Monitor and record the volumes of waste and the methods and locations of disposal.

Submit a progress report every two months, and a summary report before Completion, on the implementation of waste management measures, including the total quantity of material purchased, the quantity purchased with recycled content, the total quantity of waste generated, the total quantity recycled, the total quantity disposed of and the method and location of disposal in the form of a *Waste Recycling and Purchasing Report* available at:

[http://www.managingprocurement.commerce.nsw.gov.au/contract\\_management/cm\\_sf\\_waste\\_recycling\\_and\\_purchasing\\_report.doc](http://www.managingprocurement.commerce.nsw.gov.au/contract_management/cm_sf_waste_recycling_and_purchasing_report.doc)

With the *Waste Recycling and Purchasing Report*, submit waste disposal certificates and/or company certification confirming appropriate, lawful disposal of waste.

## 2.9 PEST CONTROL

Do not use any chemical pesticides or termiticides for new construction work. Use preventive treatment by physical means to minimise the risk of pest infestations.

Chemical treatments may be used in existing buildings only as a last resort for the eradication of pest and termite infestations. Chemical pesticides used for this purpose must be registered by the National Registration Authority for Agricultural and Veterinary Chemicals and applied by a Pest Control Operator licensed by WorkCover.

Pest preventive methods must comply with AS 3660.1-2000 Protection of Buildings from Subterranean Termites (except for references to chemical soil barriers), as well as supplementary standards for existing buildings.

## **2.10 WORK METHOD**

If the Contract prescribes a particular work method or the Principal or Principal's Representative directs that a particular work method must be used to the exclusion of the other work methods, then that work method is part of the Contract.

Otherwise, the work method is not part of the Contract and the Contractor is free to use any work method. This is so even though, before or after acceptance of the tender, the Contractor made known to the Principal the Contractor's proposed work method and the Principal accepted or approved it.

If the work method is not part of the Contract, the fact that the proposed work method is impractical or impossible or the Contractor, with or without the approval of the Principal's Representative, uses another work method will:

- not entitle the Contractor to make a claim on the Principal;
- not be grounds for an extension of time for Completion;
- not cause the Contract to be frustrated.

## **2.11 STANDARDS**

Where the Contract requires compliance with a standard or Code, unless otherwise specified that Standard or Code shall be the one current at the closing date for tenders, except for the Building Code of Australia, which shall be the one current at the Date of Completion.

Where the Contract refers to an Australian Standard it does not preclude the adoption of a relevant international standard.

## **2.12 CLEANING UP**

All visible external and internal surfaces, including fittings, fixtures and equipment, must be free of marks, dirt, dust, vermin and unwanted materials, at Completion.

## **2.13 PROPRIETARY ITEMS**

Identification by the Principal of a proprietary item does not necessarily imply exclusive preference for that item, but indicates the required properties of the item.

The Contractor may offer an alternative to any proprietary item. Apply in writing for approval to use the alternative. The request must be accompanied by all available technical information and describe how, if at all, the alternative differs from the proprietary item and how it will affect other parts of the Works and performance of the Works.

Except to the extent that the approval, if any, of the Principal's Representative includes a contrary provision, the approval shall be deemed to include the conditions that:

- use of the alternative must not directly or indirectly result in any increase in the cost to the Principal of the Works;
- the Contractor must indemnify the Principal against any increase in costs;

- use of the alternative must not directly or indirectly cause any delay to the Works and if it does, the Contractor will compensate the Principal for any loss which the delay causes.

## 2.14 GUARANTEES

### Generally

Obtain and ensure that the NSW State Property Authority will have the benefit of warranties or guarantees as specified in the Contract or offered by suppliers, including warranties or guaranties that are obtained by, or offered to the subcontractors of the Contractor.

## 2.15 SCHEDULE TO PRELIMINARIES - ENVIRONMENTAL MANAGEMENT PLAN

## IMPLEMENTATION

ENVIRONMENTAL OBJECTIVES	ACTION TO BE TAKEN	WHEN ACTION WILL BE TAKEN	PERSON RESPONSIBLE	ACTION COMPLETED
<b>1. CONSERVATION OF PLANTS &amp; WILDLIFE</b>				
1.1 Protect flora and fauna	Protect existing trees and plants at and around the Site from damage unless approved by the Principal			
	Do not remove trees and plants without approval from the Principal			
	Control weeds on the Site			
	Protect birds, fish and animals at and around the Site from harm			
	Do not remove birds, fish and animals from the Site without the written agreement of the Principal			
	Do not bring birds, fish, animals and plants onto the Site without written agreement from the Principal			
	Minimise the use of pesticides and herbicides for minimal impact on the environment			
1.2 Control movement of pedestrians, materials, vehicles and plant to minimise damage to the environment	Use only designated routes for access to the Site			
	Use designated site roads and access routes for all movements on and adjacent to the Site			
	Locate compounds, and park all vehicles and plant, in designated areas on the Site			
<b>2. CONSERVATION OF RESOURCES</b>				
2.1 Design for energy efficiency	Adopt energy efficiency, environmental enhancement and waste minimisation as design criteria			
	Use low energy usage construction, fittings and appliances (including heating/cooling and lighting)			
2.2 Select materials to minimise: 1. resource use and waste 2. ozone depleting	Incorporate conservation of resources obligations into subcontracts			
	Reuse all topsoil on the Site and minimise the use of imported topsoil			
	Mulch and chip cleared vegetation as appropriate			
	Maximise use of materials that are recyclable or from a sustainable source			
	Use timber from sustainable managed sources only			

## 2. PRELIMINARIES

ENVIRONMENTAL OBJECTIVES	ACTION TO BE TAKEN	WHEN ACTION WILL BE TAKEN	PERSON RESPONSIBLE	ACTION COMPLETED
effects 3. detrimental effects on air, water, and land quality  2.3 Conserve heritage items and other physical attributes of the Site	Implement a strategy to reduce the quantity of waste, including minimising and recycling packaging			
	Use low water demand fittings & appliances (dual flush toilets, water conserving shower roses & taps)			
	Minimise the use of solvents, glues, paints and other materials which release odours or vapour			
	Comply with statutory requirements for conservation of heritage items			
	Manage the conservation of physical attributes of the Site, including (LIST THE ATTRIBUTES):			
	•			
<b>3. POLLUTION CONTROL</b>				
3.1 Control discharges and emissions from vehicles and plant to minimise damage to the environment	Do not use vehicles, plant or equipment that produce excessive emissions			
	Monitor emissions from vehicles and plant			
	Do not bring vehicles or plant and equipment with hydraulic fluid, fuel or oil leaks to the Site			
	Wash down vehicles, plant and equipment only in controlled areas acceptable to the Principal			
	Prevent and clean up any spills from transport vehicles			
3.2 Prevent pollution of stormwater and adverse effects on land and vegetation by control of cleaning activities and discharges	Use only water based, non-toxic paints and use only water to clear point brushes and rollers			
	Control all run-off from cleaning activities			
	Discharge only non-toxic cleaning products generally			
3.3 Control soil erosion	Identify the existing drainage paths on the Site and protect them against siltation			
	Protect vulnerable and exposed surfaces and stockpiles against scouring			
	Install the following sediment control devices before starting construction (LIST THE DEVICES):			
	•			

## 2. PRELIMINARIES

ENVIRONMENTAL OBJECTIVES	ACTION TO BE TAKEN	WHEN ACTION WILL BE TAKEN	PERSON RESPONSIBLE	ACTION COMPLETED
	Monitor and manage the effectiveness of sediment control devices			
	Remove sediment control devices when no longer required			
3.4 Prevent release of soil contamination to the environment	Establish, before commencing work on the Site, in consultation with the Principal, if contaminated soil is present at the Site			
	If contaminated soil is present, manage the work to prevent release to the environment			
3.5 Manage refrigerants and other dangerous goods to meet statutory requirements	Ensure the procedures used for the charging and disposal of refrigerants and use of dangerous goods meet statutory obligations			
	Use appropriately trained employees			
	Obtain the licences required			
	Document dangerous goods identification, disposal and management, and retain the documentation			
3.6 Minimise noise and vibration impacts on neighbours, occupants and users of any facility	Comply with noise limits and conditions prescribed by the EPA, Department of Environment and Conservation and Council (as applicable)			
	Use equipment in good repair and condition			
	Use noise suppression equipment (e.g. silencers on compressors) and acoustic barriers as required			
	Do not expose workers, neighbours or visitors to excessive noise, and cooperate and coordinate with operators of any neighbouring facility			
	Do not expose people or property to excessive vibrations			
3.7 Comply with Trade Waste Licence conditions applicable to the facility	Implement procedures to avoid breaches of the Trade Waste Licence conditions (may apply to discharges from cooling water systems, condenser water systems, heating water systems, cooking facilities, engine discharges, water treated with chemicals or where large sediment loads exist)			
3.8 Minimise air	Minimise areas of exposed earth and stockpiles			

## 2. PRELIMINARIES

ENVIRONMENTAL OBJECTIVES	ACTION TO BE TAKEN	WHEN ACTION WILL BE TAKEN	PERSON RESPONSIBLE	ACTION COMPLETED
pollution from dust and emissions	Cover and secure materials in open transport			
	Use water sprays and/or other means to control dust			
	Keep emissions within statutory or other required limits			
	Minimise fire risks, and prevent and control fires			
3.9 Dispose of waste in accordance with statutory requirements	Implement appropriate disposal procedures for all waste items, including using lawful places for disposal, recording and reporting on the method and location of disposal and any non-conformances			
	<b>EITHER</b> Provide valid disposal certificates for each applicable item <b>OR</b> Provide company certification of appropriate disposal of the following (LIST THE ITEMS): <ul style="list-style-type: none"> <li>• Packaging materials</li> <li>• Replaced or redundant materials</li> <li>• Chemicals</li> <li>• Oils and greases from machinery, cooking and other processes</li> <li>• Paints and solvents, including those used to clean equipment, tools and brushes</li> <li>• Cleaning materials and rags</li> <li>• Materials unsuitable for re-use, including hazardous materials such as asbestos</li> </ul>			
3.10 Minimise damage to the environment from emergencies	Document emergency procedures to manage all reasonably foreseeable harm, including spills and other environmental emergencies			
	Ensure emergency procedures are followed			
	Obtain the agreement of the Principal to procedures for handling oil, chemicals and other dangerous goods before placing them on the Site, including secure storage arrangements			

## 2. PRELIMINARIES

ENVIRONMENTAL OBJECTIVES	ACTION TO BE TAKEN	WHEN ACTION WILL BE TAKEN	PERSON RESPONSIBLE	ACTION COMPLETED
	Re-instate and clean damaged areas and features, including work areas			
	Re-instate damaged eco-systems and features to their previous condition			
	Identify key contacts: (LIST NAMES and ROLES) •			
3.11 Comply with environmental requirements and rectify breaches	Inspect the Site daily to ensure appropriate environmental controls are in place and operating effectively, and that all environmental management requirements are being met			
	Cooperate with environmental audits by others			
	Rectify any environmental breaches identified within the time specified in an audit or by the Principal			
<b>4. RECORDS AND REPORTING</b>				
4.1 Provide sufficient documentation to demonstrate appropriate environmental management, including:	Prepare, submit and update the Environmental Management Plan			
	Maintain and submit records of environmental training			
	Report on implementation of the Environmental Management Plan			
	Submit applicable waste disposal certificates and/or company certification of appropriate disposal			
	Submit to the Principal copies of correspondence with regulators, including incident reports and notification of non-compliances or fines			
	Submit documentation evidencing that the causes of non-compliances have been corrected			
	Keep records for inspection securely filed using an effective document retrieval system			
4.2 Report environmental incidents	Immediately report all environmental incidents to the Principal			
	Immediately report environmental incidents as otherwise required			



## 2. PRELIMINARIES

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**END OF SECTION - PRELIMINARIES**

## A GENERAL REQUIREMENTS

### 1 GENERAL

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#### 1.1 SPECIFIED IN THIS SECTION

##### Outline

The works are to comprise the provision of all materials, labour, transport, tools, plant, applications, payment of fees and everything else necessary for the construction, installation, testing, commissioning and maintenance of the works as detailed in this specification, together with all minor and incidental work not specifically mentioned herein, to the true intent and meaning of this specification, and the accompanying drawings.

The aim is to replace old and outdated equipment with new equipment and new controls to improve reliability, control and efficiency and reduce energy costs.

The system is to be changed from a constant volume, multi-zone system with direct expansion (DX) cooling coils to a variable volume system with chilled water cooling coil.

The changes include the following: -

- Remove the existing refrigeration compressors, air cooled condenser, direct expansion cooling coils and associated pipework, equipment and controls.
- Remove the existing, oil fired, heating water boiler, circulating pump, heating coil, underground oil tank, flue and associated pipework, equipment and controls. Inaccessible pipework and flue in the riser shaft may be left in position.
- Install a new chiller together with a remote, air cooled condenser including unloading the equipment from the delivery vehicle and hoist into position.
- Provide a chilled water coil to replace the existing DX coils,
- Clean and protect from rust existing zone face and bypass dampers. The multi-zone function will be retained to provide control of the supply duct temperature to each zone.
- Provide chilled water pump, feed and expansion tank, piping, valves, insulation and metal sheathing to form a complete system. Provide new stands or when suitable existing stand may be modified, repaired and reused.
- Provide new motors and variable speed drives to the existing supply and return fans.
- Enlarge existing outside air intake and provide a new motorised damper to utilise fully economy cycle.
- Provide variable air volume (VAV) boxes where shown on drawings and modify ductwork to suit. Blank off redundant spigots and provide new spigots.
- Provide new ceiling diffusers and linear slot diffusers with directional control as documented on the drawings. Existing linear slot diffusers might be reused if their performance is satisfactory however all flexible ducts have to be replaced.
- Repair/provide new thermal insulation to existing ducts where required.
- Upgrade the existing Building Management Control System (BMCS) and all necessary wiring and controls to control and monitor the old and new plant and VAV boxes. is to be considered if significantly cheaper and still ensuring reliability of the system. Alternatively consider provision of a new (BMCS) if more practical and with similar cost.

- All associated electrical work.
- All associated building work, including plinths, roof penetrations and flashing, removal of parts of the ceiling as necessary and reinstatement of the ceilings. Replace any damaged ceiling tiles. Repair any damage to the building caused by the air conditioning upgrade.
- Painting and labelling.
- Balance, test and commission the complete system, including existing reused equipment, services and systems.
- Provide programmed preventative and breakdown maintenance of the existing and reused mechanical services during the construction period and the defects liability period. Maintenance of plant scheduled to be replaced is to be adequate to keep it in good, safe working condition until it is replaced.
- Provide comprehensive maintenance of the new plant, equipment and controls during the defects liability period.
- Provide programmed preventative and breakdown maintenance for the 2 years commencing at the end of the defects liability period. This period may be extended a further 2 years

## 1.2 AIMS

### General

Selections: As shown on the drawings.

Design: Provide design work necessary to enable completion of the works as documented.

### Cooling and heating performance

Air quantities: Achieve air quantities under operating conditions given that the air quantities in the contract documents are for standard dry air with a density of  $1.2 \text{ kg/m}^3$ .

Indoor conditions: Maintain the conditioned areas, as measured at the points of control in accordance with the **Indoor design conditions schedule** when loads imposed by the outdoor conditions stated in the **Outdoor design conditions schedule** are not exceeded.

### Electrical

General: Supply system to be 415V, 3-phase, 4-wire, 50Hz.

Fault level protection: To withstand the fault level of the incoming supply at the equipment location.

### Noise levels

- Conference, Training and Interview rooms NR 35
- Mechanically ventilated areas NR 45
- Other rooms: To be within the limits as specified in AS 2107.

Noise at site boundary: In accordance with NSW EPA requirements.

## 1.3 CROSS REFERENCES

### Common technical requirements

Associated worksections: Conform to the following:

- *Adhesives, sealants and fasteners.*

- *Fire-stopping.*
- *Quality.*
- *Demolition.*

### Cross referencing

Within the text:

- Worksection titles are indicated by *Italicised* text.
- Clause titles are indicated by **Bold** text.

## 1.4 STANDARDS

### General standards

Degree of electrical protection (IP Code): To AS 60529.

Electrical work: To AS/NZS 3000.

Electromagnetic compatibility of electrical and electronic apparatus: To AS/NZS 4251.1 and AS/NZS 4252.1.

Mechanical ventilation and air-conditioning: To AS/NZS 1668.1 and AS 1668.2, as required by the Building Code of Australia.

Microbial control: To AS/NZS 3666.1.

Refrigeration systems: To AS 1677.

Ductwork for air-handling systems in buildings: To AS 4254

Air filters for use in general ventilation and air conditioning: To AS 1324

Rotating and reciprocating machinery noise and vibration: Vibration severity in Zone A to AS 2625.1 and AS 2625.4.

Sanitary plumbing and drainage: To AS/NZS 3500.2.

Sound power level tests: To AS 1217.5 and AS 1217.7.

Water supply: To AS/NZS 3500.1.

## 1.5 HAZARDOUS MATERIALS

### Generally

Where equipment involving hazardous materials is to be modified, demolished or removed comply with relevant clauses in other sections of this specification and all relevant legislation governing the safe handling and removal of hazardous materials.

A hazardous materials survey on the building was carried out in June 2005. A full copy of the report will be made available to the contractor. The report listed the following:

### Asbestos

Asbestos was detected in the items as follows:

- Heating water boiler and flue in the plant room– in gaskets.
- Soffit lining of colonnades, partition walls in toilets and cleaner's cupboard, infill panels inside the ceiling - in asbestos cement sheeting.

The asbestos containing materials were reported as being in good and stable condition with minimal risk of fibre release. The risk category was considered to be Priority 4: Negligible risk under present conditions.

#### **Lead based paints**

Lead based paints were detected in the plant room in supply air ducting, pumps structural supports and air conditioning control panel.

#### **Synthetic Mineral Fibres (SMFs)**

The report made no mention of synthetic mineral fibres, however it is reasonable to expect that existing building and ductwork insulation may include SMFs and appropriate precautions should be exercised.

### **1.6 EXISTING AIR CONDITIONING SYSTEM DESCRIPTION**

The building is generally of concrete construction and consists of 3 levels plus a roof top plant room.

The air conditioning consists of one built up multi-zone air handling unit serving 11 zones (three perimeter zones for each level, central zone for levels 1 and 2 and central zone for level 3). The DX cooling coil is in 4 sections and is fitted with face and by pass dampers. A hot water heating coil is located above cooling coils, There is a return air fan and the return and outside air dampers are arranged to allow a full outside air economy cycle.

The refrigeration system consists of 4 reciprocating compressors operating on R22 with 2 remote, air cooled condensers. Heating water is provided by an oil fired boiler located in a separate room.

Zone temperature control is achieved by temperature sensors on each level to control the cooling coil face and bypass dampers, and the heating coil.

### **1.7 OCCUPIED BUILDING**

#### **Work Program**

Contractor to develop a work implementation plan in consultation with Principal Representative. An agreement and approval of the implementation plan is required by Principal Representative before contractor can commence works.

The building will be occupied throughout the construction period. Ensure that ventilation and sufficient cooling and heating capacity is available to provide reasonable conditions during normal office hours. No functions of the building will be interrupted except where such stoppage is unavoidable and takes place only as planned and agreed to by. Principal Representative.

Any work that will require the interruption of the normal operation of the building, and/or will cause significantly inconvenience to occupants shall be carried out at times approved by Principal Representative. In general, all work that will cause interruptions will be allowed only at times outside the normal working hours and/or at specific hours at weekends. Such works would include, but not limited to:

- All works within the building that will restrict normal access at any level
- All works within the building, other than the plant room area that would adversely affect the occupants and/or normal operation.
- All works that would involve the use of power tools or similarly noisy procedures in location that would adversely affect the occupants and/or normal operation.
- All works that will require the temporary loss of power to the building, air conditioning plant and equipment

- All works that will require the temporary loss of air conditioning and ventilation supply to the building. Note in cool weather it may be possible to achieve satisfactory conditions by operating the plant on outside air cycle with no refrigeration to allow work on the refrigeration system to proceed.

Within one week of the contract commencement, the contractor shall prepare a work program, complete with all main activities and dates indicating clearly all critical activities and target dates to be met to achieve the specified period of completion.

The proposed work program must be designed to minimise the losses of cooling and ventilation provision. Unavoidable shutdowns can only take place at times permitted by Principal Representative. Works that would cause Occupation Health and Safety issues to the occupants must only be carried out outside normal working hours and/or during hours that are coordinated with Principal Representative.

All request or notice must be in writing and provide with adequate time to notice the Client and Principal Representative.

All works shall be carried out in accordance with schedule of work stated in the work program. Any amendments to the schedule of works shall be mutually agreed by the Client and Principal Representative. Claim for additional costs for unforeseen difficulties with this aspect of the works will not be accepted.

### **Temporary Protection**

Protection of the building fabric and finishes to prevent damage. Making good of all damage made by this contract to all items of building fabric and finishes during the execution of the works.

Provide drop sheets and covers to protect equipment, furniture and building surfaces during construction.

Remove all the rubbish and clean up the work areas inside the building everyday.

Where work is carried out in an area outside normal hours, the area is to be cleaned and any staging removed so that staff can resume their normal business during office hours.

## **1.8 CRANAGE**

The contractor must be deemed to have obtained all necessary details of, and to have included all necessary costs for plant deliveries, crantage, rigging and hoisting. Where required make temporary holes in the plant room roof to allow for equipment to be installed Provide all necessary weatherproofing and reinstate the roof as soon as possible to minimise the risk of damage. Claim for additional costs for unforeseen difficulties with this aspect of the works will not be accepted.

## **1.9 DISPOSAL OF PLANT REMOVED**

The contractor must dispose or deliver to other site (as per the schedules under "Demolition" clauses) of all items of existing plant, which are to be removed under the contract. Removed equipment, pipes, valves, electric and control cables, circuit breakers, relays and etc must not be re-used in the new installation works.

## **1.10 SEQUENCE OF WORKS**

The contractor has to develop the actual sequence of works and to submit to the client and Principal Representative for approval.

Claim for additional costs for unforeseen difficulties with this aspect of the works will not be accepted.

## 1.11 PRECEDENCE

### Precedence

General: Requirements of subsequent worksections of the specification override conflicting requirements in this worksection.

## 1.12 REFERENCED DOCUMENTS

### Contractual relationships

General: Responsibilities and duties of the principal, contractor and contract administrator are not altered by requirements in the documents referenced in this specification.

### Current editions

General: Use referenced documents which are the editions, with amendments, current 3 months before the closing date for tenders, except where other editions or amendments are required by statutory authorities.

## 1.13 INTERPRETATIONS

### Abbreviations

General: For the purposes of this worksection the abbreviations given below apply.

- APAS: Australian Paint Approval Scheme.
- AS: Australian Standard.
- BCA: Building Code of Australia.
- NATA: National Association of Testing Authorities.
- NZS: New Zealand Standard.
- PCA: Plumbing Code of Australia.
- SSL: Scientific Services Laboratory.

### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Attendance: “Attendance”, “provide attendance” and similar expressions mean “give assistance for examination and testing”.
- Contract administrator: “Contract administrator” has the same meaning as “architect” or “superintendent” and is the person appointed by the “owner” or “principal”.
- Geotechnical site investigation: The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
- Give notice: “Give notice”, “submit”, “advise”, “inform” and similar expressions mean “give notice (submit, advise, inform) in writing to the contract administrator”.
- Hold point: The activity cannot proceed without the approval of the contract administrator.
- IP: “IP”, “IP code”, “IP rating” and similar expression have the same meaning as “IP Code” in AS 60529.
- Maintenance period: Synonymous with “Defects liability period”.

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### 3. TECHNICAL SPECIFICATION

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- Obtain: “Obtain”, “seek” and similar expressions mean “obtain (seek) in writing from the contract administrator”.
- Professional engineer: A person who is listed on the National Professional Engineers Register (NPER) in the relevant discipline at the relevant time.
- Metallic-coated steel: Includes zinc-coated steel, zinc/iron alloy-coated steel, and aluminium/zinc-coated steel.
- Pipe: Includes pipe and tube.
- Principal: “Principal” has the same meaning as “owner”, “client” and “proprietor” and is the party to whom the Contractor is legally bound to construct the works.
- Proprietary: “Proprietary” mean identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Provide: “Provide” and similar expressions mean “supply and install”. Installation shall include development of the design beyond that documented.
- Tests:
  - Pre-completion tests: Tests carried out before completion tests.
  - Type tests: Tests carried out on an item identical with a production item, before delivery to the site.
  - Production tests: Tests carried out on a purchased item, before delivery to the site.
  - Site tests: Tests carried out on site.
  - Completion tests: Tests carried out on completed installations or systems before the date for practical completion, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements. The superintendent may direct that completion tests be carried out after the date for practical completion.
- Registered testing authority:
  - The CSIRO Division of Manufacturing and Infrastructure Technology (CSIRO-MIT).
  - An authority registered by the National Association of Testing Authorities (NATA) to test in the relevant field.
  - An organisation outside Australia recognised by NATA through a mutual recognition agreement.
- Required: Means required by the documents, the local council or statutory authorities.
- If required: A conditional specification term for work which may be shown in the documents or be a legislative requirement.
- Samples: Includes samples, prototypes and sample panels.
- Supply: “Supply”, “furnish” and similar expressions mean “supply only”.
- Verification: Provision of evidence or proof that a performance requirement has been met or a default exists.
- Witness points: Provides an opportunity to attend an activity but does not involve an obligation. The activity can proceed without approval from the contract administrator.



- Network Utility Operator: A person who undertakes the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or a stormwater system.
- Hot dip galvanized: Zinc coated to AS/NZS 4680 with coating thickness and mass to Table 1.

## 1.14 CONTRACT DOCUMENTS

### Services diagrammatic layouts

General: Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable.

Before commencing work:

- Obtain measurements and other necessary information.
- Coordinate the design and installation in conjunction with all trades.

### Levels

General: Spot levels take precedence over contour lines and ground profile lines.

## 1.15 DRAWINGS AND MANUALS FOR EXISTING SERVICES

### General

Warranty: No warranty is given as to the completeness or accuracy of drawings and/or manuals of existing services.

### Existing mechanical services drawings

The following additional drawings are the original design drawings. They do not contain “as installed” information or details of later changes and are issued for information purposes only.

MISC. 354 – 3/5 Plant room plan & elevation

MISC. 354 – 3/6 Air conditioning sections

## 1.16 PERFORMANCE

### General

General: If required, provide structures, installations and components as follows:

- Fixed access ways: To AS 1657.
- Structural design actions: To AS/NZS 1170.0.

## 1.17 INSPECTION

### Notice

General: Maximum notice for inspections to be made: 3 working days.

Inspection: If notice of inspection is required in respect of parts of the works that are to be concealed, advise when the inspection can be made before concealment.

### Attendance

General: Provide attendance.

## 1.18 SUBMISSIONS

### Authorities

Authorities' approvals: Submit documents showing approval by the authorities whose requirements apply to the work.

Correspondence: Submit copies of correspondence and notes of meetings with authorities.

### Electronic submissions

File format: Drawing: AutoCAD.dwg or Microstation.dgn; Text document: pdf or word format.

Transmission medium: email or CD email shall be limited to 4 MB file size only.

### Hard copy submissions

Quantity: 3 sets as paper prints

- Bound documents: 3 sets as paper prints
- Loose documents larger than A3: One transparency on heavyweight plastic film the same size as the standard contract drawings.
- Loose documents up to and including A3: One copy.

Standard contract drawing size: A1

### Errors

General: If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

### Identification

General: Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent contract document references. Include service connection requirements and product certification. Identify proposals for non-compliance with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

### Inspection and testing plan

General: Submit an inspection and testing plan which is consistent with the construction program. Include particulars of test stages and procedures.

Test reports: Submit written reports on nominated tests.

### Notice

Minimum notice: 5 working days

### Materials and components

Product certification: If products must conform to product certification schemes, submit evidence of conformance.

Product data: For proprietary equipment, submit the manufacturer's product data as follows:

- Technical specifications and drawings.
- Type-test reports.
- Performance and rating tables.

- Recommendations for installation and maintenance.
- Additional product data for services equipment:
  - Model name, designation and number.
  - Country of origin and manufacture.
  - Capacity of all system elements.
  - Size, including required clearances for installation.
  - Materials used in the construction.

Proposed products schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use within 3 weeks of site possession.

### **Samples**

Submission: Submit nominated samples.

Incorporation of samples: If it is intended to incorporate samples into the works, submit proposals. Incorporate samples in the works which have been endorsed for incorporation. Do not incorporate other samples.

Retention of samples: Keep endorsed samples in good condition on site, until practical completion.

### **Drawings**

General: Minimum A1 drawing size.

Standard: To AS 1100 Parts 101, 201, 301, 401 and 501 as applicable.

Building work drawings: Submit detailed dimensioned drawings showing all:

- Access doors and panels.
- Conduits to be cast in slabs.
- Fire and smoke dampers including dimensional tolerances.
- Floor wastes.
- Holding down bolts and other anchorage and/or fixings required complete with loads to be imposed on the structure during installation and operation.
- Openings, penetrations and block-outs.
- Pipe sleeves.
- Plinths, kerbs and bases.
- Required external openings.

Mechanical services drawings: Submit the following:

- Detailed drawings, at 1:50 scale or larger, showing:
  - Ductwork, pipework and equipment layouts and sections. Show the location of fire rated building elements.
  - Diffuser and grille reference numbers corresponding to commissioning test results.
  - Riser layouts and sections.

- Plant room layouts and sections.
- Acoustic details.
- Conditioner construction details
- Seismic restraint details.
- Relevant performance data for each item of equipment including make, model, speed, capacity etc., as appropriate.
- Piping and other schematic drawings including numbering of each valve to correspond to specified valve tags.
- Submission drawings required by authorities.
- Automatic control details.
- Switchboard details.
- Wiring diagrams.

Services coordination: Ensure coordination with other building and service elements. Show adjusted positions on the shop and record drawings.

Space requirements: Check space requirements of equipment and services indicated diagrammatically in the contract documents and submit a report on consequent variations to the design.

### Shop drawings

General: Include dimensioned drawings showing details of the fabrication and installation of services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

Diagrammatic layouts: Coordinate work shown diagrammatically in the contract documents, and submit dimensioned set-out drawings.

Submission medium:

- Electronic.
- Hard copy.

### Execution details

General: Before starting the respective portions of the installation, submit the following:

- Embedded services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls.
- Fixing of services: Typical details of locations, types and methods of fixing of services to structure.
- Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.

### Electrical loading information

General: Submit electrical loading information for all equipment before completion of the main switchboard shop drawings.

Electric motors: Ensure motor efficiency and power factor are in accordance with the **Electric Motors** clause.

Loading and connection: Submit the information for items not supplied from the mechanical switchboards.

Starting characteristics: Submit details for motors with reduced current starting. Ensure starting characteristics are within the characteristics of the respective submain protection devices.

Switchboards: Submit the following information for each mechanical switchboard:

- Board location and designation.
- For each submain connected to the board, submit the following for each item connected to it:
  - Submain designation.
  - Item designation and name.
  - Power rating in kW.
  - Number of phases.
  - Full load amps per phase.
  - Power factor.
  - Total amps on each phase for respective sub main.

### Quantity and format

General: Refer to **Submissions**.

### Marking and labelling

General: Before marking and labelling submit:

- Samples of the proposed labels.
- A schedule showing, for each item or type of item:
  - A description of the item or type of item sufficient to identify it.
  - The proposed text of the marking or label
  - The proposed location of the marking or label.

### Building penetrations

General: If it is proposed to penetrate or fix to the following, submit details of the methods proposed to maintain the required structural, fire and other properties:

- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings. If penetrating membranes, provide a waterproof seal between the membrane and the penetrating component.

### Technical data

General: Take note that fan pressures and pump heads provided in the contract documents are based on provisional equipment selections and estimated pressure drops.

Selections: Before ordering equipment, calculate the respective system pressure losses based on the equipment offered and layouts shown on the shop drawings and submit the proposed selections.

Submissions: Submit technical data for all items of plant and equipment.

Data to be submitted: Include at least the following information in technical submissions:

- Assumptions.
- Calculations.
- Model name, designation and number.
- Capacity of all system elements.
- Country of origin and manufacture.
- Materials used in the construction.
- Size, including required clearances for installation.
- Certification of compliance with the applicable code or standard.
- Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change.
- Manufacturers' technical literature.
- Type-test reports.

#### **Certification**

General: Submit certification that the plant and equipment submitted meets all requirements and capacities of the contract documents except for departures that are identified in the submission.

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## **2 PRODUCTS**

### **2.1 TESTS**

#### **Notice**

Notice: Give notice of time and place of nominated tests.

Minimum notice for inspections to be made: 5 working days.

#### **Attendance**

General: Provide attendance on tests.

#### **Testing authorities**

General: Except for site tests, have tests carried out by a Registered testing authority.

- Reports: Submit copies of test reports, including certificates for type tests, showing the observations and results of tests and conformance or non-conformance with requirements.
- Site tests: Use instruments calibrated by authorities accredited by a Registered testing authority.

## 2.2 MATERIALS AND COMPONENTS

### Consistency

General: For the whole quantity of each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

### Corrosion resistance

General: Conform to the following corrosivity category with regard to worksection corrosion resistance tables.

Corrosivity category: Low

### Corrosion protection

General: Provide insulation between dissimilar metals to prevent galvanic corrosion.

### Manufacturers' or suppliers' recommendations

Proprietary items: Select, if no selection is given, and transport, deliver, store, handle, protect, finish, adjust, prepare for use, and provide manufactured items in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Proprietary systems/assemblies: Assemble, install or fix to substrate in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Project modifications: Advise of activities that supplement, or are contrary to, manufacturer's or suppliers' written recommendations and instructions.

Product certification: If products must comply with product certification schemes, provide them in accordance with the certification requirements.

### Proprietary items

Implication: Identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item.

Alternatives: If alternatives are proposed, submit proposed alternatives and include samples, available technical information, reasons for proposed substitutions and cost. If necessary, provide an English translation. State if provision of proposed alternatives will necessitate alteration to other parts of the works and advise consequent costs.

### Sealed containers

General: If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

### Sources policy

General: A preference for Australian or New Zealand goods.

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## 3 EXECUTION

### 3.1 DEMOLITION

#### General

General: Decommission, isolate, demolish and remove from the site all existing redundant mechanical services equipment as shown on the drawings including minor associated components that become redundant as a result of the demolition.

### Refrigeration systems

General: Undertake demolition work on refrigeration systems in conformance with:

- AS/NZS 1677.2.
- The recommendations of SAA HB40.1 and SAA HB40.2.

### Salvaged materials

General: Except as listed in the **Salvaged materials for re-use schedule** and all existing materials removed are Demolished for Removal as defined in the *Demolition* worksection. Ownership of materials is as defined in the *Demolition* worksection.

Breaking down: Disassemble or cut up equipment where necessary to allow removal.

Salvaged materials: Salvage all components associated with the listed items. Minimise damage during removal and deliver to the locations scheduled.

## 3.2 WORK ON EXISTING SYSTEMS

### General

General: Before starting work on existing air and water systems, for equipment to be worked on:

- Measure existing air and water quantities.
- Measure total flows and pressure drops.
- Measure total and static pressures at significant points in the system.

Submit the results for information.

## 3.3 INSTALLATION

### General

Fixing: If non-structural building elements are not suitable for fixing equipment and services to, fix directly to structure and trim around holes or penetrations in non-structural elements.

Installation: Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.

Lifting: Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

Suspended ground floors: Keep all parts of services under suspended ground floors > 150 mm clear of the ground surface. Make sure services do not impede access.

Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements.

### Differential movement

General: If the geotechnical site investigation report predicts differential movements between buildings and the ground in which pipes or conduits are buried, provide movement control joints in the pipes or conduits.

- Location: Adjacent to the pipe or conduit supports which are closest to the perimeter of the building.
- Arrangement: Arrange pipes and conduits to minimise the number of movement control joints.



- Magnitude: Accommodate the predicted movements.

### 3.4 BUILDING PENETRATIONS

#### Embedded pipes

General: Do not embed pipes that operate under pressure in concrete or surfacing material.

#### Penetrations

Fire rated building elements: Seal penetrations with a system conforming to AS 4072.1.

Non-fire rated building elements: Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustically rated, maintain the rating.

#### Sleeves

General: If piping or conduit penetrates building elements, provide metal or UPVC sleeves formed from pipe sections as follows:

- Diameter (for non fire-rated building elements): Sufficient to provide an annular space around the pipe or pipe insulation of at least 12 mm.
- Prime paint ferrous surfaces.
- Terminations:
  - If cover plates are fitted: Flush with the finished building surface.
  - In fire-rated and acoustic-rated building elements: 50 mm beyond finished building surface.
  - In floors draining to floor wastes: 50 mm above finished floor.
  - Elsewhere: 5 mm beyond finished building surface.
- Termite management: To AS 3660.1.
- Thickness:
  - Metal:  $\geq 1$  mm.
  - UPVC:  $\geq 3$  mm.

#### Sleeves for cables

General: For penetrations of cables not enclosed in conduit through ground floor slabs, beams and external walls provide sleeves formed from UPVC pipe sections.

- MIMS cables: Provide sleeves for penetrations through masonry.

### 3.5 CONCRETE PLINTHS

#### Construction

General: Provide plinths for all floor mounted equipment.

- Concrete: Grade N20.
- Finish: Steel float flush with the surround.
- Reinforcement: Single layer of F62 fabric.

- Surround: Provide galvanized steel surround at least 100 mm high and 1.6 mm thick. Fix to the floor with masonry anchors. Fill with concrete.

### 3.6 PLANT AND EQUIPMENT ACCESS

#### General

Services and equipment: Locate and arrange all services and equipment so that:

- Failure of plant and equipment (including leaks) does not create a hazard for the building occupants.
- Failure of plant and equipment (including leaks) cause a minimum or no damage to the building, its finishes and contents.
- Fan coil units, valves or other potential leak sources are not be located over rooms containing water sensitive equipment or finishes.
- Inspection and maintenance operations can be arranged to minimise inconvenience and disruption to building occupants or damage to the building structure or finishes.
- Safe tray and an overflow pipe are provided to each tank, hot water heater and storage vessel.
- Services and equipment are readily accessible for inspection and maintenance and arranged so that inspection and maintenance can be carried out in a safe and efficient manner. Include the following:
- Conform to the relevant requirements of AS 1470, AS 1657, AS/NZS 1892.1 and AS/NZS 2865.
- If parts of the plant (including high level tanks) require regular inspection and maintenance either locate plant so it is safely accessible from floor level or provide permanent access platforms and ladders.
- In false ceilings locate items of equipment that require inspection and maintenance above tiled parts where possible. If this is not possible (for example if above set plaster or other inaccessible ceilings) provide access panels. Arrange services and plant locations to reduce the number of access panels. Coordinate with other trades to use common access panels where feasible.
- Modify manufacturer's standard equipment when necessary to provide the plant access in the contract documents.

### 3.7 ELECTRIC MOTORS

#### General

Dimensions and performance: To AS 1360.11.

Installation: To AS 1359.107.

Motors  $\geq 0.75$  kW: Three phase.

Noise and vibration limits: To AS 1359.109 and AS 1359.114.

Noise and vibration: Support motors to minimise noise and vibration.

#### Motor selection

Provide motors selected in conformance with AS 1359.101, motor manufacturers' recommendations and the following:

- Motor enclosure classification and degree of protection: To AS 1359.20 and AS 60529.

### 3. TECHNICAL SPECIFICATION

- Motor enclosure: Provide enclosures appropriate to the environment in which the motor operates.
- Motor operation: Select motor for mode of operation appropriate to the duty e.g. continuous, frequent starting and stopping.
- Motor power rating: The greater of the specified minimum motor size and 110% of the maximum load of the driven equipment.
- Speed and torque: To suit the driven equipment. Ensure each motor develops torque relative to the starting load of the driven machine such that it runs up to full speed steadily and within a time period compatible with motor winding temperatures, class of insulation and rating of the starting equipment.
- Starting method: As specified or, if none specified, appropriate to the driven equipment, electrical services infrastructure and supply authority requirements.
- Starting performance: To IEC 60034-12 and AS 1359.41.
- Temperature rating: Select motors for continuous operation at an ambient  $\geq 40^{\circ}\text{C}$ .

Variable frequency drive: If supplied from variable frequency drives, provide motors that, in addition to the above:

- Are selected for low noise and vibration under all operating conditions.
- Have Class F insulation with Class B temperature rise or better.

#### Motor power factor and efficiency

Motors specified as high efficiency: To AS/NZS 1359.5 Table A3 or Table B3.

All other motors: To AS/NZS 1359.5 Section 2.

<http://www.greenhouse.gov.au/motors/meps/index.html> Power factor: In conformance with the **Minimum power factor table** for the respective motor size.

#### Minimum power factor table

Rated output kW	Minimum power factor at rated output
$\leq 0.37$	0.72
$> 0.37$ to $\leq 0.55$	0.76
$> 0.55$ to $\leq 3.0$	0.83
$> 3.0$ to $\leq 18.5$	0.86
$> 18.5$ to $\leq 37$	0.87
$> 37$	0.88

#### Overload protection

Provide each motor with overload protection.

- Motors  $\geq 22$  kW: Fit embedded winding temperature thermistors complying with AS 1023.1 in each phase and connect to a protection relay that trips the starter in the event of over temperature. Match trip operating temperature to motor winding insulation classification.

## 3.8 VIBRATION SUPPRESSION

### General

General: Minimise the transmission of vibration from rotating or reciprocating equipment to other building elements.

### Connections

General: Provide flexible connections to rotating machinery and assemblies containing rotating machinery.

- Isolate ducts by flexible connections.
- Isolate pipes by incorporating sufficient flexibility into the pipework or by use of proprietary flexible pipe connections installed so that no stress is placed on pipes due to end reaction.

### Inertia bases

General: If necessary to achieve the required level of vibration isolation, provide inertia bases having appropriate mass and conforming as follows:

Construction: Steel or steel-framed reinforced concrete. Position foundation bolts for equipment before pouring concrete.

- Supports: Support on vibration isolation mountings using height saving support brackets.

### Speeds

General: If no maximum speed is prescribed do not exceed 1500 rpm for direct driven equipment.

### Vibration isolation mountings

General: Except for external equipment that is not connected to the structure of any building, support rotating or reciprocating equipment on mountings as follows:

- For static deflections < 15 mm: Single or double deflection neoprene in-shear mountings incorporating steel top and base plates and a tapped hole for bolting to equipment.
- For static deflections  $\geq$  15 mm: Spring mountings.

Installation: Set and adjust vibration isolation mounting supports to give adequate clearance for free movement of the supports.

Selection: Provide mountings selected to achieve 95% isolation efficiency at the normal operating speeds of the equipment.

Spring mountings: Provide freestanding laterally stable springs as follows:

- Clearances:  $\geq$  12 mm between springs and other members such as bolts and housing.

High frequency isolation: 5 mm neoprene acoustic isolation pads between baseplate and support.

- Levelling: Provide bolts and lock nuts.
- Minimum travel to solid:  $\geq$  150% of the designated minimum static deflection.

Ratio of mean coil diameter to compressed length at the designated minimum static deflection:  
 $\square$  0.8:1.

- Snubbing: Snub the springs to prevent bounce at start-up.

Vertical resilient limit stops: To prevent spring extension when unloaded, to serve as blocking during erection and which remain out of contact during normal operation.

### 3.9 SEISMIC RESTRAINT

#### Provisions

General: Arrange all components, other than service items exempted in AS 1170.4 clause 5.1.4, to resist seismic loads determined in accordance with AS 1170.4. Securely fix all plant and equipment to the building structure. Do not rely on gravity and/or friction to resist seismic forces.

- Anti-vibration mounts: Use horizontally restrained type.

Components: Do not use components that will be damaged by earthquake conditions. Protect systems against the adverse effects of components such as mercury switches that, although not damaged by earthquake, may malfunction.

### 3.10 PAINTING AND FINISHES

#### General

General: If exposed to view (including in plant rooms) paint new services and equipment.

Surfaces painted or finished off-site: Conform to *Metals and prefinishes*.

Exceptions: Do not paint chromium or nickel plating, anodised aluminium, GRP, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Surfaces with finishes applied off-site need not be re-painted on-site provided the corrosion resistance of the finish is not less than that of the respective finish in the **On-site paint systems table**.

#### Standard

General: Conform to the recommendations of AS/NZS 2311 Sections 3, 6 and 7 or AS/NZS 2312 Sections 5, 8 and 10, as applicable.

Specifications: Conform to the **On-site paint systems table**.

#### On-site paint systems table

Substrate	1 <sup>st</sup> coat	2 <sup>nd</sup> and 3 <sup>rd</sup> coat
Aluminium	APAS-0035/3	APAS-0015/1
Concrete	APAS-0280/1	APAS-0015/1
Copper	APAS-2921	APAS-0024/1
GRP	APAS-2971	APAS-0015/1
Iron and steel	APAS-0032	APAS-0015/1
Organic or inorganic zinc primed metal	APAS-0016/1	APAS-0015/1
Timber	APAS-0181	APAS-0015/1
Metallic-coated steel	APAS-0134	APAS-0015/1

#### Oil and petrol resistant finishes

General: If the finished surface may be subject to oil and/or petrol provide APAS-0024/1 for the 2nd and 3rd coats in the **On-site paint systems table**.

### **Paint application**

Coats: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Ensure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture and free of runs, sags, blisters or other discontinuities.

Combinations: Do not combine paints from different manufacturers in a paint system.

Protection: Remove fixtures before starting to paint and refix in position undamaged on completion.

### **Underground metal piping**

Corrosion protection: Provide corrosion protection for the following:

- Underground ferrous piping.
- Underground non-ferrous metal piping in corrosive environments.

Protection methods: Select from the following:

- Cathodic protection: Sacrificial anodes or impressed current. Incorporate a facility for periodic testing. Comply with the recommendations of AS/NZS 2832.1.
- Continuous wrapping using proprietary petroleum taping material.
- Impermeable flexible plastic coating.
- Sealed polyethylene sleeve.

## **3.11 MARKING AND LABELLING**

### **General**

General: Mark services and equipment to provide a ready means of identification.

- Locations exposed to weather: Provide durable materials.
- Pipes, conduits and ducts: Identify and label to AS 1345.
- Cables: Label to indicate the origin and destination of the cable.

Consistency: Label and mark equipment using a consistent scheme across all services elements of the project.

Operating and maintenance manuals: Provide marking and labelling text identical to the text and terminology used in operating and maintenance manuals.

### **Labels and notices**

General: Select from the following materials:

- Cast metal.
- For indoor applications only, engraved two-colour laminated plastic.
- Proprietary pre-printed self-adhesive flexible plastic labels.
- Stainless steel or brass  $\geq 1$  mm thick with black filled engraved lettering.

Colours: Generally in conformance with AS 1345 as appropriate, otherwise black lettering on white background except as follows.

- Danger, warning labels: White lettering on red background.

- Main switch and caution labels: Red lettering on white background.

Edges: If labels exceed 1.5 mm thickness, radius or bevel the edges.

Fixing: Fix labels securely using screws, rivets, proprietary self-adhesive labels or double-sided adhesive tape.

- If labels are mounted in extruded aluminium sections, use rivets or countersunk screws to fix the extrusions.
- Use aluminium or monel rivets for aluminium labels.

Label locations: Locate labels so that they are easily seen and are either attached to, below or next to the item being marked.

Label text: To correspond to terminology and identifying number of the respective item as shown on the record drawings and documents.

Lettering heights:

- Danger, warning and caution notices:  $\geq 10$  mm for main heading,  $\geq 5$  mm for remainder.
- Equipment labels within cabinets:  $\geq 3.5$  mm.
- Equipment nameplates:  $\geq 40$  mm.
- Identifying labels on outside of cabinets:  $\geq 5$  mm.
- Isolating switches:  $\geq 5$  mm.
- Switchboards, main assembly designation:  $\geq 25$  mm.
- Switchboards, outgoing functional units:  $\geq 8$  mm.
- Switchboards, sub assembly designations:  $\geq 15$  mm.
- Valves:  $\geq 20$  mm.
- Other locations:  $\geq 3$  mm.

Operable devices: Mark to provide a ready means of identification. Include the following:

- Controls.
- Indicators, gauges, meters and the like.
- Isolating switches.

Vapour barriers: Do not penetrate vapour barriers.

### **Piping**

General: Identify piping to AS 1345 throughout its length, including in concealed spaces.

### **Pressure vessels**

General: Mount manufacturer's certificates in glazed frames on a wall next to the vessel.

### **Valves and pumps**

General: Label to associate pumps with their starters and valves. Screw fix labels to body or attach label to valve handwheels with a key ring.

### 3.12 ADDITIONAL MARKING

#### Location

Equipment concealed in ceilings: Provide a label on the ceiling indicating the location of each concealed item requiring access for routine inspection, maintenance and/or operation. In tiled ceilings locate the label on the ceiling grid closest to the item access point. In flush ceilings locate adjacent to closest access panel. Items to be labelled include but are not limited to:

- Fan coil units and terminal equipment (e.g. VAV boxes).
- Fire and smoke dampers.
- Isolating valves not directly connected to items otherwise labelled.
- Motorised dampers.

Wall mounted equipment in occupied areas: Provide labels on wall mounted items in occupied areas including the following:

- Services control switches.
- Temperature and humidity sensors.

#### Labels

General: Provide clear self-adhesive film tape labels with machine printed black lettering.

Label text: To correspond to identifying number of the respective item as shown on the record drawings and documents.

Lettering height:

- Labels < 2000 mm above floor: 3 mm on 6 mm wide tape.
- Labels  $\geq$  2000 mm above floor: 8 mm on 12 mm wide tape.

### 3.13 SOFTWARE

#### General

General: Provide the software required for the operation and management of building services systems and equipment including the following:

Absolute right and all necessary facilities for the principal to modify extend or reduce any or all functions, hardware and software that form part of the system.

- All passwords.
- All software and manuals necessary to modify or extend the software.
- Back-up copies of software in electronic format.

Full listings of all software supplied which has been developed, modified or adapted to meet the requirements of this project.

- Installation of all software updates issued before the end of the defects liability period.
- Record drawings, functional specifications and point schedules of all systems.



### 3.14 RECORD DRAWINGS

#### General

General: Submit record drawings. Show the “as installed” locations of building elements, plant and equipment. Include “as installed” amendments to shop drawings. Show off-the-grid dimensions where applicable.

Date for submission: Within 2 weeks after practical completion.

#### General

General: Show dimensions, types and location of the services in relation to permanent site features and other underground services. Show the spatial relationship to building structure and other services. Include all changes made during commissioning and the maintenance period.

Diagrams: Provide diagrammatic drawings of each system including the following:

- Controls.
- Piping including all valves and valve identification tags.
- Principal items of equipment.
- Wiring.

Drawings: Include all specified shop drawings.

#### Accuracy

Documents: Incorporate all modifications made during the progress of the work and testing period. Show any provisions for the future.

Endorsement: Sign and date all record drawings. Keep one set of shop drawings on site at all times expressly for the purpose of marking changes made during the progress of the works.

#### Drawing layout

General: Use the same borders and title block as the contract drawings.

#### Quantity and format

General: Refer to **Submissions**.

### 3.15 OPERATION AND MAINTENANCE MANUALS

#### General

General: Submit operation and maintenance manuals for installations.

Authors and compilers: Personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Referenced documents: If referenced documents or technical worksections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

Subdivision: By installation or system, depending on project size.

Date for submission: Within 2 weeks after practical completion.

#### Contents

General: Include the following:

- Certificates:

- Certificates from authorities.
- Copies of manufacturers' warranties.
- Product certification.

Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, subconsultants, contractor, subcontractors and names of responsible parties.

Drawings:

Record drawings, full size.

Drawings and technical data: As necessary for the efficient operation and maintenance of the installation.

- Equipment descriptions:
  - - Name, address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.
  - - Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed.
- Maintenance procedures:
  - Detailed recommendations for preventative maintenance frequency and procedures.
  - - Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment.
  - - Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure.
  - - Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply.
- Operation procedures:
  - - Manufacturers' technical literature as appropriate.
- Table of contents: For each volume. Title to match cover.

#### **Format – electronic copies**

Printing: Except for drawings required in the **Record drawings** clause provide material that can be legibly printed on A4 size paper.

Scope: Provide the same material as specified for hardcopy in electronic format.

Quantity and format: Refer to **Electronic submissions**.

#### **Format – hard copy**

General: A4 size loose leaf, in commercial quality, 4 ring binders with hard covers, each indexed, divided and titled. Include the following features:

- Cover: Identify each binder with typed or printed title “*OPERATION AND MAINTENANCE MANUAL*”, to spine. Identify title of project, volume number, volume subject matter, and date of issue.
- Dividers: Durable divider for each separate element, with typed description of system and major equipment components. Clearly print short titles under laminated plastic tabs.
- Drawings: Fold drawings to A4 size and accommodate them in the binders so that they may be unfolded without being detached from the rings. Provide with reinforced punched binder tabs.
- Pagination: Number pages.
- Ring size: 50 mm maximum, with compressor bars.
- Text: Manufacturers’ printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.

Number of copies: 3.

### 3.16 TOOLS AND SPARE PARTS

#### Tools and spare parts schedule

General: At least 8 weeks before the date for practical completion, submit a schedule of tools, portable instruments and spare parts necessary for maintenance of the installation. For each item state the recommended quantity and the manufacturer’s current price. Include the following in the prices:

- Checking receipt, marking and numbering in accordance with the spare parts schedule.
- Packaging and delivery to site.
- Painting, greasing and packing to prevent deterioration during storage.
- Referencing equipment schedules in the operation and maintenance manuals.
- Suitable means of identifying, storing and securing the tools and instruments. Include instructions for use.

Replacement: Replace spare parts consumed during the maintenance period.

### 3.17 TRAINING

#### General

Duration: Instruction to be available for the whole of the commissioning and running-in periods.

Format: Conduct training at agreed times, at system or equipment location. Also provide seminar instruction to cover all major components.

Operation and maintenance manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents in detail with the principal’s staff.

#### Demonstrators

General: Use only qualified manufacturer’s representatives who are knowledgeable about the installations.

### **Maintenance**

General: Explain and demonstrate to the principal's staff the purpose, function and maintenance of the installations.

### **Operation**

General: Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.

### **Seasonal operation**

General: For equipment requiring seasonal operation, demonstrate during the appropriate season and within 6 months.

## **3.18 COMPLETION**

### **Samples**

General: Remove unincorporated samples on completion.

### **Warranties**

General: Name the State Property Authority as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Commencement: Commence warranty periods at practical completion or at acceptance of installation, if acceptance is not concurrent with practical completion.

Approval of installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.

## **B CHILLERS**

### **1 GENERAL**

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#### **1.1 AIMS**

##### **Responsibilities**

Provide a factory assembled, liquid chilled with air cooled, remote condenser and fitted with microprocessor control, HFC-134A refrigerant complete with on board starters and controls.

The chiller shall have an oil free, variable speed drive centrifugal compressor equipped with magnetic bearings, electronic expansion devices, internal power circuits, controls and motor starter.

The chiller shall be fitted with 2 independent refrigeration circuits allowing operation of a chiller if a component in one circuit (i.e compressor or evaporator) fails.

In addition to meeting the performance criteria the chiller must meet the noise level criteria.

#### **1.2 QUALITY ASSURANCE**

##### **Type tests**

To ARI 550/590.

##### **Pressure tests**

Standard: To AS/NZS 1677.2.

##### **Performance rating**

To ARI 550/590.

### **2 PRODUCTS**

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#### **2.1 COMPRESSORS**

Compressor shall be of the oil free centrifugal type, suitable for continuous operation at any load between the minimum and maximum values listed in the schedule and shall be equipped with discharge and suction shutoff valves.

Compressor shall start unloaded and current inrush shall be limited by control to less than 105% of full load amps.

Provide motor cooling by either an integrated liquid refrigerant injection system controlled by the compressor or by suction gas cooling.

#### **2.2 SHELL AND TUBE LIQUID COOLER**

##### **General**

Type: Provide horizontal shell liquid coolers consisting of a shell containing a tube bundle, refrigerant circuits, water drain and vent connections, insulation, and necessary valves and fittings.

### **Flooded type**

Operation: Refrigerant liquid evaporates around the tubes.

Refrigerant system: Submerge the tube bundle in liquid refrigerant and incorporate provision for complete separation of liquid droplets from leaving vapour. Do not place the tube bundle in the 20% of the refrigerant volume closest to the refrigerant outlet.

### **Type tests**

To ASME CODE or AS 1210

### **Pressure tests**

Refrigerant side: shall be tested to working pressure of 1300 kPa

Water Side: shall be tested to a maximum pressure of 1000 kPa

### **Construction**

Shells: Hot rolled low carbon steel plate to AS 1548 with seams precision electric welded and ground smooth externally.

Tube bundles: Unjoined seamless copper tube to AS 1569 expanded into tube plates. Finish tubes flush with the outside edge of the tube sheet. If necessary, provide intermediate tube supports along the length of the shell, to prevent sagging of the tubes. Prevent tube from vibrating against supports.

Fixing: Fix rigidly to support structures with either

- mounting feet incorporated in cradles welded to the shell; or
- fixing straps, if recessed into cradles formed in factory-made mounting feet.

### **Water boxes**

General: Provide removable water boxes for flooded type coolers.

Arrange water connections so that piping does not need to be removed in order to remove the water boxes or to mechanically clean water tubes.

### **Liquid Cooler Insulation**

Closed cell elastomeric foam, minimum thickness 19mm with max K-factor of 0.28 and fitted with a vapour barrier.

## **2.3 AIR COOLED CONDENSER**

### **General**

Type: Provide remote, air cooled condenser consisting of condensing coil, fans, evaporating cooling pads, water pump and associated piping and electrical connections, mounted within an enclosure.

Performance rating: Rate to ARI 460.

Coil mechanical protection: Provide protection against mechanical damage during transport and installation.

### **Equipment enclosure**

General: Provide an enclosure, materials and finishes that are weatherproof and corrosion-resistant, assembled and reinforced to prevent flexing and drumming. Provide mounting legs for fixing to the support structure.

Materials:

- a) Metallic-coated steel  $\geq 1.0$  mm thick panels, fixed to  $\geq 1.6$  mm folded thick metallic-coated steel sheet frames and supports. Powder coat all interior and exterior surfaces to AS 3715 or AS 4506 as appropriate, using APAS-0155/2 or
- b) Aluminium  $\geq 1.6$  mm thick grade 5251 panels with  $\geq 2.0$  mm aluminium frames and supports. Provide stainless steel fasteners.

Moisture retention: All parts free draining with no pockets in which condensation and/or rainwater may be retained.

Backflow prevention: Provide internal baffles to prevent backflow of air through idle fans when multiple fans are sequentially switched.

Access panels: Hinged doors or lift-off panels with camlock fasteners.

### Condensing coil

Tube material: Copper

Fin material: Aluminium with proprietary coil corrosion protection coating

Proprietary coil corrosion protection coating:

- Type: Factory applied coating resistant to dilute acids, dilute alkalis, solvents, inorganic salts and salt laden air.
- Application: Apply after coil fabrication.
- Performance: When tested to ASTM B117, show no sign of attack after 3000 hours in salt spray.
- Aluminium finned coils: Aluminium alloy to AS 2848.1, designation 5005, or metallic-coated steel sheet coating class Z275.

Tube material: Copper to AS/NZS 1571 or AS 1572 designation C12200.

Header material: Copper to AS 1432 or AS/NZS 1571.

Installation: Attach to the frame and provide baffle plates between coil frames and condenser enclosure, to prevent air bypass.

### Evaporative pre-cooling

Generally: Provide evaporative cooling pads to pre-cool the incoming air. The pads have to cover the entire air inlet faces on both sides of the unit, supported by water distribution trays on top and drain troughs at the bottom.

Operation: Pre-cooling, achieved by pumping water over the pads, has to be activated only when ambient air temperature exceeds the designed preset set point. The system shall include a dump valve, which has to open daily or when pre-cooling is not required to drain all the water from the unit to eliminate any potential risk of bacteria growth.

### Condenser fans

General: Provide statically and dynamically balanced fans, with metallic-coated steel fan guards.

Impellers: Keyed to drive shafts by means of taper-lock fixing devices or taper keys.

Vibration isolation: Provide each fan with at least four anti-vibration mountings, selected to give an isolation efficiency not less than 95%.

Aerofoil bladed axial fans: Direct driven, high efficiency, with aluminium, ultraviolet light resistant polypropylene or glass fibre blades.

Operation: Low speed fans controlled by PLC controller and fitted with wide chord blades to provide optimum performance and low noise.

Motors:

- Degree of protection:  $\geq$  IP54.
- Finish: Air drying enamel or powder coat.

#### **PLC Controller**

- Use the PLC controller to control fan speed (to match cooling demand) and active pre-cooling function.
- The controller shall have the following features:
- Full microprocessor control with real time clock
- Memory backup in case of power failure
- Multi-line LCD display of vital parameters and alarms
- User interface for set point adjustments
- Analogue output for fan speed control
- Digital outputs for cooling pads pump, water dump valve and water make up valve.
- Water dump and auto dry control
- Password protection of all set points.

#### **Control panel**

Degree of protection:  $\geq$  IP44.

### **2.4 REFRIGERATION SYSTEM**

#### **General**

Design refrigeration systems for minimum refrigerant leakage potential.

#### **Standards**

To AS/NZS 1677.2 and SAA HB40.1.

#### **Acceptable refrigerants**

HFC134A

### **2.5 CONTROLS, SAFETIES AND DIAGNOSTICS**

#### **Type**

Menu driven, microprocessor-based module.

#### **Controls**

Include the following components:

- Microprocessor control with non-volatile memory
- Power and control circuit terminal blocks



- On/off control switch
- Temperature sensors installed to measure cooler and condenser entering and leaving fluid temperatures
- Suction and discharge pressure sensors
- Suction and discharge temperature sensors

Include the following functions:

- Capacity control based on leaving chilled water temperature with set point offset load compensation.
- Rate of change control at start up to prevent overshoot.
- Auto-restart after power failure.

### **Indication**

The control panel shall include a clear backlit LCD display and keypad for setting of user set points and providing alarm description.

General: Provide indication of the following:

- System on.
- Fault requiring manual reset.
- Entering and leaving liquid cooler water temperature.
- Chilled water set point.
- Voltage on each phase, for solid-state starters.
- Drawn current on each phase, for solid-state starters.
- Electrical current limit set point, for solid-state starters.
- Chiller diagnostics.
- Remote chilled water set point signals.
- Hours run.
- Start counter.
- A general fault alarm
- Refrigerant suction temperature.
- Refrigerant discharge pressure.
- Oil Pressure (except for oil free systems)

### **Safety Controls**

Provide electrical interlocks to protect against the following:

- Chilled water low flow.
- Compressor motor thermal or electrical overload.
- High and low pressure for compressors.

- Short cycling of compressors.
- Low chilled water temperature.
- Phase failure under voltage, single phase and phase rotation protection.
- Loss of refrigerant charge.

#### **BMS interface**

The chiller controller shall be able to communicate with the existing Building Management System (BMS) to provide basic operation and information.

Include contacts or high level interface for interfacing to the existing Building Management System (BMS) for the following functions:

- Common Alarm
- Start/Stop
- Chilled water flow and return temperatures

The control system shall allow software upgrade without the need for new hardware modules.

#### **Capacity Control**

Operation: Provide for chillers to start unloaded and for subsequent loading and unloading to be by the control system.

Control system: Provide a control system which senses the leaving chilled water temperature and maintains it at the desired setting, regardless of variations in load or the chilled water flow rate.

Current limiter: Provide control to limit the maximum current drawn by the compressor motor by monitoring the 3 phases of supply power.

Demand limiter: Provide control to permit continuous manual control of power demand at operating points from 40 – 100% of full load power.

## **2.6 ELECTRICAL**

- Unit primary electrical power supply shall enter the unit at a single location
- Unit shall be provided with a main power disconnects
- Unit shall operate on 3-phase power at  $415V \pm 10\%$  at 50Hz
- Control voltage shall be 24 Vac
- Unit shall be with be shipped with factory installed control and power wiring
- Power factor shall be greater than 0.9 at full design load

## **2.7 MARKING**

#### **Labels**

Show the following:

- Manufacturer's name.
- Model number.
- Serial number.

- Refrigerant type.
- Refrigerant charge.
- Water side pressure drop and design water flow rates.
- The nominal capacity and rated power input.

#### **Rating plates**

Required.

### **3 EXECUTION**

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#### **3.1 INSTALLATION**

##### **Manufacturer's instructions**

Install in accordance with instructions supplied by chiller manufacturer. Include completed manufacturer's checklists in commissioning data.

##### **Piping**

If marine water boxes are not provided, provide removable piping sections to allow pipe cleaning.

##### **Safety provisions**

Provide ventilation: To AS/NZS 1677.2.

Alarm system: Provide vapour activated alarms set at the designated level and to suit the refrigerant to be sensed.

#### **3.2 COMMISSIONING**

##### **Operational check**

Check operation of the chiller system including auxiliary equipment and control systems. After starting up, adjust and calibrate the chiller system.

##### **Commissioning**

Commission the chiller system under the supervision of the equipment manufacturers' authorised field technicians.

## C. MECHANICAL PUMPS

### 1 GENERAL

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#### 1.1 AIMS

##### Responsibilities

General: Provide a pump.

Selections: As documented.

#### 1.2 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

#### 1.3 DESIGN

##### Single operation

General: Provide pumps selected for:

- Constant falling head versus quantity curve.
- Stable operation.
- Duty point near the maximum efficiency point for the impeller diameter.

##### Parallel operation

General: Provide pumps selected for:

- Constant falling head versus quantity curve.
- Stable operation.
- Duty point near the maximum efficiency point for the impeller diameter.
- No instability when operating either singly or in parallel at the same shaft speed.
- Shut-off head difference between pumps > 10% of that of the pump with the lowest shut-off head.

##### Selection

General: Provide pumps selected for the maximum flow rate in the **Pump schedule** that is ≤ 80% of the maximum flow for the pump shown in the manufacturer's catalogue.

## 1.4 PRE-COMPLETION TESTS

### Standard

General: To AS 2417.

### Type tests

General: Required.

### Accuracy of measurement

Tolerance factors to AS 2417: Grade 2.

## 1.5 SUBMISSIONS

### Type test records

General: Submit type test curves for each size and type of pump.

## 2 PRODUCTS

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### 2.1 END-SUCTION CENTRIFUGAL PUMPS

#### Standard

General: To ISO 2858 or DIN EN 733.

#### Type

General: Provide single stage, radially split, end-suction, back pull out pumps.

#### Bases

General: Mount pumps and motors on bases sufficiently rigid to prevent distortion under normal operating conditions. Select from the following:

- Cold-formed bases: Mild steel plate minimum 6 mm thick.
- Fabricated bases: Fully welded fabricated from hot rolled steel channel sections.

#### Mountings

General: Mount each pump on a concrete filled inertia base supported on a plinth with 4 captive low profile spring mounts.

#### Drip trays

General: For uninsulated chilled water pumps, provide grade 316 stainless steel drip trays between the pump and the base, to catch condensate from the pump body.

Size: Extend beyond the pump suction by 100 mm minimum, and beyond uninsulated pump flanges.

Drainage: Provide 25 mm diameter sockets for drainage. Drain to the nearest waste with DN 25 copper pipe.

Sealant: Seal between trays and pumps with silicone sealant.

#### Casing

Pressure rating:

- For systems with a design pressure  $\leq 500$  kPa: Minimum static test pressure of 1.6 MPa.
- For systems with a design pressure  $> 500$  kPa: Minimum static test pressure of 1.6 MPa or 1.5 x the total of the pump shut-off head plus the static and system pressures, whichever is the greater.

Material:

- For fluid temperatures  $< 90^{\circ}\text{C}$ , pumping clean water: Cast iron to AS 1830 Table 1 (ISO 185/JL/250), minimum.
- For fluid temperatures  $\geq 90^{\circ}\text{C}$ : Bronze, grade 836B.
- For open systems including cooling tower water and for pumping aggressive water: Bronze, grade 836B.

Drip well drainage: Provide embossed, drilled and tapped drainage holes in seal drip wells. Drain to AS/NZS 3666.1.

Jointing: Provide gaskets or O-rings, or both, compatible with the liquid to be pumped and shaped to prevent contact between the liquid and the casing fixings.

### Connections

Piping connections:

- Screwed connections: Screwed female fittings to AS 1722.1. Provide union on each connection. Do not provide screwed connections for working pressures  $> 250$  kPa, temperatures  $> 100^{\circ}\text{C}$  or connections  $\geq \text{DN } 50$ .
- Flanged connections: To AS 2129, minimum Table E or equivalent.

Fluid release: Provide embossed, drilled and plugged openings at the lowest casing points for drain cocks.

Pressure gauge tappings: Provide accessible, embossed, drilled and plugged openings integral with casings.

### Rotating assemblies

Balancing: Statically and dynamically balance completed rotating assemblies.

Shaft: Solid grade 416 stainless steel, machined all over, free of stress concentrations.

- Maximum surface roughness:  $25\text{ }\mu\text{m}$ , under sleeves, seals and bearings.
- Maximum deflection:
  - Torsional: 0.002 rad.
  - Lateral:  $1\text{ }\mu\text{m/mm}$  of shaft length.

Impellers:

- Type: One piece shrouded type with machined sealing collars.
- Material: Grade 836B bronze.
- Securing to shaft: Use a key and locking nut.
- Locking nut: Grade 316 stainless steel, or bronze.
- Parallel operation pumps: Matched impellers.
- Maximum diameter: 90% of maximum impeller size for the casing.

Shaft sleeves: Provide a sleeve extending the full length of the seal housing.

Thrower rings: Fit water thrower rings to shafts.

### **Couplings for direct coupled pumps**

Couplings: Direct couple pumps and motors with flexible spacer couplings.

Spacers: For rear access pumps provide spacer couplings long enough to permit removal of rotating elements without disturbing piping connections or motor alignment. Provide a spigot for the flanged joint between the coupling and the spacer.

Coupling guards: Enclose couplings in coupling guards.

### **Bearings**

General: Provide at least 2 deep groove ball bearings, widely spaced and selected for a minimum rating fatigue life of 17 500 hours.

Lubrication: Provide either grease or oil lubrication. Seal bearings against ingress of dust and moisture, with lip seals. Allow for release of excess lubricant. Provide grease nipples for grease lubrication.

### **Shaft seals**

General: Provide seals compatible with the working conditions, including temperature and pressure of the fluid being pumped.

Type:

- Mechanical seals: Provide carbon elements rotating against a ceramic stationary face.

### **Motors**

General: Provide electric motors compatible with pump requirements, giving efficient, non overloading pumping units.

Minimum power rating: At least the maximum power required by the pump when projecting the system resistance curve to the maximum impeller size for the pump casing size.

Minimum degree of protection: IP54.

### **Installation**

General: Adjust mountings so that units are level. Following connection and filling of piping, and before operation, align pumps and motors.

Maximum misalignment: < 50% of the manufacturer's recommended maximum.

Packing: Minimise the number of packers and shims.

### **Piping**

General: Support pipes independently of pumps.

Disconnectable connections: Provide flanges or screwed connections with unions, for removal of pump casings without disturbing piping.

Suction connections: Provide demountable pipe sections between pumps and system isolating valves, for removal of impellers.

Pumps with packed gland seals: Drain drip well to the nearest waste with DN 25 copper pipe.

## 2.2 MARKING

### Direction of rotation

General: Provide permanent indication on the principal component of the casing, indicating the direction of rotation.

### Name plates

General: Attach to the casing permanent labels indicating the following:

- Make.
- Model.
- Serial number.
- Casing material.
- Impeller material.
- Shaft material.
- Impeller diameter (if reduced).
- Seal type.
- Flow rate.
- Design head

## 3 SELECTIONS

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### 3.1 PUMP SCHEDULE

As specified on drawings.



## D. AIR COILS

### 1 GENERAL

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#### 1.1 AIMS

##### Responsibilities

General: Provide an air coil as follows:

Selections: As documented.

- Fin pitch:
  - Cooling coils:  $\leq 480$  fins/m.

#### 1.2 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

#### 1.3 STANDARDS

##### Rating

Standard: To ARI 410.

#### 1.4 PRE-COMPLETION TESTS

##### Production tests

Pressure test: Leak test coils for at least 1 hour by either of the following:

- Submerging in warm water and applying air or other gas under pressure.
- Hydrostatic test.

Minimum test pressure: The greater of 2 MPa or 1.5 times the working pressure.

Refrigerant coils: After testing, dehydrate, charge with dry nitrogen to 7 kPa (minimum), and seal.

### 2 PRODUCTS

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#### 2.1 FABRICATION

##### Arrangement

General: Arrange tubes with uniform spacing in a staggered pattern.

## Fins

General: Provide plate fins to tubes.

Spacing: Space equally, perpendicular to the tubes.

Fin collars: Provide collars to control of fin spacing and provide a permanent mechanical bond between the tubes and the plate fins, by expanding tubes into fin collars, so that fin collars completely cover the tubes.

Material:

- Heating coils, condenser coils and non-sprayed cooling coils: Aluminium alloy to AS 2848.1, designation 3003 or 8011.
- Sprayed cooling coils: Copper.

Thickness:

- Aluminium alloy:  $\geq 0.12$  mm.
- Copper:  $\geq 0.15$  mm.

## Frames

General: Form rigid frames, from channel-type tube sheets and top and bottom channels and intermediate tube sheets as necessary.

Minimum flange height (to provide for duct connections): 25 mm.

Drain holes: Provide drain holes in cooling coil frames where water may collect.

Material:

- Aluminium finned coils:
  - Cooling coils: Aluminium alloy to AS 2848.1, designation 5005.
  - Heating coils: Aluminium alloy to AS 2848.1, designation 5005, or metallic-coated steel sheet coating class Z275.
- Copper finned coils: Heavy gauge brass, designation 260.

## Air leakage

General: Minimise air leakage through gaps between the fin ends and frames.

Deemed-to-satisfy: Recess fin ends into the top and bottom channels, close gaps with sealing strips, or gaps to a maximum clearance of 1.5 mm.

## 2.2 WATER COILS

### Chilled water coils < 100°C

Tube material: Copper to AS/NZS 1571 or to AS 1572, designation C12200.

Header material: Copper to AS 1432.

### Headers

Fluid flow: Arrange headers for even cooling and heating fluid flow to tube circuits.

Header/tube joints: Braze.

- Tube holes: Provide intruded or extruded tube holes in headers.

Vents: Provide vent plugs to top of headers.

Drains: Provide drain plugs to bottom of headers, arranged to fully drain coils.

Piping connections: Provide inlet connections at the bottom of supply headers at the 'air-off' face of coils and outlet connections at the top of return headers at the 'air-on' face of coils.

## 2.3 MARKING

### Labels

General: Provide labels showing the following:

- Manufacturer's name.
- Model.
- Serial number.

## 3 EXECUTION

---

### 3.1 PROTECTION

#### General

General: Prevent ingress of foreign matter and moisture during transport and storage.

Deemed-to-satisfy: Temporary sealing of end connections as follows:

- Water coils: Plastic end caps.

Mechanical damage: Prevent damage to fins, piping and connections during transport, storage and installation.

Deemed-to-satisfy:

- Fins: Cover with double corrugated cardboard or hardboard fixed securely.

### 3.2 COILS

#### Configuration

General: Install coils so that fluid and air flow directions are counter flow.

Water coil: Arrange to enter the bottom of the inlet header (air leaving side) and leave at the top of the outlet header (air entering side).

#### Fin damage

General: Comb damaged fins straight.

### 3.3 CHILLED WATER PIPING

#### General

Access and removal: Install piping to coils to allow access to equipment, and to minimise disturbance to piping when coils are removed. Arrange piping and isolating valves to minimise drain-down if coil is removed. Provide unions on connections  $\leq$  DN 50 and flanges on connections  $>$  DN 50.

Pipe Material: Type B copper pipe.

Support: Prevent stress on coils by supporting piping to coils independently.

## 4 SELECTIONS

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### 4.1 AIR COIL SCHEDULES

#### Chilled water coil schedule

As specified on drawings.

## **E DUCTWORK**

### **1.1 AIMS**

#### **Responsibilities**

General: Provide ductwork as documented.

### **1.2 CROSS REFERENCES**

#### **General**

General: Conform to the *General requirements* worksection.

#### **Associated worksections**

Associated worksections: Conform to the following:

- *Ductwork insulation.*

### **1.3 STANDARD**

#### **General**

Ductwork: AS 4254.

#### **Proprietary and non-standard systems**

Standard: Conform to functional criteria in AS 4254.

#### **Microbial control**

Standard: To AS/NZS 3666.1 and the recommendations of SAA/SNZ HB32.

### **1.4 INTERPRETATIONS**

#### **Abbreviations**

General: For the purposes of this worksection the abbreviations given below apply.

FRL: Fire-resistance level.

### **1.5 SAMPLES**

#### **Flexible duct**

General: Submit sample 2 metre length of 300 mm diameter flexible duct with sheet metal spigot attached.

### **1.6 SUBMISSIONS**

#### **Fire hazard properties**

General: Submit evidence of conformance with the following:

- Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3:
  - Spread of flame index: 0.

- Smoke developed index:  $\leq 3$ .
- Facing materials when tested to AS 1530.2: Flammability index:  $\leq 5$ .
- Assembled duct systems: Pass the UL 181 burning test.
- Fire protection of duct systems: Achieves the required FRL to AS/NZS 1530.4.

#### Access panels

General: Submit proposed alternative sizes, if any.

#### Rigid ductwork

General: Submit test data establishing conformance of the assembled duct system with AS 4254 clause 2.1.2 with respect to AS/NZS 1530.3 and UL181 burning test.

#### Sealants and tapes

General: Submit type-test certificates showing conformance with the following standards:

- Sealants: To AS 1530.3.
- Tapes: Test to AS/NZS 1635.10.1 demonstrating performance not less than that required by AS 4254 Clause 2.2.1.

---

## 2 PRODUCTS

### 2.1 MATERIALS AND COMPONENTS

#### Corrosion resistance

General: Metallic-coated sheet Z275/AZ150.

### 2.2 SHEET METAL DUCTWORK

#### Material

General: Galvanized steel duct and mild steel components < 3 mm thick: Prime quality lock forming galvanized steel, to AS 1397 Grade G2 or G3 with Z275 coating.

Thickness: To AS 2338.

Components for stainless steel and aluminium ductwork: Use materials with corrosion resistance not less than that of the duct wall material.

#### Fasteners

Rivets: Expanding solid end type, aluminium base alloy for galvanized duct, stainless steel for stainless steel duct, minimum size as follows:

- For sheet metal to sheet metal: 3 mm.
- For sheet metal to supports, brackets and rolled steel angles: 4.8 mm.

Self tapping screws: Zinc-plated for galvanized duct, stainless steel for stainless steel duct.

Self drilling and tapping screws: Zinc-plated for galvanized duct, stainless steel for stainless steel duct. Provide only if base material into which they screw is thicker than 1.5 mm and they are unlikely to be removed or replaced.

Bolts, nuts, washers and drop rods: Zinc-plated steel, service condition number 2 for galvanized duct, stainless steel for stainless steel duct. Parts on stainless steel duct not in

contact with air stream or corrosive conditions may be zinc-plated as for galvanized duct. Provide washers under nuts and bolt heads.

### Duct sealing

General: Seal all openings in the surface, joints and seams of ducts in accordance with AS 4254 clause 2.2.1 and the **Duct seal class table**.

Duct seal class: Not lower than Class C to AS 4254 regardless of duct pressure or location.

Sealant materials: Use only sealants that:

- Do not foster microbial growth.
- Have a smoke developed index  $\leq 3$  and a spread of flame index  $\leq 0$  when tested to AS/NZS 1530.3.
- Will maintain their sealing performance for the life of the duct system.

Adhesive duct tapes: Use only as a secondary sealant on joints sealed by other means such as mastic, liquids or gaskets. Do not use duct tapes for non-sealant purposes.

Machine rolled flanges: Use mastic at corners.

### Duct seal class table

Duct location	Seal class to AS 4254 Table 2.2.1			
	Supply ducts		Exhaust ducts	Return ducts
	(Static pressure classification Pa)			
	≤ 500	> 500		
Outdoors	A	A	A	A
Unconditioned spaces	B	A	B	B
Conditioned spaces (concealed ductwork)	C	B	B	B
Conditioned spaces (exposed ductwork)	A	A	B	B
Office-type spaces				
Factory-type spaces	C	B	B	B

## 2.3 FLEXIBLE DUCT

### Materials

Uninsulated flexible duct: Aluminised fabric clamped on a formed metal helix. Do not use adhesives.

Insulated flexible duct: As for uninsulated flexible duct with flexible blanket insulation wrapped around duct and covered with an outer vapour barrier.

Insulation material: Conform to the *Ductwork insulation* worksection.

## 2.4 FLEXIBLE CONNECTIONS

### General

General: Isolate fans and conditioner casings from ductwork, by means of airtight flexible connections.

Materials: Heavy duty, waterproof.

Length: Provide sufficient slack to ensure free movement and vibration isolation under operating and static conditions.

Alignment: Align openings of connected equipment.

Fixing: Fix to attachments with metallic-coated steel strip. Seal joints. Do not paint flexible material.

Fire protection: To AS 1530.4.

Maintenance: Arrange to permit easy removal and replacement without disturbing ductwork or plant.

Restriction: Do not protrude connections or frames into the airstream where this would be detrimental to the air flow.

## 2.5 DAMPERS – GENERAL

### Location

Provide balancing dampers at each branch duct or tee:

- Splitter type: Use only for supply branches up to 600 mm wide and with velocity in main < 10 m/s. Do not use on return or exhaust ducts.
- Opposed blade dampers: Use for any size supply and for all return and exhaust ducts. Locate in each branch.

## 2.6 VOLUME CONTROL DAMPERS

### General

General: Provide dampers which are free of rattles, fluttering or slack movement and capable of adjustment over the necessary range without excessive self-generated noise or the need for special tools.

Face dimensions: Duct size.

Connections: Mating angle flanged cross joints.

Frames: 1.6 mm minimum thickness metallic-coated steel or 2 mm minimum thickness aluminium folded to form channel sections at least 150 mm wide and welded at corners.

Dampers required to provide tight shut-off: Comply with the **Motorised dampers** clause.

Dampers in smoke-spill systems: Metallic-coated steel or stainless steel blades and frames.

### Blades

Material: Metallic-coated steel, aluminium or stainless steel.

Form: No sharp edges. Sufficiently rigid to eliminate movement when locked.

Minimum thickness:

- Metallic-coated sheet steel and stainless steel:
  - Single thickness blades: 1.6 mm.
  - Double thickness blades: 1.2 mm.
- Aluminium:



- Single thickness blades: 2.4 mm.
- Double thickness blades: 1.8 mm.

Maximum length: 1200 mm. If necessary provide intermediate mullions.

Single blade dampers:

- For single thickness blades: 600 mm maximum length, 600 mm maximum width or 600 mm maximum diameter.
- For single thickness blades with 6 mm minimum edge breaks: 1200 mm maximum length x 175 mm minimum width.
- For double thickness blades: 1200 mm maximum length x 300 mm minimum width.

Multi-blade dampers:

- For single thickness blades with 6 mm minimum edge breaks: 1200 mm maximum length 175 mm minimum width.

Housings: Rivet to damper frames.

### Spindles

Material: Stainless steel in stainless steel dampers, zinc-plated steel or stainless steel otherwise.

Construction: Securely fix to damper blades.

Minimum diameter:

- Blade lengths  $\leq 600$  mm: 10 mm.
- Blade lengths  $> 600, \leq 1200$  mm: 12 mm.

### Linkages

Fix securely to blades so that the blades rotate equally and close tightly without slip.

### Damper adjustment

Provide for adjusting the damper and locking it in position. Locate in an accessible position. Label the open and closed positions clearly and permanently.

## 2.7 SPLITTER DAMPERS

### Construction

Fabricate to AS 4254 Figure 2.3 (H) with a minimum length 1.5 times the width of the larger branch.

Limitation: Use only on supply ducts and only if duct velocity is less than 10 m/s. Provide volume control dampers otherwise.

Push rods: 5 mm diameter on 600 mm centres with screw locking bushes to fix position.

## 2.8 ACCESS OPENINGS – LOCATION

### Access doors

Provide an access door in each section of air handling units where access is required for maintenance, inspection or removal of components. Removable panels may be used instead of doors where access is required only for removal of coils.

### Access panels

Provide access panels in the following locations:

- Next to each component located inside the duct requiring regular inspection and maintenance including, but not limited to:
  - Filters.
- In air handling units where unit size is insufficient to fit an access door.
- In other locations specified and/or shown on the drawings.

## 2.9 ACCESS PANELS

### Sizes

Access panels: Minimum clear opening:

- Personnel access: 450 x 600 mm.
- Hand access: 200 x 300 mm.

### Construction

Type: Double panel, deep formed, zinc-coated steel construction, insulated to match the duct, or filled with at least 25 mm mineral wool insulation.

Cold bridging: Arrange to prevent condensation on cold surfaces.

Frames: Provide rigid matching galvanized steel frames securely attached to the duct. Do not protrude any part of the panel or frame into the airstream.

Seals: Silicone rubber or soft neoprene gaskets mechanically fixed to either the panel or the frame to ensure an airtight seal against the operating pressure when latched in the closed position. For fire rated seals, provide woven ceramic fibre material.

Latches: Wedge type sash latches.

Number of latches:

- For personnel access: 4.
- For hand access: 2.

Handles: Provide a "D" handle on access panels for personnel access.

## 3 EXECUTION

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### 3.1 DUCTWORK INSTALLATION

#### Arrangement

Provide stream splitter dampers at each branch duct. Some duct transformations (offsets, transitions, sets up and down) not shown on the drawings shall be determined and installed by the contractor.

Provide butterfly dampers at each flexible duct spigot and OBD's at grilles where not controlled by spigot dampers.

All ducts bends and tees shown shall be fitted with turning vanes or alternatively replaced with radius bends and tees.

All flexible duct connections shall not be shorter than 1.2 metre and longer than 5 metres including any rigid duct or sleeves used to join lengths of flexible duct. Flexible ducts should not be kinked or have excessively bends, particularly near diffusers/grilles. Ensure there are no protrusions inside the duct that could generate noise.

Arrange ductwork neatly. Provide access to ductwork components which require inspection, entry, maintenance and repairs. Where possible arrange duct runs adjacent and parallel to each other and to building elements.

Balance the air handling system using dampers on duct branches, with dampers at diffusers and grilles being used for minor adjustments of air volumes. Where excessive noise levels are due to noise generated at dampers near diffusers/grilles, the branch dampers shall be readjusted to eliminate excessive dampering.

### Spacing

Provide minimum clear spacing, additional to duct insulation, as follows:

- 25 mm between adjacent ducts.
- 25 mm between duct flanges or upper surfaces of ducts and undersides of beams and slabs.
- 50 mm between ducts and electric cables.
- 150 mm between ducts and ground, below suspended floors.

### Flexible duct

General: Install flexible duct as straight as possible with minimum number of bends. Maximise bend radius but not less than AS 4254 clause 2.8.5 (h).

Joints: Securely fix flexible duct to rigid spigots and sleeves using sealant and draw band encased with duct sealing tape.

Joints between flexible ducts: Join lengths of flexible duct only for the purpose of providing an air tight or acoustic sleeve at a partition.

Support: To AS 4254. Limit sag to < 40 mm/m.

Maximum length of flexible duct sections: 6 metres including any rigid duct or sleeves used to join lengths of flexible duct.

Flexible ducts used for air containing free moisture: Locate supporting helix outside airstream.

### Cleaning

During installation progressively remove construction debris and foreign material from inside ducts.

### Drainage

Provide drainage to AS/NZS 3666.1 at locations in ductwork where moisture may accumulate including at outside air intakes.

## F DUCTWORK INSULATION

### 1 GENERAL

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#### 1.1 AIMS

##### Responsibilities

General: Provide insulation of ductwork and related items as shown on the drawings.

##### Alternative insulation methods and materials

General: Do not submit alternatives for materials or methods that have lesser quality or characteristics in terms of the following:

- Performance.
- R value.
- Durability during and after installation.
- Corrosion resistance.
- Cold bridging.

#### 1.2 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

#### 1.3 STANDARDS

##### General

Ductwork insulation: To AS 4254.

##### Installation of mineral wool insulation

Comply with the AMWU/CFMEU/CEPU/ICANZ Industry Code of Practice for the Safe Use of Glass Wool and Rock Wool Insulation.

Marking: Deliver mineral wool products to site in packaging labelled FBS-1 BIO-SOLUBLE INSULATION.

#### 1.4 INTERPRETATIONS

##### Definitions

For the purposes of this worksection the definitions given below apply.

- Mineral wool (including glasswool and rockwool): Entangled mat of fibrous non-crystalline material derived from inorganic oxides or minerals, rock, slag or glass, processed at high temperatures from a molten state.
- Polyester: Insulation manufactured from thermally bonded polyester fibres.

- R value: The thermal resistance ( $\text{m}^2\text{K/W}$ ) of a component calculated by dividing its thickness by its thermal conductivity. R value does not include air space or surface resistances.

## 1.5 SUBMISSIONS

### Fire hazard properties

General: Submit evidence of conformance with the following:

- Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3:
  - Spread of flame index: 0.
  - Smoke developed index:  $\leq 3$ .
- Facing materials when tested to AS 1530.2: Flammability index:  $\leq 5$ .
- Assembled duct systems: Pass the UL 181 burning test.

### Samples

Samples: Submit samples of the following:

- Each type of insulation, applied to a sample section of ductwork.

## 2 PRODUCTS

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### 2.1 INSULATION MATERIALS

#### Insulation material type

General: Choose from the following:

- Mineral wool (including glass fibre).
- Polyester.
- Polyolefin foam.

#### Fire hazard properties

General: Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3:

- Spread of flame index:  $\leq 0$ .
- Smoke developed index:  $\leq 3$ .

Facing materials:

- Flammability index:  $< 5$ .

#### Insulation properties

Type: In batt, board or blanket form.

Mineral wool: To AS/NZS 4859.1.

Polyester: Thermally bonded polyester fibres.

Polyolefin: Closed cell cross-linked polyolefin foam produced using non-CFC blowing agent.

Flexible type: Blanket form.

### Insulation thicknesses

To comply with BCA , section J.

### Semi-rigid insulation

General: Physical properties:

- Alkalinity: pH 7 – 9.
- Moisture absorption: Non-hygroscopic.

Type: Batt or board form with a maximum mean deflection of 6 mm for 50 mm thick material and 20 mm for 25 mm thick material, tested as follows:

- Freely support a 900 x 1500 mm test piece on its longer sides.
- Allow the test piece to stand for 10 minutes and measure the vertical deflection.
- Turn the test piece over and repeat the test.
- Average the results.

### Minimum absorption coefficients table

Insulation	Absorption coefficients (nominal) to AS 1045 at					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Perforated foil faced: R 0.9 to AS 4508	0.12	0.48	0.84	0.96	0.97	0.94
R 1.5 to AS 4508	0.23	0.62	1.00	1.07	1.12	0.78

### Adhesives

Type: Suitable for bonding facing to the insulation. Apply in an even coat.

Fire hazard properties:

- Smoke developed index: 0.

### Aluminium foil laminate sheet

Physical characteristics:

- Tensile strength (minimum) to ASTM D828 or AS/NZS 1301.404s.
  - Machine direction: 14.5 kN/m.
  - Lateral direction: 9.8 kN/m.

### Aluminium foil laminate tape

Physical properties: To SMACNA Fibrous Glass Duct Construction Standards.

See AS 4426 Table C1 for permeance values and Table C2 for guidance to life/duty classification as a function of vapour pressure and permeance.

Adhesive: Non toxic, high tack synthetic pressure sensitive type.

Liner: Silicone coated paper.

Backing: Aluminium foil laminate.

Physical properties:

- Tensile strength: 4.8 kN/m (average minimum).
- Shear adhesion: To SMACNA Fibrous Glass Duct Construction Standards Table 3.2.
- Peel adhesion at 180°: 0.68 kN/m (average minimum).

Water vapour permeance to AS 1301.419s Condition B, or ASTM E96 Procedure E:

- Creased:  $\leq 2.26$  ng/N.s.
- Uncreased:  $\leq 1.13$  ng/N.s.

### Elastomeric foam insulation

Material: Chemically blown closed cell nitrile rubber in sheets or rolls. Provide with a smooth natural finish and vapour barrier properties.

Standard: To ASTM C534.

Physical properties:

- Thermal performance: As for the attached duct.
- Moisture absorption: Non-hygroscopic.
- Water vapour permeability:  $\leq 0.065$  ng/Pa.m.s.

Adhesives: Adhesive fix and seal exterior joints. Use only solvent-based adhesive supplied by insulation manufacturer and designed specifically for the material being used.

Protection: Metal sheath insulation where:

- Exposed to sunlight.
- Subject to mechanical damage.

Alternative protection: Where exposed to sunlight but not exposed to mechanical damage, provide 2 coats of tintable, water-based, rubberised, UV resistant, flexible paint finish to outdoor installations.

### Minimum elastomeric foam absorption coefficients table

Insulation	Absorption coefficients (nominal) to AS 1045 at				
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz
Elastomeric foam, 20 mm thick	0.04	0.07	0.16	0.62	0.25

## 3 EXECUTION

### 3.1 GENERAL

#### Fixing devices

Standard: To AS 4254 clause 2.7.

Speed clips: Bevel edged metal type with an area not less than that of a 25 mm circle. Secure speed clips flush to the face of the insulation.

Protection: Cover fixing pins on external insulation with foil tape where sharp pins will present a hazard to personnel. Cut off excess length of pins after insulation and speed clips have been applied.

#### Insulation overlap

General: Provide an overlap of at least 300 mm where insulation changes from the inside of the duct to the outside.

#### Insulation near moisture producing equipment

General: Where the likelihood exists of moisture accumulation inside ducts, in the vicinity of moisture producing equipment use only external insulation.

Metal sheath insulation: In plant rooms and where nominated in the **Ductwork insulation schedule**.

#### Vapour barriers

Type: Free from perforations and leaks, continuous, and sealed continuously at penetrations.

Location: Place vapour barriers on the side of the insulation that will be warm during cooling mode operation.

#### Application of tapes

Tape width:  $\geq 100$  mm.

Make sure surfaces are dry and free of dust and grease before applying tapes.

### 3.2 INTERNAL INSULATION – LAMINATE FACED

#### System description

Insulation type: Semi-rigid board or batt.

Surface facing: Factory applied perforated aluminium foil laminate.

#### Application

General: Cover parts of ducts designated to be insulated, with individual pieces of insulation for each side of the duct. Where this is not possible, butt join edges of adjacent pieces. Where multi-layers are used (round or oval ducts) stagger all joints.

#### Joins in insulation

General: Cover joints with 100 mm wide aluminium foil laminate tape, centrally located.

Longitudinal joints: Locate behind corner angles or cover strips.

#### Fixing method

Select from the following:

- Corner angle and end nosing method.
- Free edge method.

Fixing pins: Provide to AS 4254 clause 2.7.1 (g).

#### Corner angle and end nosing method

Corners: Overlap insulation on adjacent sides at corners. Hold insulation in position with metallic-coated steel corner angles. Fix corner angles under the turn back of the end nosing.



For corner angles longer than 1600 mm provide additional fixing at 1600 mm maximum centres.

Corner angles:

- Ducts with faces < 300 mm: 25 x 25 x 0.55 mm, minimum.
- Other ducts: 40 x 40 x 0.55 mm, minimum.

End nosings: At ends of ducts, hold insulation in position with U-shaped metallic-coated steel end nosings, with edges crimped towards the surface. Rivet end nosings to ducts.

Size: 0.55 mm thick with a minimum 50 mm turn back over the insulation.

Butt joints: Square cut and butt tightly together edges of adjacent pieces of insulation. Cover with 50 x 0.55 mm metallic-coated steel strip. Rivet cover strips under corner angles or under turn-back of end nosings. For cover strips longer than 1600 mm, provide additional fixing at 1600 mm maximum centres.

Fixing pins: For ducts with faces  $\geq$  300 mm, fix the insulation at 300 mm maximum centres with at least one row per duct face.

### Free edge method

General: Use only where larger duct side is  $\leq$  300 mm.

Edges: Extend insulation proud of ductwork at each end, to provide cushion joints that fully seal during assembly.

## 3.3 EXTERNAL INSULATION – LAMINATE FACED

### System description

Insulation type: Flexible batts or blanket.

Surface facing: Factory applied aluminium foil laminate.

### Application

General: Wrap insulation around the outside of ducts, covering the parts designated to be insulated. Minimise the number of joints.

Joints: Square cut and butt together the edges of adjacent pieces of insulation.

Vapour sealing: Seal the vapour barrier at joints with 100 mm wide aluminium foil laminate tape, applied centrally over the joint. Where the insulation is impaled over pins, seal the vapour barrier by covering pins with water-based mastic vapour barrier or reinforced aluminium foil faced tape.

Flanges and joints: Maintain insulation thickness over flanges, joints and stiffeners.

Polyolefin foam insulation: Apply proprietary 120 mm wide polyolefin foam flange strips over flanges, joints and stiffeners.

### Fixing method

Materials other than polyolefin foam: Select from the following:

- Provide pins to each face of the duct as follows:
  - Horizontal ducts < 380 mm wide: Pins not required.
  - Horizontal ducts > 380, < 760 mm wide: One row of pins along centreline to side and bottom duct faces at 380 mm maximum centres.

- Horizontal ducts  $\geq 760$  mm wide: Pins spaced at 380 mm maximum centres.
- Vertical ducts  $< 610$  mm wide: Pins not required.
- Vertical ducts  $\geq 610$  mm wide: Pins spaced at 380 mm maximum centres.
- Strap and pin method: Provide 12 mm wide polypropylene strapping at maximum 600 mm intervals.
  - Horizontal ducts  $\geq 600$  mm wide: Hold insulation in position on the underside with fixing pins spaced at 400 mm maximum centres with at least one row per duct face.
  - Vertical ducts  $\geq 600$  mm wide: Provide pins to all faces at 400 mm maximum centres.

Polyolefin foam: Provide pins spaced 50 mm from all edges and spaced 200 to 300 mm apart in all directions.

### 3.4 INSULATION OF DUCTWORK ACCESSORIES

#### Plenum boxes on air outlets

Insulation type: Internal insulation, with perforated aluminium foil laminate, black finish.

Minimum insulation R value:  $0.4 \text{ m}^2\text{.K/W}$ .

Insulation fixing: Turn facing back over raw edges of insulation for at least 75 mm and bond the turn back to the insulation before installation. Provide fixing pins at 250 mm maximum centres with at least one pin per face. Fully bond insulation around neck with adhesive.

#### Dampers

Internal: Leave clearance between insulation and edges of the splitter or manually operated damper blades.

External: For manual and motorised dampers, provide removable insulated sheet metal top hat sections to encase dampers.

#### Access doors

General: Provide insulation to access doors and openings. Arrange to prevent condensation on cold surfaces.

### 3.5 INSULATION OF DUCT FLEXIBLE CONNECTIONS

#### General

General: Insulate duct flexible connections if the temperature of the air inside the duct may cause condensation on the outside of the flexible connection.

#### Method

General: If the insulation of the connecting ductwork is:

- External laminate faced on one or both sides of the flexible connection: Insulate duct flexible connection as required in the **External laminate faced** clause.
- Any other insulation system: Insulate duct flexible connection with elastomeric foam as required in the **Elastomeric foam insulation** clause.

## **G VARIABLE AIR VOLUME TERMINALS**

### **1 GENERAL**

---

#### **1.1 AIMS**

##### **Responsibilities**

General: Provide to variable air volume terminals

Selections: As documented.

#### **1.2 CROSS REFERENCES**

##### **General**

General: Conform to the *General requirements* worksection.

##### **Associated worksections**

Associated worksections: Conform to the following:

- *Mechanical general requirements.*
- *Ductwork.*
- *Ductwork insulation.*
- *Automatic controls.*

#### **1.3 STANDARD**

##### **General**

Ductwork: AS 4254.

#### **1.4 INTERPRETATIONS**

##### **Abbreviations**

General: For the purposes of this worksection the abbreviations given below apply.

- VAV: Variable air volume.

#### **1.5 SUBMISSIONS**

##### **Product data**

General: Submit type test data as follows:

- Variable volume boxes: Discharge and radiated sound power levels.

## 2 PRODUCTS

---

### 2.1 VARIABLE AIR VOLUME (VAV) BOXES

#### Selection

Maximum design air flow rate of each unit: Provide boxes selected for  $\leq 80\%$  of the maximum rating shown in the manufacturer's catalogue.

Inlet velocity at documented air flow: 8 to 10 m/s.

Site adjustment: Provide for site adjustment of the maximum capacity by  $\pm 25\%$  of the design value.

#### Pre-completion tests

Variable air volume boxes: Test fan motor assembly. Test volume dampers, wiring and controls. Check sequence of operation and preset air volume rate before shipment.

#### Casings

Material: Metallic-coated steel, minimum 1 mm thick.

Leakage:  $< 1\%$  at maximum operating pressure.

Fan assisted boxes: Provide access panels conforming to *Ductwork* with quick release fastenings, to allow fan removal with the box connected to the ductwork.

Duct connections:

- Inlet: Round, oval or rectangular, to suit application.
- Outlet: Drive slip or flanged.

#### Dampers

Material: 1.6 mm minimum thickness metallic-coated steel or aluminium, with no deflection at inlet pressures.

Shafts: Bolt or weld blades to a continuous shaft rotating on self-lubricating nylon bearings.

Seals: Provide closed cell gasket seal. Preload blades to create a tight seal.

Leakage:  $< 2\%$  of maximum primary air flow at static pressure differential of 250 Pa.

#### Internal insulation

General: Conform to *Ductwork insulation* except as follows:

- Insulation type: Semi-rigid mineral wool, 25 mm minimum thickness.
- Surface facing type: Factory applied perforated aluminium foil laminate.

#### Accessories

Provide the following:

- Outlet sound attenuators: Conform to *Attenuators and acoustic louvres*.
- Multi outlet plenums: Provide balancing dampers at each spigot or outlet.
- Electric duct heaters: Conform *Ductwork*. Provide terminal box external to the unit, wired to the heating elements.

- Inlet velocity sensors: Averaging sensors, removable without removing connecting ductwork.
- Induction port sound baffles: Provide at plenum intake. Fabricate from 1 mm thick metallic-coated steel and insulate as for casing.
  - Minimum noise reduction: 5 dB.

#### Access panels

General: If required provide access panels to give access to each component located inside the VAV box that requires regular inspection or maintenance.

Construction: Conform to **Access panels** in the *Ductwork* worksection.

---

### 3 SELECTIONS

#### 3.1 VARIABLE AIR VOLUME TERMINALS

##### VAV box schedule

As specified on drawings.

## H AIR GRILLES

### 1 GENERAL

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#### 1.1 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

- *Ductwork.*
- *Ductwork insulation.*

#### 1.2 STANDARDS

##### General

General: AS 4254.

#### 1.3 INTERPRETATIONS

##### Abbreviations

VAV: Variable air volume.

##### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Air grille: A general term referring to a grille of metal or other material fitted to the inlet or outlet end of an air duct or within walls, floors ceilings or doors.
- Diffuser: A supply air grille mounted in a ceiling or on the underside of a duct through which air is supplied and distributed within a room or interior space of a building.
- Register: A supply air grille mounted in a wall or on the side of duct.
- Grille: A grille fixed over the aperture from which air is removed from an enclosed space.
- Plenum box: A lower velocity (larger volume) duct element behind an air grille intended to allow equalisation of air flow over the air grille.
- Cushion head box: A plenum box fitted above a diffuser.

#### 1.4 SUBMISSIONS

##### Samples

General: Submit a sample of each type of air grille and diffuser. Include plenum box and blanking plates as documented.

### Product data

General: Submit type test data as follows:

- Air diffusion equipment: Acoustic performance to ISO 5135, ASHRAE/ANSI 70 or ARI 890.

---

## 2 PRODUCTS

### 2.1 GENERAL

#### Manufacture

General: Provide proprietary grilles as follows:

- Free from distortion, bends, surface defects, irregular joints, exposed fastenings and operation vibration.
- Mounted with secure and concealed fixings.
- With flanges lining corners neatly mitred, butted and buffed, with no joint gaps.

Material: Steel or aluminium.

Finish:

- Exposed surfaces: Powder coated.
- Visible internal elements: Matt black.

Fixings: Provide concealed fixings which allow removal without damage to surrounds or grilles.

#### Volume control dampers

Dampers attached to grilles and diffusers: Provide dampers adjustable through the grille faces. Paint dampers matt black if visible through grilles.

### 2.2 AIR GRILLE TYPES

#### Louvre ceiling diffusers

General: Provide either:

- Multi-bladed, removable core 4-way blow configuration, fitted with a blanking plate for 1-, 2-, or 3-way blow, as appropriate.
- Multi-bladed, removable core 1-, 2-, 3- or 4-way blow configuration

Reducer necks: If the outlet neck is smaller than the outlet necessary to suit the louvre face size, provide a reducer neck.

Frame: Provide a frame style to suit the ceiling system.

Cushion head: If the diffuser is connected to a flexible duct, provide a cushion head box.

Air volume control: Conform to **Dampers on diffusers and grilles attached to flexible duct**.

#### Slot diffusers

Type: Linear slot type ceiling diffusers with one or multiple slots, nominally 20 mm wide and integral air pattern control.

Construction: Extruded aluminium with parallel, inverted T members supported and spaced to form continuous discharge slots.

Plenum: Supply air to the active lengths of each diffuser via plenum ducts on the back of the diffuser with circular or oval spigots for flexible duct connections. Design the plenum ducts to ensure even distribution of air flow along the active length of the diffuser.

Frame: Flanged with outside edge returned and coordinated with the ceiling system.

Finished appearance: Continuous and unbroken irrespective of the purpose of the slot. Blank off all slots not used for supply or return air. For long lengths, provide mechanical aligning devices to produce a rigid assembly that minimises the visibility of joints.

Air pattern control: Provide an adjusting device which can be operated from the face of the diffuser through the slot to allow 180° deflection of air pattern from vertical to horizontal in either direction.

Air volume control: Conform to **Dampers on diffusers and grilles attached to flexible duct**.

### Weatherproof louver grilles

Construction: Extruded aluminium with fixed horizontal blades set into a fixed frame.

Louvre blades: Set at nominal 45° angle and incorporating at least one hooked edge to prevent ingress of water under all operating conditions. Brace and stiffen to prevent rattling or movement.

Frame: Flanged or channel to suit the installation profile.

Pressure drop:  $\leq 15$  Pa at the documented air flow.

Screens: Provide metallic-coated steel wire or UPVC mesh screens behind louvres to prevent the entry of vermin, birds, rodents and wind blown extraneous material such as leaves and papers.

### Return or exhaust grilles – indoor

Construction: Extruded aluminium with fixed horizontal blades set into a fixed support frame with mitred corners. Fit blades tightly into the frame to prevent rattling or movement. Brace and stiffen to produce a rigid assembly.

Pressure drop:  $\leq 10$  Pa at the documented air flow.

Blades:

- Half chevron type: Blades at nominal 45° angle on a nominal 25 mm pitch.
- Inverted V chevron type: Blades at nominal 25 mm pitch. Provide a telescopic frame with clip-on pattern surround frames on both sides.
- Light proof grilles: As specified for Inverted V chevron type but with double inverted V chevron blades and blade pitch to stop light penetration.

Damper: If the grille is connected to a duct, provide an opposed blade damper behind the grille core, key operated without removing the grille core.

### Mesh grilles

Light duty type: Fabricate from 1.5 mm thick galvanized steel or bronze wire at 12 mm centres fixed into a folded metallic-coated steel or aluminium frame.

Heavy duty type: Fabricate from 3 mm thick galvanized steel or bronze wire at 20 mm centres, welded into a 3 mm thick galvanized steel frame.

Bronze mesh: If bronze mesh is provided on external grilles, provide a bronze frame.



### **Egg crate return or exhaust grilles**

Construction: Nominal 12 x 12 mm square, 12 mm deep egg crate type aluminium core fixed in an extruded aluminium frame with mitred corners. Fit core tightly into the frame to prevent rattling or movement.

Free Area:  $\geq 90\%$  of nominal face area.

Damper: Provide an opposed blade damper behind the grille core, key operated without removing the grille core.

---

## **3 EXECUTION**

### **3.1 INSTALLATION OF AIR GRILLES**

#### **Protection**

Wrapping: Leave protective wrappings in place until final mounting.

#### **Mounting**

General: Provide a matching escutcheon to close gaps between the grille and its surrounds. Provide grilles with flanges to cover penetrations and irregularities in surrounds.

Tiled ceilings: Locate grilles and diffusers to minimise cut tiles. Otherwise, locate grille symmetrically in the tile.

Appearance: Install square.

#### **Dampers on diffusers and grilles attached to flexible duct**

In tiled and accessible ceilings: Provide a butterfly type balancing damper with external quadrant and locking screw at the spigot take-off from the rigid duct.

If the spigot at rigid duct is not accessible through ceiling: Provide an opposed blade type damper behind the face of the grille or diffuser with adjustment accessible from the face side.

#### **Fixing**

Visibility: Provide concealed fixings.

Accessibility: Provide fixings which allow removal without damage to surrounds or outlets.

Gaskets: Provide foam type gaskets under outlet flanges or flanged supports.

#### **Plenum and cushion head boxes**

General: Provide side entry plenum or cushion head boxes to diffusers and grilles connected to flexible ductwork.

Design: To achieve even air flow across the face of the diffuser or grille.

Material: Prime quality lock forming galvanized steel, to AS 1397 Grade G2 or G3 with Z275 coating.

Insulation: Conform to the **Insulation of ductwork accessories** clause in the *Ductwork insulation* worksection.

Painting: Paint interior of plenum box matt black if visible through grilles.

Flexible duct connections: Provide round or oval spigots on plenum boxes.

Support of plenum boxes: For louvre ceiling and slot diffusers support the plenum from above independently of the ceiling.

## I. MECHANICAL PIPING

### 1 GENERAL

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#### 1.1 AIMS

##### Responsibilities

General: Provide mechanical piping. Provide bosses as necessary for control system sensors.

Selections: As documented.

##### Design

General: Base design pressures on the following:

- The maximum hydrostatic head at the location.
- The pump shut off head at the maximum impeller size for the pump casing.

System: Provide piping systems complete with all necessary piping, valves, supports, guides, drains, vents, expansion compensation and all fittings necessary for their safe and efficient operation.

Installation: Follow the line of walls, ceilings, etc., and include all necessary offsets and arrange to avoid interference with the building or other services regardless of whether or not these aspects are shown on the drawings.

Plant access: Make provision for plant isolation and maintenance. Locate valves and other components in ceilings where they are easily accessible and where access or leaks will not cause inconvenience or risks to occupants, or damage to water sensitive equipment.

Connections: Arrange connections to plant to permit dismantling of the plant without disturbing other pipes and to permit removal of the plant without removal of the piping. Provide union on at least one side of each screwed valve and screwed pipeline component requiring removal for inspection or maintenance. Make all connections to plant by one of the following methods:

- Flare compression joints (up to 20 mm copper and only where there is no vibration).
- Screwed brass unions (up to 50 mm size and for pressures up to 800 kPa).
- Bolted flanges (no limitation).

#### 1.2 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

- *Water treatment.*

## 1.3 STANDARD

### General

Standard: To AS 4041.

## 1.4 INTERPRETATIONS

### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Accuracy: The closeness of the agreement between the result of a measurement and the true value of the particular quantity being measured.
- Error: The measured value minus the true value of the particular quantity being measured.
- Resolution: The smallest difference between indications of a displaying device that can be meaningfully distinguished.

## 1.5 SUBMISSIONS

### Valves

Calibrated balancing valves: For each type and size of valve, submit a manufacturer's calibration chart relating pressure drop to fluid flow across the valve opening range. Submit independent test reports giving accuracy and repeatability tolerances.

Automatic/dynamic system balancing valves: For each type and size of valve, submit a manufacturer's report verifying a flow rate control accuracy of  $\pm 5\%$  or better is maintained over the selected pressure differential control range.

## 2 PRODUCTS

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### 2.1 COPPER PIPING

#### Pipes

Standard: To AS 1432 type B, hard drawn.

#### Jointing

General: Select from the following except where a specific jointing method is documented:

- Silver brazed capillary joints.
- Brass flanges with brass nuts and bolts.
- Flare compression joints:  $\geq 20$  DN nominal size and only where no vibration occurs.
- Proprietary grooved joints.

#### Fittings

Capillary fittings including adaptor capillary fittings with threaded ends or compression-type connector ends: To AS 3688, of copper or dezincification-resistant copper alloy.

Compression fittings including adaptor compression fittings with connector-ends for screwed or capillary joints: To AS 3688, flared type, of copper or dezincification-resistant copper alloy.

Unions: Bronze, proprietary manufacture, with ground or accurately machined face joints.

Flanges: Brazing metal to AS 2129.

Demountable joints: Expand pipes into flanges and braze.

### Permanent joints

General: Provide brazed slip joints. Provide either capillary fittings, or expand one pipe over the other leaving a minimum clearance and an effective overlap.

### Slip joint overlap table

Nominal pipe size, DN	Overlap (mm)
$\geq 15, < 20$	12
$\geq 20, < 32$	15
$\geq 32, < 50$	25
$\geq 50, < 80$	30
$\geq 80, < 125$	35
$\geq 125, < 200$	40

## 2.2 STAINLESS STEEL PIPING

### Pipes

General: Pipe to ASTM A312/A312M, or spiral butt welded from stainless steel sheet.

Grade: 316L.

Wall thickness:

- Piping  $\leq$  DN 150: At least 1.6 mm.
- Piping  $>$  DN 150,  $<$  DN 305: At least 2 mm.

Outside diameter tolerance:  $\pm 1.5$  mm.

### Jointing

General: Select from the following except where a specific jointing method is documented:

- Butt welded.
- Welded-on flanges.
- Proprietary grooved joints.

### Fittings

Material: Stainless steel of the same grade and wall thickness as the pipe.

Unions: Grade 316 stainless steel, proprietary manufacture, with ground or accurately machined face joints.

Flanges: Angle face rings, galvanized steel backing flanges and reinforced neoprene gaskets. Fabricate so that only stainless steel or the gasket material is in contact with the fluid within the pipe.

Bends: Long radius type.

### **Welding**

General: Fully butt weld using gas tungsten arc welding process. Passivate joints after welding.

## **2.3 PVC PIPING**

### **Standards**

Unplasticised pipes and fittings (PVC-U): To AS/NZS 1477.

Oriented PVC (PVC-O) pipes: To AS 4441 (Int).

Solvent cement: To AS/NZS 3879.

### **Installation**

Standard: To AS/NZS 2032.

### **Jointing**

Permanent joints: Solvent cement.

Demountable joints:

- Piping  $\leq$  DN 50: Threaded fittings.
- Piping  $>$  DN 50: Flanges with backing rings.

## **2.4 VALVES AND FITTINGS – GENERAL**

### **Components**

Valve size: Generally at least the nominal pipe size, unless a smaller size is necessary for throttling purposes or flow measurement.

Insulated valves: Provide extended shafts or bodies to butterfly and ball valves to allow full thickness of insulation without restricting movement of hand-wheel or lever.

Automatic control valves: Conform to the *Automatic controls* worksection.

Connections:

- Valves  $\leq$  DN 50: Screwed to AS 1722.1.
- Valves  $>$  DN 50, valves in headers: Flanged to AS 2129.

Handwheels and handles: Removable, with the direction of closing marked permanently on handwheels.

Copper alloy valves: Dezincification resistant and stamped accordingly.

Valves for water circuits open to air including open condenser water circuits: Body bronze for sizes  $\leq$  DN 50.

### **Installation**

Valves: If practicable, install with the stem horizontal.

Non-return valves: Provide at least 6 pipe diameters of straight pipe on the upstream side.

Flow measuring valves: Install with pressure tapings accessible.

### Valve Identification

General: Tag all valves and flow measuring devices for identification purposes. Provide a circular brass disc attached to the valve by a stainless steel wire drawn through the holes in the disc on each valve provided with operating handwheel or lever stamp the valve identification mark on the disc in characters 10 mm high.

Valves without operating handwheels: Mark by aluminium or brass strap 20 mm wide by 90 mm long stamped in the same manner as the valve identification discs. Attach by wire to the body of the valves.

## 2.5 VALVE TABLES

### Closed copper piping systems: Chilled water

Function	Valve type	Size range (mm)
Isolating	Copper alloy wedge gate	15 – 50
	Ball or diaphragm	15 – 65
	Cast iron wedge gate or diaphragm	≥ 80
Non-return	Copper alloy lift or swing check	15 – 50
	Cast iron lift or swing check	65 – 100
Throttling or balancing	Copper alloy globe, needle or diaphragm	15 – 65
	Cast iron globe or diaphragm	≥ 80
	Proprietary integral globe with press tappings/locking stem	No size limitation
Level control	Copper alloy ball float	15 – 65
	Cast iron ball float	≥ 80
Pressure relief	Copper alloy type	15 – 65
	Cast iron type	≥ 80
Air relief	Copper alloy automatic air vent	15 – 20
Strainer	Copper alloy	15 – 65
	Cast iron	80 – 150
Pressure reducing	Copper alloy	15 – 100
	Cast iron	15 – 100
Bleed	Ball	15 – 65
Gauge	Ball	15 – 65
Drain	Ball	15 – 65

## 2.6 WATER VALVES AND FITTINGS

### Selection

Working pressure rating: Minimum 1.4 MPa and to suit the system pressure requirements.

Working temperature rating: To suit the system requirements.

Limitations on size and type:

- Isolating valves:
  - Gate valves: No limitation.
  - Ball valves:  $\leq$  DN 50.
  - Butterfly valves:  $>$  DN 50.
- Throttling valves:
  - Globe valve: No limitation.
  - Calibrated balancing valve: No limitation.
  - Butterfly valve:  $>$  DN 65.
- Valves for potable water: To AS/NZS 3500.1.

### Gate valves

Description: Straight-through flow, solid wedge type, inside screw design, medium pattern.

Standards:

- Bronze valves: To AS 1628.
- Flanged cast iron valves: To AS 2638.1.

Construction:

- Body:
  - $\leq$  DN 80: Bronze.
  - $>$  DN 80: Cast iron.
- Seats: Integral seats for bronze valves, replaceable bronze seats for cast iron valves.

### Ball valves

Description: Full bore pattern with handle parallel to the direction of flow when the valve is fully open.

Construction:

- Body: Bronze.
- Ball: Hard chromed brass.
- Gland seal: Adjustable.
- Seat: PTFE.

Reduced bore ball valves: Constructed as for full bore ball valves. May be used for drains, air vents and gauges.

### Butterfly valves

Description: Tapped lug type.

Standard: To BS EN 593.

Operation:

- $\leq$  DN 150: Positive locating operating bar, parallel to the disk with notch plate.
- $>$  DN 150: Geared or motorised operators.
- All sizes used for throttling and balancing: Geared operators.

Construction:

- Body: Cast aluminium or cast iron.
- Shaft: Stainless steel.
- Disc: Bronze generally, stainless steel for condenser water systems.
- Disc fixing method as follows:
  - One-piece disc and shaft.
  - Disc keyed and screwed to shaft.
- Seat: Bonded EPDM.

### **Non-return valves**

Flanged valves for water: To AS 4794.

Disc type:

- Body: Stainless steel or bronze.
- Disc and spring: Stainless steel.

Swing type: To AS 1628.

- Body: Bronze or cast iron to AS 3578.
- Plates: Bronze or stainless steel.

Dual flap type:

- Body: Cast iron.
- Pin and spring: Stainless steel.
- Seat: Integral nitrile rubber.
- Plates: Bronze or stainless steel.

### **Globe valves**

Description: Inside screw design.

Construction:

- Body:
  - $\leq$  DN 50: Bronze.
  - $>$  DN 50: Steel.
- Stem and gland: Forged brass.



### **Calibrated balancing valves**

Description: Continuously adjustable graduated limit stop for precise setting of the maximum valve opening, a numeric indication of valve opening position, and pressure tappings across the variable orifice.

Accuracy and repeatability errors:  $\pm 5\%$  or better over the normal measuring range of the valve.

Handwheel scale resolution:  $< 2.5\%$  of full scale.

Construction:

- Body:
  - $\leq$  DN 50: Dezincification resistant copper alloy of Brinell hardness  $> 130$ .
  - $>$  DN 50: Cast iron.
- Seat: PTFE.

### **Automatic/dynamic system balancing valves**

Description: Pre-calibrated special purpose valve which automatically controls flow rate within  $\pm 5\%$  tolerance, with an internal spring loaded cartridge control mechanism and external tappings for pressure and temperature.

Construction:

- Body: To suit the piping and fluid.
- Cartridge: Passivated stainless steel, spring loaded type, incorporating a variable ported piston stamped with the manufacturer's identification number.

### **Pressure relief valves**

Description: Direct acting, spring loaded with adjustable setting.

Standard: To AS 1271.

Construction:

- Body: Bronze or cast iron.
- Valve disc and seat: Bronze.

### **Pressure reducing valves**

Description: Self-actuated, spring loaded with adjustable setting.

Construction:

- Body: Bronze or cast iron.
- Valve disc and seat: Bronze.

### **Ball float valves**

Description: Copper or plastic float with stainless steel or copper linkage.

Copper alloy: To AS 1910. Bronze body, needle and pins.

Cast iron: Cast iron body, bronze needle and pins.

### **Strainers**

Selection: 15 kPa maximum pressure drop.

Construction:

- Body: Bronze or cast iron.
- Screen: Stainless steel.

Strainers > 65 mm diameter: Fit a 25 mm ball valve blowdown.

### **Automatic air vents**

Description: Float operated.

Construction:

- Body: Copper alloy.
- Float: Non-metallic.
- Seat: Stainless steel.

### **Vacuum breaker valves**

Description: Ball valve operation.

Construction:

- Body: Copper alloy or stainless steel.
- Valve and seat: Stainless steel.

## **2.7 WATER VALVES AND FITTINGS**

Provide an electric motorised by-pass valve where shown on drawing, to maintain the circulation of water through the chiller when some of the chilled water valves at the coils are partly closed.

The design location is to be as far as reasonably possible from the chiller, the exact location can be determined on site to a position where it is accessible for maintenance.

The valve shall be suitable for the system pressure differential without cavitation at the valve seat or excessive noise generation, if required provide a pressure control valve in series with the by pass valve to limit the pressure differential. Valve motor shall be suitable for the control system and shall give visual indication of the valve position.

Construction:

- Body: Bronze or cast iron.
- Stem: Stainless steel
- Valve disc and seat: Bronze or stainless steel

## **2.8 INSTRUMENTS - GENERAL**

### **Location**

Test plugs: Provide in each pipe connection to every heat exchanging device and wherever else shown on the drawings.

Thermometer wells: Provide for each pipe mounted temperature sensor.

Pressure tapplings: Provide test plugs or valved tapplings at each pump automatic control valve and wherever else shown on the drawings.

## 2.9 PRESSURE GAUGES

### General

Standard: Bourdon pipe type to AS 1349.

Scale range: Full scale between 130% and 200% of maximum working pressure.

Construction:

- Case: Glass filled nylon. Minimum diameter 100 mm.
- Lens: UV stabilised polycarbonate.
- Dial: UV stabilised polycarbonate.
- Indicating pointer: Adjustable.
- Configuration: Direct mounting, bottom entry.
- Bourdon pipe material: Stainless steel for hot water systems. Phosphor bronze for other services.

### Installation

General: Mount gauges vertically free from vibration. Provide gauge line connection cocks. If necessary, eliminate needle fluctuations caused by pressure fluctuations, by either

- an orifice or restrictor; or
- a capillary pipe pressure pulse damper.

Pressure gauge connections: For gauges not permanently connected seal outlets of isolating valves with flared seal cap nuts.

## 2.10 THERMOMETERS

### Dial thermometers

Type: Mercury in steel.

Accuracy:  $\pm 1\%$  of full scale deflection or better.

Construction:

- Case: Glass filled nylon. Minimum diameter 100 mm.
- Lens: UV stabilised polycarbonate.
- Dial: UV stabilised polycarbonate.
- Indicating pointer: Adjustable.
- Bulb: Grade 316 stainless steel.
- Configuration: Direct mounting, bottom entry.

Installation: Install thermometers vertically, free from vibration, in thermometer wells.

## 2.11 SENSING POINTS

### Test plugs

Material: Suitable for the service fluid up to maximum pressures and temperatures. Machined brass hexagon body with nodel synthetic rubber cores and gasketed brass hexagon screw cap.

Installation: Screwed into sockets welded to pipes and extended above insulation.

### Thermometer pockets

General: Arrange for use with glass stem thermometers. Use the same material as the pipe. Weld or braze to pipes. Fill pockets with conductive medium.

Length: Extend to within 5 mm of opposite pipe wall and extended above insulation.

Pipe enlargement: If thermometer pocket would otherwise decrease the pipe cross sectional area by more than 25%, provide a section of larger diameter at the location to mount the pocket.

### Thermometer wells

General: Provide stainless steel thermometer wells of the separable type to enable the sensing element to be withdrawn without draining the system. Screw wells into a boss welded to the pipe, to suit the installed sensing element and extended above insulation. Fill wells with conductive medium.

## 2.12 WATER FLOW MEASUREMENT

### Sensing element

Type: Low loss pitot type averaging sensor, with 2 flared isolating valves for connection of pressure lines.

Material: Stainless steel.

Installation: Comply fully with manufacturer's recommendation for installation, connection and valving. Provide manufacturers recommended straight lengths of pipe upstream and downstream of tapping point. Mount in the piping using an adaptor bushing and welding boss.

Accuracy: Within  $\pm 1.5\%$  over the range of flow anticipated.

Stability: Within  $\pm 0.125\%$  over five years.

Repeatability:  $\pm 0.1\%$ .

Marking: Provide a stamped tag showing normal, maximum and minimum flows, pipe size, serial number and related data.

### Flow meters

General: Graduated meters incorporating variable pulsation dampening control, integral equalising valve, 2 bleed valves, and a direct reading scale linear to flow rate. Provide nylon connecting hoses suitable for a pressure of 1030 kPa.

Function: To read directly the flow rate in the pipe with a scale appropriate to the expected flow rate.

## **3 EXECUTION**

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### **3.1 INSTALLATION – GENERAL**

#### **Arrangement**

Changes of direction: Provide long radius elbows or bends where practicable, and swept branch connections. Provide elbows or short radius bends where pipes are led up or along walls and then through to fixtures. Do not provide mitred fittings.

#### **Installation**

General: Install piping in straight lines at uniform grades with no sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant.

Arrangement: Arrange and support piping so that it remains free from vibrations whilst permitting necessary movements. Minimise the number of joints.

Spacing: Provide at least 25 mm clear between pipes and between pipes and building elements, additional to insulation.

Dissimilar metals: Join dissimilar metals with fittings of electrolytically compatible material.

### **3.2 ACCESSIBILITY**

#### **General**

General: Provide access and clearance at fittings which require maintenance or servicing, including control valves and joints intended to permit pipe removal. Arrange piping so that it does not interfere with the removal or servicing of associated equipment or valves or block access or ventilation openings.

#### **Gauges**

General: Locate thermometers, pressure gauges and similar instruments so that they are easily read after installation.

### **3.3 CLEANING**

#### **External preparation**

General: Remove scale, rust, burrs and grease and ensure that surfaces are clean and dry.

Protection: During construction, prevent the entry of foreign matter into the piping system by temporarily sealing the open ends of pipes and valves with purpose-made covers of pressed steel or rigid plastic.

### **3.4 SUPPORTS**

#### **Support systems**

General: Provide hangers, brackets, saddles, clips, and support system components, incorporating provisions for adjustment of spacing, alignment, grading and load distribution. Support pipework from associated equipment or building structure. Support valves, strainers and major line fittings so that no load is placed on adjacent tubes or transmitted to them during operation and maintenance.

Support type: Proprietary metallic-coated steel channel section with clamps and hangers sized to match external diameter of pipe being supported.

Vertical pipes: Provide anchors and guides to maintain long pipes in position, and supports to balance the mass of the pipe and its contents.

Saddles: Do not provide saddle type supports for pipes  $\geq$  DN 25.

Dissimilar metals: If pipe and support materials are dissimilar, provide industrial grade electrically non-conductive material securely bonded to the pipe to separate them. Provide fixings of electrolytically compatible material.

Uninsulated pipes: Clamp piping supports directly to pipes.

Insulated pipes:

- Spacers: Provide spacers at least as thick as the insulation between piping supports and pipes. Extend either side of the support by at least 20 mm.
- Spacer material: Rigid insulation material of sufficient strength to support the piping and suitable for the temperature application.
- Vapour barriers: For cold pipes apply aluminium foil tape over the circumference of the spacer to form a vapour barrier. Fit to spacer before installation of the bracket on the pipe.
- Metal sheathing: Provide a 0.55 mm thick metallic-coated steel band between the aluminium foil tape and the support for the full width of the spacer.

### Support spacing

Ferrous pipes: To AS 4041 Table 3.28.2.

Copper pipes: To AS 4809 Table 6.2.

Other non-ferrous pipe: To AS/NZS 3500.1 Table 5.2.

### Hanger size table

Outside diameter of pipe or sheathing (mm)	Minimum hanger diameter (mm)	
	Light series	Heavy series
< 20	6	6
$\geq 20$ , < 35	10	10
$\geq 35$ , < 65	12	12
$\geq 65$ , < 120	12	16
$\geq 120$ , < 220	16	16
$\geq 220$ , < 275	16	20
$\geq 275$ , < 325	20	24
$\geq 325$ , < 410	24	30

## 3.5 FLEXIBILITY

### General

General: Provide pipe anchors offsets or expansion devices and pipe guides which accommodate expansion and contraction, and minimise the transmission vibration and noise to building structures. Locate anchors and guides at equal distances on each side of expansion devices. Weld or securely clamp anchors to bare pipe. If limitations in the strength of structures prevent the use of expansion devices and anchors, arrange piping to move in lateral and linear directions (e.g. at bends) while not deviating from gradients.

### Flexible connections

General: Minimise the transmission of vibration and noise through the piping. Provide flexible connections between piping and vibrating sources.

Connections to major plant items: Reinforced rubber type, spherical shape with flanged ends.

Elsewhere: Flexible reinforced nylon hose.

## 3.6 SLEEVES

### General

Location: Provide sleeves that permit normal pipe movement through all walls, floor slabs, and building elements.

### Cover plates

General: Where exposed to view provide cover plates fixed to the pipe or insulation sheathing and free to move with respect to sleeve and building surface.

Material: Non-ferrous metal, finished to match the pipe, or of stainless steel, close fitting and firmly fixed in place.

### Cover plate sizes table

Nominal pipe size, DN	Cover plate diameter
< 20	65 mm
≥ 20, < 50	100 mm
≥ 50	50 mm larger than pipe

## 3.7 JOINTS

### General

Minimise the number of joints. If practicable, provide welded or brazed joints or a proprietary pipe coupling system.

### Demountable joints

General: Provide demountable joints as follows:

- At connections to mechanically cleanable heat transfer vessels and pumps.
- At maintenance locations.

Pipes > DN 50: Flanged type.

### Flanged joints

Metal flanges: Full face flanges with undistorted machined joint faces, to AS 2129.

Minimum flange thickness: 12 mm.

Bolting: To AS 2129 Appendix C and AS 2528.

- Material:
  - Corrosion resistant environments: Zinc-plated steel.

- Corrosive environments: Material with equivalent corrosion resistance to, and compatible with, the flanges.

Flange jointing material: Preformed proprietary type at least 0.8 mm thick.

Installation: Install flanges square with the run of pipe and aligned parallel to each other. Do not correct misalignment by bolting.

### Screwed joints

General: To AS 1722.1. Do not provide long screws or barrel nipples. Seal threads of screwed connections with degreased PTFE tape or a thread sealing compound.

## 3.8 DRAINS, VENTS AND GRADING

### Drains

Water systems: Provide valved drains to the bottom of riser piping and as necessary to drain liquids completely from piping.

Other drains: Provide drains to drip trays, automatic air vents and equipment with drain points.

Drain size: Minimum DN 20. Match equipment drain size if larger.

Drain points: Pipe drains to discharge points via air breaks.

Air inlet vents: Provide at high points in the system.

### Drain size table

Nominal size of pipe to be drained, DN	Nominal size of drain and valve, DN (minimum)
> 50, ≤ 100	20
> 100, ≤ 150	25
> 150, ≤ 300	32
> 300	50

### Air release vents

Material: Copper pipe.

Location: Provide 15 mm minimum size air vents at the following locations:

- High points of the system.
- Sections of the piping in which air may collect.
- Upstream from each item of equipment.

Risers: Provide a 150 mm high riser set vertically from the pipe. Connect the air vent to the top of the riser.

- Diameter: Pipe diameter.

Water systems: Provide manual air vents.



### Grading

Water systems: Grade to rise in the direction of flow to points of air venting, except, if the water piping is exposed in a run with other services, run the water piping to the same grade as the other services.

- Minimum grade: 1 in 200.

## 3.9 COMPLETION TESTS

### Hydrostatic testing

Preparation for testing: Isolate items of equipment not designed to withstand test pressures. Leave pipe joints exposed to enable observation during tests. Secure pipes and fittings in position to prevent movement during tests. Restrain expansion bellows.

Water pre-treatment: Conform to *Water treatment*. For steel piping, introduce corrosion inhibiting chemicals. Use chemicals from a water treatment specialist in accordance with the specialist's instructions and under the specialist's supervision. Leave pre-treated water in the system until the system is ready for chemical cleaning and flushing.

Procedure: Test completed piping systems including equipment designed to withstand test pressures. Isolate equipment not designed to withstand the test pressure.

Test criteria: No loss of pressure over the test period after taking account of changes in ambient temperature.

Test pressures:

- Pressure piping: To AS 4041.
- Other piping: Test systems at 1.5 times the working pressure or 1 MPa, whichever is the greater, for at least 24 hours.

## J. MECHANICAL PIPING INSULATION

### 1 GENERAL

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#### 1.1 AIMS

##### Responsibilities

General: Provide insulation to hot and cold piping, flues, tanks vessels and plant.

Selections: As documented.

#### 1.2 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

- *Mechanical general requirements.*

#### 1.3 STANDARDS

##### Installation of mineral wool insulation

General: Comply with the ICANZ Industry Code of Practice for the Safe Use of Glass Wool and Rock Wool Insulation.

Marking: Deliver mineral wool products to site in packaging labelled FBS-1 BIO-SOLUBLE INSULATION.

#### 1.4 INTERPRETATIONS

##### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Mineral wool (including glasswool and rockwool): Entangled mat of fibrous non-crystalline material derived from inorganic oxides of minerals, rock, slag or glass, processed at high temperatures from a molten state.
- Polyester: Insulation manufactured from thermally bonded polyester fibres.
- R value: The thermal resistance ( $\text{m}^2\text{K/W}$ ) of a component calculated by dividing its thickness by its thermal conductivity. R value does not include air space or surface resistances.

#### 1.5 SUBMISSIONS

##### Fire hazard properties

General: Submit evidence of conformance with the following:

- Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3, including, if the material has a reflective facing, scoring and blackening to AS/NZS 1530.3 clause A6:

- Spread of flame index: 0.
- Smoke developed index:  $\leq 3$ .
- Facing materials when tested in conformance with AS 1530.2: Flammability index:  $\leq 5$ .

#### Thermal insulation performance

General: Submit evidence of conformance to AS/NZS 4859.1.

### 1.6 SAMPLES

#### General

General: Submit samples of the following:

- Each type of insulation, including at least one transverse joint, bend and one hanger on a  $\geq 1.5$  m long section of pipe. If the piping system to be insulated using the respective type of insulation includes flanges, provide an insulated flange in the sample.

Cutaway sections: For each sample, provide cutaway sections to permit inspection of application details including insulation materials, adhesives, mastics, fixings and sheathing.

### 1.7 ALTERNATIVE INSULATION METHODS AND MATERIALS

#### General

General: Do not submit alternatives for materials or methods that have lesser quality or characteristics in terms of the following:

- Thermal and other performance.
- Suitability for the operating temperature range.
- Durability during and after installation.
- Corrosion resistance.
- Cold bridging.

## 2 PRODUCTS

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### 2.1 GENERAL

#### General

General: Provide piping insulation in conformance with the **Minimum piping insulation thickness table**.

Condensate drains from air handling plant: If included in the **Piping insulation schedule** provide 25 mm thick insulation.

**Minimum piping insulation thickness table**

Temperature of piping contents	Maximum thermal conductivity at mean temperature (W/m.K)	Nominal pipe size, DN					Tanks, vessels and heat exchangers
		15-40	50-80	100-125	150	200	
		Minimum insulation thickness (mm)					
≥ -20°, < 2°C	0.037 at 20°C	50	63	75	75	100	100
≥ 2°, < 20°C	0.037 at 20°C	Total R-value to BCA Specification J5.4 but not less than 50 mm.					63
≥ 40°, < 90°C	0.037 at 50°C	Total R-value to BCA Specification J5.4 but not less than 25 mm.					50
≥ 90°, < 120°C	0.038 at 65°C	38	38	50	50	50	100
≥ 120°, < 175°C	0.042 at 90°C	63	63	63	75	88	100
≥ 175°C	0.047 at 120°C	63	75	75	100	125	125

## 2.2 MATERIALS

### General

Prohibited materials: Do not provide materials:

- Containing asbestos, lead, mercury or mercury compounds.
- Containing substances listed as hazardous in the NOHSC Hazardous Substances Information System.
- Which use CFC or HCFC as blowing agents in the manufacturing process.

Materials in contact with stainless steel: To have properties including leachable chloride content that does not cause corrosion or other deterioration of the stainless steel.

### Fire hazard properties

General: Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3:

- Spread of flame index: 0.
- Smoke developed index:  $\leq 3$ .

Facing materials:

- Flammability index when tested in conformance with AS 1530.2:  $< 5$ .

Materials with reflective foil facing: Test to AS/NZS 1530.3 clause A6.

### Insulation materials

Standard: To AS/NZS 4859.1.

### **Vapour barrier**

Standard: If vapour barrier performance is documented, provide a system with a vapour barrier classification of High to AS/NZS 4200.1.

### **Polystyrene foam**

Description: To AS 1366.3 Class S or SL self-extinguishing grade, machine cut to form tubular half-sections for pipe insulation or batts for insulating fittings. For tanks, vessels and heat exchangers, mould to shape.

Density (minimum):

- Moulded grades:
  - Class S: 16 kg/m<sup>3</sup>.
  - Class SL: 13.5 kg/m<sup>3</sup>.
- Extruded grade: 32 kg/m<sup>3</sup>.

### **Polyolefin foam**

Type: Closed cell cross-linked polyolefin foam produced using non-CFC blowing agent.

Insulation surface facing: Heat-bonded aluminium foil laminate.

### **Phenolic, polyurethane and polyisocyanurate foam**

Description: machine cut to form tubular half sections.

Density:  $\geq 32$  kg/m<sup>3</sup>.

### **Mineral wool and polyester**

Description: Select from the following:

- Mineral wool (glasswool or rockwool) resin-bonded to form tubular sections.
- Polyester in moulded tubular sections.

Cold piping: Do not use mineral wool or polyester for piping with contents  $\leq 10^{\circ}\text{C}$ , except for the following:

- To provide a fire rated building penetration.
- For filling air gaps around valves and fittings.

### **Adhesives, sealants and mastics**

Mastic vapour barrier:

- Water vapour permeance to AS 1301.419s Condition B, or ASTM E96/E96M.
  - Chilled water pipes:  $\leq 15$  ng/N.s.
  - Cold water pipes:  $\leq 50$  ng/N.s.

### **Aluminium foil laminate sheet**

Standard: AS/NZS 4200.1.

Material: Glass fibre reinforced, aluminium foil-paper laminate.

Duty classification to AS/NZS 4200.1: Heavy duty.

Water vapour classification to AS/NZS 4200.1: High (permeance  $\leq 0.002 \mu\text{g/N.s}$ ).

#### **Aluminium foil laminate tape**

Adhesive: Non toxic, high tack, synthetic pressure-sensitive type.

Liner: Silicone coated paper.

Backing: Glass fibre reinforced, aluminium foil-paper laminate.

Minimum width: 50 mm.

Mechanical properties: To AS 4254.

#### **Elastomeric foam insulation**

Type: Chemically blown closed cell nitrile rubber in tubular sections for pipe insulation, in sheets for insulating pipe fittings, and in sheets or rolls for large pipes, tanks, vessels and heat exchangers. Provide with smooth natural finish and vapour barrier properties.

Standard: To ASTM C534.

Physical properties:

- Moisture absorption: Non-hygroscopic.
- Water vapour permeability:  $\leq 0.065 \text{ ng/Pa.m.s}$ .

Adhesives: Adhesive fix all joints. Use only solvent-based adhesive supplied by insulation manufacturer and designed specifically for the material being used.

### **3 EXECUTION**

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#### **3.1 GENERAL**

##### **General**

General: Do not apply insulation to piping joints until piping pressure testing is complete.

Preparation: Before installing insulation, remove weld slag, rust, grease and the like from the surface of the pipe and ensure it is clean and dry. For black steel pipe, apply one coat water-borne primer for steel to AS 4089 Type 3.

Supports: Do not apply insulation at supports until the spacers, vapour barrier (if any) and metal sheathing (if any) has been installed.

Joints: Install insulation with the least number of joints practicable.

Use of multiple layers: If insulation is applied in more than one layer, stagger longitudinal and end joints.

##### **Cold piping**

General: Insulate piping carrying fluids at temperatures below ambient including chilled water piping, cold refrigerant and condensate piping, and associated valves and fittings.

##### **Pump and valve insulation**

General: Insulate all pumps, flanges, unions and valves as for attached pipework.

Serviceable items: Arrange insulation so that it can be easily removed and refitted without damage and without reducing its insulating and vapour barrier performance. Locate joints in

the insulation and sheathing to coincide with joints in the pumps, flanges, unions and valves. Secure sections with captive fasteners or latches.

### 3.2 PIPING INSULATION SYSTEMS

#### Insulation systems

General: Comply with the **Insulation systems table** for the selection and application of insulation systems.

**Insulation systems table**

Insulation system	Application for piping	Insulation material	Insulation surface facing	Insulation fixing material
Mineral wool	Hot or selected sections of cold	Mineral wool	Aluminium foil laminate	None required
Polyester fibre	Hot piping up to 100°C	Polyester fibre	Aluminium foil laminate	None required
Polyolefin foam	Hot piping up to 100°C	Polyolefin foam	Aluminium foil laminate	None required
Polyolefin foam	Cold	Polyolefin foam	Aluminium foil laminate as a vapour barrier	Adhesive
Cold system	Cold	Polystyrene foam Phenolic foam Polyurethane foam Polyisocyanurate foam	Aluminium foil laminate as a vapour barrier	Adhesive or oil based sealant

### 3.3 COLD PIPING INSULATION

#### Cold system and polyolefin

Vapour barrier: Factory bond aluminium foil laminate to insulation and provide a minimum overlap of 50 mm at the longitudinal joint.

Extent of application of adhesive or sealant:

- To mating faces of insulation sections on joints between sections.
- To steel pipe to be insulated.
- To faces of insulation sections and pipe support blocks at joints.

Longitudinal joints: Stagger longitudinal joints between sections a minimum of 75 mm. Seal aluminium foil laminate overlap with contact adhesive or 50 mm wide (minimum) self adhesive aluminium foil tape, to complete the vapour barrier.

Butt joints: Provide 50 mm minimum width aluminium foil laminate tape over joints. Neatly finish joints and provide a seal free of perforations or leaks.

Straps: Fix insulation at maximum 500 mm centres with 12 mm wide polypropylene, metallic-coated steel or aluminium straps.

Bends: Cut insulation into segments and seal together with adhesive, or provide preformed bends, following bend contours. Fix to piping.

Fittings, valves and flanges: Cut insulation and form it to fit around fittings, valves and flanges. Provide loose mineral wool to fill air gaps and voids. Provide a continuous vapour barrier.

#### **Elastomeric foam insulation**

Application: For straight and curved pipe provide preformed sections sized to suit the pipe. If practicable, do not slit. If slit, and for valves, fittings and large diameter pipes, fix with adhesive at joints.

Installation: Adhesive fix joints. Adhere to the pipe at end joints, for a distance of 25 mm, to compartmentalise each section.

Protection: Provide metal sheath insulation:

- Where exposed to sunlight.
- Where subject to mechanical damage.

Alternative protection: Where exposed to sunlight but not exposed to mechanical damage provide 2 coats of tintable, water-based, rubberised, UV resistant, flexible paint finish to outdoor installations.

### **3.4 SHEATHING OF PIPING INSULATION**

#### **Location**

General: Provide metal sheathing to all piping insulation:

- In plant rooms.
- Exposed to weather.
- Subject to mechanical damage.
- On valves, pipeline components and pumps in sheathed pipework.

#### **Metal sheathing**

Material: Metallic-coated sheet steel, 0.55 mm minimum thickness coating class Z275.

Installation: Cut and roll the metal sheathing to the correct size. Lap longitudinal and transverse joints a minimum of 40 mm and arrange longitudinal laps to shed water. Cone down at terminations and transitions.

Fixing: Select from the following:

- Clamp sheathing at 500 mm maximum centres with 12 x 0.55 mm metallic-coated sheet steel straps.
- Fix sheathing with screws or rivets at 150 mm maximum centres. Do not penetrate the vapour barrier. Protect the vapour barrier with reinforced cloth tape.

Bends: Provide pre-drilled lobster back bends containing at least 3 segments. Provide mitred elbows where the size of the piping or the radius of pipe bends do not allow the use of segmented bends. Provide each segment with an inner and outer swage formed at the transverse edges. Fix longitudinal joints with pop rivets of correct length so that the vapour barrier is not damaged. Further protect insulation vapour barrier with reinforced cloth tape where pop rivets are installed.

Weatherproofing: Weatherproof external joints and fixings with silicone sealant.

Serviceable items: Provide removable boxes or cover plates to equipment requiring maintenance. Provide proprietary toggle action catches for removable boxes. The following equipment requires maintenance:



- Insulated strainers.
- Valves at pumps.
- Flow regulating valves.
- Control valves.
- Flexible connections.
- Demountable joints.
- Flow measuring devices.

### 3.5 TANK, VESSEL AND HEAT EXCHANGER INSULATION

#### Thermal performance

General: Conform to the **Minimum pipe insulation thickness table**.

#### Cold (< 20°C) tanks, vessels and heat exchangers

Material: Polystyrene, phenolic, polyurethane or polyisocyanurate foam sheets.

#### Hot (≥ 40°C) tanks, vessels and heat exchangers

Material: Mineral wool or polyester blanket.

#### Removable covers

General: Provide removable insulated covers, attached with toggle action catches or self-tapping screws, to serviceable items.

### 3.6 COLD TANK, VESSEL AND HEAT EXCHANGER INSULATION

#### Rigid foam sheet

System: Cold system in **Insulation systems table**.

Application: Comply with **Cold system**.

Insulation layers: Provide sections cut to the shapes of tanks, vessels or heat exchangers, or sheets formed to fit the contours of tanks, vessels or heat exchangers. Apply the insulation in more than one layer. Glue the initial layer to tanks, vessels or heat exchangers and hold in place with 12 x 0.55 mm metallic-coated steel straps, machine pulled, at 500 mm maximum centres. Glue and strap subsequent layers to each other until the designated thicknesses are attained. Form ends with cut segments of insulation to match the contours of tanks, vessels or heat exchangers.

Joints: Staggered.

#### Elastomeric foam insulation

General: Adhere to total area of tank. Oversize at butt joints so that insulation is under compression. Seal joints with adhesive.

### 3.7 SHEATHING OF TANK, VESSEL AND HEAT EXCHANGER INSULATION

#### Metal sheathing

Material: ≥ 0.55 mm metallic-coated sheet steel coating class Z275.

### *3. TECHNICAL SPECIFICATION*

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Installation: Cut and roll metal sheathing to the correct sizes. Lap longitudinal and transverse joints a minimum of 40 mm and arrange longitudinal laps to shed water, with exposed edges swaged.

Fixing: Clamp sheathing with 12 x 0.55 mm metallic-coated sheet steel straps at 500 mm maximum centres.

Weatherproofing: Weatherproof external joints and fixings with sealant.

## K. WATER TREATMENT

### 1 GENERAL

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#### 1.1 AIMS

##### Responsibilities

General: Provide water treatment by chemical means; active cathodic protection by impressed current is not required.

Selections: As documented.

##### Design

General: Limit corrosion rates to the following:

- Copper:  $\leq 12 \mu\text{m/year}$ .
- Mild steel and iron:  $\leq 150 \mu\text{m/year}$ .
- Stainless steel:  $\leq 5 \mu\text{m/year}$ , with no pitting.

Requirements: Water treatment systems must:

- Be compatible with the fluid being treated and the system construction.
- Clean corrosion products and foreign matter from new piping.
- Effectively control:
  - In closed systems: Corrosion, microbiological growth, pH, scale formation and sludge accumulation.
  - In open systems: Chlorides, corrosion, fouling, microbiological growth including *Legionella* species, pH, scale formation, sludge accumulation, total alkalinity and total dissolved solids.
- Meet regulatory requirements.
- Not be hazardous in normal use.
- Not cause components to deteriorate.

#### 1.2 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

- *Mechanical general requirements*.

## 1.3 STANDARDS

### General

Control of microbial growth: To the recommendations of SAA HB 32.

Design, installation and commissioning: To AS/NZS 3666.1.

Operation and maintenance: To AS/NZS 3666.2.

Performance-based maintenance: To AS/NZS 3666.3.

Storage and handling of corrosive substances substances: To AS 3780.

## 1.4 INTERPRETATIONS

### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Closed system: A water distribution or circulation system in which the water does not come into contact with air during circulation and to which, in normal operation, no water is added.
- Open system: A water distribution or circulation system that is not a closed system.

## 1.5 INSPECTIONS

### Notice

Inspection: Give sufficient notice so that inspection may be made of the following:

- Inspection of the contents of strainer baskets after initial chemical cleaning and flushing.

## 1.6 SUBMISSIONS

### Executions - proposals

General: Submit proposals for the methods and equipment to be used, including the following:

- Cathodic protection systems: Details, including a statement of experience, of proposed designer and installer.
- Microbial testing authority: Accreditation details.
- Water treatment systems: Details for each system of:
  - Chemicals. Include material safety data sheets.
  - Method of dosing.
  - Method of control.
  - Method of minimising water consumption.

## 2 PRODUCTS

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### 2.1 CHEMICAL DOSING – OPEN SYSTEMS

#### General

General: For each independent system to be treated, provide a separate chemical dosing system consisting of a storage tank supplying chemicals to a dosing pump automatically activated by a control unit.

Standard: Comply with AS/NZS 3666.1 Section 4.

#### Storage tanks

Standard: To AS/NZS 4766.

Size: Low density polyethylene construction with lid, sized to hold > 150% of estimated monthly usage.

Bund: Provide bunds to AS 3780.

Alarm: Provide a low chemical level alarm.

#### Dosing pumps

General: Electrically direct driven, manually adjustable type. Provide clear plastic suction lines.

#### Automatic bleed

General: Provide for automatic control of total dissolved and non-dissolved solids in each system, using conductivity control units activating two position or modulating bleed valves in water bleed lines.

Controller: Provide accurate conductivity sensor and control to maintain high total dissolved solids and cycles of concentration.

Control valves: Motorised ball type, sized to suit the expected bleed off rate. Provide upstream Y-type strainers with 1.6 to 3.2 mm aperture size and isolation and throttling valves.

Stand-by bleed: Provide additional bleed lines for manual bleeding, with throttling valves.

Adjustment: Adjust bleed rate to maximise the total dissolved solids cycles of concentration consistent with the **Aims** clause.

#### Biocide dosing

System: Provide automatically controlled biocide treatment direct into each system. Provide for contamination dosing of any alternate biocide.

Materials: Rotate the type of biocide regularly according to schedules prepared by a suitably qualified person.

Bleed: Provide an adjustable automatic lockout to prevent the bleed from operating while biocide is being added to the system.

### 2.2 CHEMICAL DOSING – CLOSED SYSTEMS

#### General

General: For each independent system to be treated, provide a separate chemical dosing system consisting of a by-pass slug-dose feeder vessel employing discharge flow to flush chemicals into the system.

### **Feeder vessels**

General: Provide a storage tank capable of withstanding the maximum pump pressure. Provide a funnel, DN 15 piping and valve for adding chemicals, a vent line with valve, a DN 15 drain line with valve discharging to drain, and a DN 15 outlet line with valve.

## **2.3 WATER FILTERS**

### **Construction**

General: Provide proprietary filter systems consisting of storage tanks, piping, valves, instruments timers and controls to provide automatic backwashing.

Backwash system: Complete with piping, valves, pressure gauges and ancillary devices to show the need for backwash.

Backwash cycle: Initiated by automatic timer with provision for manual override.

## **3 EXECUTION**

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### **3.1 CHEMICALS**

#### **General**

General: Supply chemicals for pre-cleaning, cleaning, flushing and treatment of mechanical piping systems. Ensure correct use of the chemicals by providing instructions and supervision.

Quantities: Supply sufficient quantities of chemicals to treat the water from the time of initial filling to beyond the end of the maintenance period.

### **3.2 MARKING**

#### **Hazard identification**

General: Identify piping and storage vessels containing hazardous materials.

Standard: AS 1345.

#### **Safety signs**

General: If hazardous chemicals are to be stored, provide safety signs to AS 1319.

### **3.3 INITIAL TREATMENT**

#### **Chemical cleaning and flushing**

General: Before setting the systems into operation and commissioning, carry out initial chemical cleaning and flushing for control of corrosion and microbial growth.

Initial fill: Introduce chemicals into the initial fill water.

Detergent flushing: After hydrostatic testing has been completed, release the testing water and flush piping systems using non foaming alkali detergent solution.

Cleaning and flushing: Introduce cleaning chemicals to piping systems and circulate continuously for at least 24 hours, with control and manual valves open. Drain the systems and clean strainers. Flush with clean water until cleaning chemicals are removed.

#### **Initial treatment**

General: Drain piping systems and charge with chemically treated water.

**Discharge to sewer**

General: Conform to AS/NZS 4494.

**3.4 COMPLETION**

**Tests before building occupation**

General: Provide routine tests to AS/NZS 3666.3 before the building is occupied.

For bacteria including *Legionella* species: Sampled and tested by a Registered testing authority accredited to perform the specific tests.

*Legionella* analysis: To AS/NZS 3896.

Bacteria analysis: Total plate count to AS 4276.3.1 or AS 4276.3.2 as appropriate.

Test report: Required.

## L. MECHANICAL ELECTRICAL

### 1 GENERAL

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#### 1.1 AIMS

##### Responsibilities

General: Provide mechanical electrical installations. Provide new fluorescent lighting to suit the revised plant room layout. Provide for controls as specified under building management system.

#### 1.2 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

### 2 LOW VOLTAGE POWER SYSTEMS

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#### 2.1 GENERAL

##### Standards

General: To AS/NZS 3000 and the recommendations of SAA HB301.

Fire and mechanical performance classification: To AS/NZS 3013.

Selection of cables: To AS/NZS 3008.1.1.

Distribution cables: To AS/NZS 4961.

Testing:

- Standard: To AS/NZS 3017.

##### Submissions

Technical data: Submit the following information for each submain and subcircuit for which calculation is the responsibility of the contractor.

- Single line diagram.
- Fault Levels at switchboards.
- Maximum demand calculations.
- Cable and conductor cross sectional area and insulation type.
- Cable operating temperature at design load conditions.
- Voltage drop calculations at design load conditions.
- Protective device characteristics, e.g. curves,  $I^2t$ .
- Discrimination and grading of protective devices.
- Prospective short circuit current automatic disconnection times.



- Final subcircuits may be treated as typical for common route lengths, loads and cable sizes.
- Earth fault loop impedance for testing and verification.
- Certify compliance with AS/NZS 3000 clause 1.8, for electrical services.

## 2.2 PRODUCTS

### Wiring systems

Selection: Provide wiring systems appropriate to the installation conditions and the function of the load.

### Shielding

Use shielded cables where necessary to prevent radio frequency disturbances from the cables affecting other equipment and if required for BMCS wiring to prevent disturbances from other sources from affecting BMCS signals.

### Power cables

Standard:

- PVC and XLPE cables: To AS/NZS 5000.1.

Cable: Use multi-stranded copper cable generally.

Minimum size:

- Power sub-circuits: 2.5 mm<sup>2</sup>.
- Sub-mains: 6 mm<sup>2</sup>.

Voltage drop: Install final subcircuit cables within the voltage drop parameters dictated by the route length and load.

Fault loop impedance: Provide final subcircuit cables selected to satisfy the requirements for automatic disconnection under short circuit and earth fault/touch voltage conditions.

## 2.3 EXECUTION

### Power cables

Handling cables: Report damage to cable insulation, serving or sheathing.

Stress: Ensure that installation methods do not exceed the cable's pulling tension. Use cable rollers for cable installed on tray/ladders or in underground enclosures.

Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints.

Cable joints: Locate in accessible positions in junction boxes.

Extra-low voltage circuits: Individual wiring of extra-low voltage circuits: Tie together at regular intervals.

Tagging: Identify multicore cables and trefoil groups at each end with stamped non-ferrous tags clipped around each cable or trefoil group.

Marking: Identify the origin of all wiring by means of legible indelible marking.

Cable systems: Provide the following:

- Cast concrete slabs: Unsheathed cable in heavy duty UPVC conduit.
- Accessible spaces: Thermoplastic insulated and sheathed cables.
- Concealed spaces: Unsheathed cable in UPVC conduit.

- Plant rooms: Unsheathed cable in heavy duty UPVC conduit.
- Plastered or rendered surfaces: Cable in UPVC conduit.
- Stud walls without bulk insulation: Thermoplastic insulated and sheathed cables.
- Stud walls with bulk insulation: Cable in UPVC conduit.
- Walls filled with thermal insulation: cables in PVC conduit.

#### **Fire-rated (other than MIMS)**

Protection: If exposed to mechanical damage, provide protection to AS/NZS 3013.

#### **Copper conductor terminations**

Within assemblies and equipment: Loom and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

Alternative: Run cables in UPVC cable duct with fitted cover.

Identification: Provide durable numbered ferrules or other approved labels fitted to each core, and permanently marked with numbers, letters or both to suit the connection diagrams.

Spare cores: Identify spare cores and terminate into spare terminals, if available. Otherwise, neatly insulate and neatly bind the spare cores to the terminated cores.

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### **3 CABLE SUPPORT AND DUCT SYSTEMS**

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#### **3.1 GENERAL**

##### **Standards**

Cable trunking systems: To AS/NZS 4296.

Conduits and fittings for electrical installations: AS/NZS 2053 Parts 1, 2, 3, 4, 5, 6, 7 and 8.

#### **3.2 PRODUCTS**

##### **Conduits**

Sizes:

- Conduits:  $\geq 20$  mm.

##### **Non-metallic conduits and fittings**

Standards: Non-metallic conduits and fittings: AS/NZS 2053 Parts 2, 3, 4, 5 or 6.

Flexible conduit: Provide flexible conduit to connect with equipment and plant subjected to vibration. If necessary, provide for adjustment or ease of maintenance. Provide the minimum possible length.

Associated fittings:

- Type: The same type and material as the conduit.
- Wall boxes on UPVC conduits: For special size wall boxes not available in UPVC, provide prefabricated earthed metal boxes.

Inspection fittings: Provide inspection-type fittings only in accessible locations and where exposed to view.

Joints: Cemented or snap on joints.

### **Ducted wiring enclosures**

Ducting: Provide purpose-made ducts. Provide rigid supports. Round off sharp edges and provide bushed or proprietary cable entries into metallic ducting.

Accessories: Provide purpose-made accessories and covers to match the duct system. Provide screw-fixed covers or clip-on covers removable only with the use of tools.

Cable support: Except for horizontal runs where the covers are on top, support wiring with retaining clips at intervals of not more than 1000 mm.

## **3.3 EXECUTION**

### **Unsheathed cables – installation**

General: Provide permanently fixed enclosure systems, assembled before installing wiring. Provide draw wires to pull in conductor groups from outlet to outlet, or provide ducts with removable covers.

### **Conduit systems – installation**

Set out: If exposed to view, install conduits in parallel runs with right angle changes of direction.

Conduits in roof spaces: General: Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

Inspection fittings: Locate in accessible positions.

Draw cords: Provide 5 mm<sup>2</sup> polypropylene draw cords in conduits not in use.

Draw-in boxes: Provide draw-in boxes as follows:

- Spacing: < 30 m.
- At changes of level or direction.

Underground draw-in boxes: Provide casketed covers and seal against moisture.

Expansion: Allow for thermal expansion/contraction of conduits and fittings due to changes in ambient temperature conditions. Provide expansion couplings as required.

Rigid conduits: Provide straight long runs, smooth and free from rags, burrs and sharp edges. Set conduits to minimise the number of fittings.

Routes: Run conduits concealed in wall chases, embedded in floor slabs or installed in inaccessible locations directly between points of termination, minimising the number of sets. Do not provide inspection fittings.

Conduits in concrete slabs:

- Route: Do not run in concrete toppings. Do not run within pretensioning cable zones. Cross pretensioning cable zones at right angles. Route to avoid crossovers and minimise the number of conduits in any location. Space parallel conduits  $\geq 50$  mm apart.
- Minimum cover: The greater of the conduit diameter and 20 mm.
- Fixing: Fix directly to top of the bottom layer of reinforcing.

## **4 SWITCHBOARDS**

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### **4.1 GENERAL**

#### **Standards**

Standards: To AS/NZS 3000 and AS/NZS 3439.3.

## Submissions

Product data: Submit the following:

- Makes, types and model numbers of items of equipment.
- Type test certificates for components, functional units and assemblies including internal arcing-fault tests and factory test data
- Overall dimensions.
- Fault level.
- IP rating.
- Rated current of components.
- Number of poles and spare capacity.
- Mounting details.
- Door swings.
- Paint colours and finishes.
- Access details.
- Schedule of labels.

## 4.2 FIRE TRIP

Provide a fire trip relay and connect to the existing fire detection system to stop the air conditioning system when a fire alarm is detected. Arrange the relay to reset automatically after the fire alarm panel is reset or after it is tripped by a power failure. Coordinate with the Building Management System to ensure a safe, staged restart of mechanical plant.

## 4.3 PRODUCTS

### General

Doors: Provide lockable doors with a circuit card holder unless enclosed in cupboards or in an area which is not readily accessible to the public.

IP rating: IP51 minimum.

Weatherproof: IP56 minimum.

Supporting structure: Wall mounted for proprietary switchboards.

Floor mounted: Assemblies > 2 m<sup>2</sup>.

Ventilation: General: Required to maintain design operating temperatures at full load.

## 4.4 EXECUTION

### General

Cable entries: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Provide the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Cable enclosures: Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

Cable supports: Support or tie mains and submains cables within 200 mm of terminations. Provide cable supports suitable for stresses resulting from short circuit conditions.

## **Maintenance**

Standard: To AS 2467.

## **5 SWITCHBOARD COMPONENTS**

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### **5.1 PRODUCTS**

#### **General**

Selection: To comply with the requirements of AS/NZS 3000 clause 1.9 and Section 2.

Rated duty: Uninterrupted in non-ventilated enclosure.

Rated making capacity:  $\geq$  fault level at assembly incoming terminals.

Rated breaking capacity:  $\geq$  rated full load current.

Utilisation category: To AS/NZS 60947.1 clause 4.4.

Circuits consisting of motors or other highly inductive loads: At least AC-23.

Other circuits: At least AC-22.

Coordination: Provide protective devices which fully grade and coordinate for short circuit current, over-current, let through energy and earth faults.

#### **Switch-isolator units**

Standard: To AS/NZS 60947.1 and AS/NZS 3947.3.

Poles: 3.

Operation: Independent manual operation including positive ON/OFF indicator.

Shrouding: Effective over range of switch positions.

#### **Moulded case and miniature circuit breakers**

Moulded case breakers: To AS/NZS 60947.1 and AS/NZS 3947.2.

Miniature circuit breakers: To AS/NZS 60898.1 or AS 3111.

Operation: Independent manual operation including positive ON/OFF indicator.

Mounting: Mount circuit breakers so that the ON/OFF and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of each circuit breaker in the same plane.

Utilisation category:

- Final subcircuits category: Category A.
- Mains and submains: Category B.

Trip settings: Set as documented, seal, and label.

Trip units: Connect circuit breakers with interchangeable and integrally fused trip units so that trip units are not live when circuit breaker contacts are open.

#### **Fuses with enclosed fuse links**

Standards: To AS/NZS 60269.1, AS/NZS 60269.2.0 and AS/NZS 60269.2.1.

Fuse links: Enclosed, high rupturing capacity type mounted in a fuse carrier.

Breaking range and utilisation category:

- Distribution/general purpose: gG.
- Motors: gM.

Fuse-holders: Mount fuse-holders so that fuse carriers may be withdrawn directly towards the operator and away from live parts. Provide fixed insulation which shrouds live metal when the fuse carrier is withdrawn.

Barriers: Provide barriers on both sides of each fuse link, preventing inadvertent electrical contact between phases by the insertion of screwdriver.

Spare fuse links: Provide 3 spare fuse links for each rating of fuse link on each assembly. Mount spares on clips within the spares cabinet.

Spare fuse holder carriers: Provide 3 spare fuse holder carriers for each size of fuse holder carriers on each assembly. Mount spares on clips within the spares cabinet.

Busbar mounted fuse holders: Provide fuse carriers with retaining clips, minimum fuse holder 32 A.

### **Instruments and meters**

Mounting: Flush mount meters on hinged panels.

Hours-run meters: 6 figure (minimum), horizontal linear digits dial with last digit read-out in 0.1 hour increments.

### **Contactors**

Standard: To AS/NZS 60947.4.1.

Type: Enclosed, block type, air break, electro-magnetic.

Poles: 3.

Rated operational current: The greater of:

- Full load current of the load controlled.
- $\geq 16$  A.

Mechanical durability: 10 million cycles to AS/NZS 60947.4.1.

Electric durability:  $\geq 1$  million operations at AC-22 to AS/NZS 60947.4.1.

Mounting: Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Auxiliary contacts: Provide auxiliary contacts with at least one normally-open and one normally-closed separate contacts with rating of 6 A at 230 V a.c., utilisation category: AC-1.

Slave relay: If the number of auxiliary contacts exceeds the number which can be accommodated, provide separate slave relays.

### **Control devices and switching elements**

Standards: To AS/NZS 60947.1 and AS/NZS 60947.5.1.

Switching elements:

- Electrical emergency stop device with mechanical latching function: To AS/NZS 60947.5.4.
- Electromechanical control circuit devices: To AS/NZS 60947.5.1.

Rotary switches: Cam operated type with switch positions arranged with displacement of 60°.

Off position: Locate at the 12 o'clock position. Test positions must spring return to off position.

Rated operational current: At least 6 A at 230 V a.c.

Escutcheon plates: Provide rectangular plates securely fixed to the assembly panel. Identify switch position and function.

Time switches:

- Operation: 365 day operation.
- Mains failure operation: 100 hour minimum operating capacity.
- Contact rating:  $\geq 16$  A at 230 V a.c.
- Construction: Provide readily accessible means of adjustment. Provide operational settings which are clearly visible when switch cover is fitted.
- Dial: Digital with hour and minute display.

Control relays:

- Standards: To AS/NZS 60947.5.1.
- Operation: Suitable for continuous operation. Provide relays selected in conformance with the **Control relay selection table**.
- Construction: Plug-in types. Receptacle bases with captive clips which can be operated without using tools.
- Contact elements: Electrically separate, double break with silver alloy, non-welding contacts.
- Configuration: For standard relays, provide assemblies with  $\geq 2$  sets of contacts and expandable to 8 sets of contacts in the same assembly. Provide at least one normally-open and one normally-closed contact.
- On site conversion: Provide contact blocks readily convertible to either normally-open or normally-closed contacts.

**Control relay selection table**

Relay type	Minimum mechanical life (million operations)	Base	Minimum contact rating	Inter-changeable	Minimum number of contact elements
1	5	Plug-in	$1.25I_L$	Yes	2
2	10	Plug-in	5 A at 240 V	Yes	2
3	10	Fixed mounting	5 A at 240 V	Yes	4

Push-buttons:

- Type: Oil-tight, minimum 22 mm diameter, or 22 x 22 mm.
- Rated operational current: At least 4 A at 240 V a.c.
- Emergency stop devices with mechanical latching: To AS/NZS 3947.5.5.
- Marking: Identify functions of each push-button. For latched STOP or EMERGENCY STOP push-buttons, provide label with instructions for releasing latches.

### Indicator lights

Standard: To AS 60947.5.1.

Incandescent indicators: Not acceptable; use LED indicators

Neon indicators: 240 V, 12 mm diameter with in-built resistor.

LED indicators: 12 or 24 V as necessary, in corrosion-resistant bezel, nominal 5 mm diameter.

Press-to-test:

- Compartments/subsections with  $< 5$  indicating lights: Provide each indicating light with a fitted integral press-to-test lamp actuator.
- Compartments/subsections with  $\geq 5$  indicating lights: Provide a common press-to-test lamp push-button.

## 5.2 EXECUTION

### Marking and labelling

General: Provide labels including control and circuit equipment ratings, functional units, notices for operational and maintenance personnel, incoming and outgoing circuit rating, sizes and origin of supply and kW ratings of motor starters.

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## 6 MOTOR STARTERS

### 6.1 PRODUCTS

#### General

Standard: To AS/NZS 3947.1.

Electromechanical motor starters: To AS/NZS 60947.4.1.

Semiconductor motor starters: To AS/NZS 60947.4.2.

Selection: Provide motor starters selected according to:

- Electricity distributor limitations for starting currents and voltage flicker.
- Torque requirements for the motor load.
- Heating effects on the motor.
- Voltage drop during start due to starting currents.
- Time required to accelerate from rest to full speed.
- Number of starts per hour.

Performance:

- Rated operational current: The full load current of the load controlled.
- Rated duty: Intermittent class 12.
- Utilisation category: AC-3.
- Mechanical durability: 3 million cycles to AS/NZS 60947.4.1.
- Electric durability:  $\geq 1$  million operations at AC-3 to AS/NZS 60947.4.1.

Mounting: Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Auxiliary contacts: Provide auxiliary contacts with at least one normally-open and one normally-closed separate contacts with rating of 6 A at 230 V a.c., utilisation category: AC-1.



Consider the following:

Type and number e.g. 2 normally-open, 1 normally-closed, 1 make-before-break.

Voltage. If a control voltage different from that applicable to the assembly is to be switched, state the value.

Slave relay: If the number of auxiliary contacts exceeds the number which can be accommodated, provide separate slave relays.

### Direct-on-line starters

Type: Direct-switching electromagnetic contactor.

Overload protection: Thermal overload unit giving overload protection in each phase of supply.

### Motor protection

General: Provide over-current protection as part of the equipment assembly for each motor starter.

Mounting: Ensure relays are not affected by the shock of mechanical contactor operation. Provide sufficient clear space for the disconnection, removal and replacement of heaters, without disconnecting other equipment and wiring.

Reset: Manual.

3-phase operation: Provide triple pole relays with differential trip bar operation for single phase protection, and ambient temperature compensation.

Single phase motor protection: Comply with **Thermal overload protection relays** and provide overload units matching the motor heating curve characteristics.

3-phase motor protection: Provide thermal overload protection relays for each motor, or select one of the following:

- Thermistor overload relay with thermal overload relay.
- Electronic motor protection relay.
- Programmable electronic motor protection relay.

## 6.2 VARIABLE SPEED DRIVES

### Standard

General: To AS/NZS 61800.2 and AS 61800.3.

### Type

General: Microprocessor controlled, solid-state electronic type, providing motor speed control of 3 phase squirrel cage induction motors by means of step less variable frequency, variable voltage pulse width modulated (PWM) output...

Application: Suitable for variable speed, fan applications

### Selection

General: Provide variable speed motor drive controllers selected for the following:

- Rating: Continuously rated to suit the full load current stated on the motor nameplate and the length and type of cable feeding the motor.
- Service conditions: To AS 61800.2 Section 4.

- Speed ranges: Suitable for the load duties.
- Control deviation band: To suit the controls functional specification.

Design: Provide the following:

- Soft start (initially start motors on low speed).
- Adjustable maximum current limit.
- Automatic reset/restart of system after removal of fault or power failure condition. If the number of reset/restart attempts is limited for safety and equipment protection, provide for safe shut down and manual restart in the event of an unsuccessful attempt to reset/restart.
- Ability to immediately restart a motor following momentary interruption of supply, even if the motor is rotating, or rotating in the reverse direction.

Protection: Provide protection against:

- Instantaneous power failure.
- Instantaneous over current.
- Internal and external overload.
- Under and over voltage.
- Over temperature of the controller.
- Earth fault.
- Contact with live parts without the removal of fixed covers or panels.

Motor protection: Provide

- Automatic, electronic motor thermal overload protection facility wherein the tripping time is based on the motor's running frequency, actual motor current, operating time, and the rated current.
- PTC thermistor input to initiate motor shutdown under fault conditions.

### **Controls**

Provide facilities for local display and control, including the following:

- Indication of run condition, motor speed or output frequency, input control parameters, output current and voltage, and alarm conditions.
- Indication of power on, zero speed, enable, earth fault, short circuit, over current, under voltage, over temperature and remote trip.
- Facilities for automatic/off/manual control.
- Local and remote analogue input, to control frequency output of controller when in manual or automatic mode.

### **Interface with BMCS**

Provide facilities for each variable speed drive to be individually controlled by the BMCS, either by a 0 to 10 Volt or a 4 to 20 mA analogue input signal to set the speed from zero to 100%, or from minimum speed of 25%, to maximum speed.

Provide a digital fault output signal to the BMCS.

### **Harmonics and EMC**

General: Provide integrated harmonic suppression filters to limit the harmonics to within the value prescribed by the electricity distributor for the motor load and environment.

Standard: To AS/NZS 61000 and AS 61800.3 Category C1 for the actual length and type of cable feeding the motor.

Authorities: Comply with the requirements of the Australian Communications Authority.

### **Installation**

Wall mounting: Install in an IP54 rated enclosure.

Locate each speed controller on a wall or a custom made stand as close as practical to the motor it serves.

### **Shielded Cables**

Provide shielded power cables from the variable speed drive units to the fan motors, to prevent radio frequency disturbances from these cables. This will require the use of metal clad isolating switches so that the shielding is continuous between the VS drive and the motor. Provide any additional shielding as recommended by the variable speed drive supplier.

## M. BUILDING MANAGEMENT SYSTEMS

### 1 GENERAL

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#### 1.1 AIMS

##### Performance

General requirements: Provide control, monitoring and management of the building services through a networked building management system (BMS) including but not limited to the following:

Dedicated web server and graphical operator interface to provide access to the BMS through a conventional web browser on any computer connected to the internet.

Connection and interface of distributed controllers and other equipment.

UDP/IP protocol in accordance with BACnet for communication with the web server and for communication between control modules.

- Schedules, alarms, trends, reports, logs and priorities.
- Monitoring, control and management of the BACnet points and objects.
- Software and software development to perform the functions.
- All hardware necessary hardware.

Selections: As documented.

Compatibility with existing controls: If the documented control systems interface or connect to existing control systems, provide new control components and software that are either identical to the existing or, if not identical, compatible. If not identical, provide evidence that the proposed components are compatible.

##### System performance

Performance: Conform to the following minimum criteria over network connections:

Graphic display: Display current data on a graphic containing 20 dynamic points within 10 seconds.

Graphic refresh: Update with current data a graphic containing 20 dynamic points within 8 seconds and automatically refresh every 15 seconds.

Configuration and tuning screens: Automatically refresh within 6 seconds screens used for configuring, calibrating or tuning points, proportional-integral-derivative (PID) loops and similar control logic.

Object reaction to command:

Binary object: react within 2 seconds.

Analogue object: Begin reacting to command within 2 seconds.

Alarm response time at the server: Annunciate an object that goes into alarm within 15 seconds.

Program execution frequency: Arrange so that custom and standard applications are capable of running once every 5 seconds. Select execution times consistent with the process under control.

- Reporting accuracy: Report values with minimum documented end-to-end accuracy.

### Expansion provisions

Network architecture: Provide facilities so the system can be expandable to at least twice the documented input and output objects.

## 1.2 SCOPE

### Outline description

Design, supply, install, commission, test and maintain an automatic Building Monitoring and Control System (BMCS) using Direct Digital Control (DDC) techniques via distributed Intelligent Stand-alone Field Stations (ISFS), together with other miscellaneous work necessary to complete the control system, operate and fine tune it in a satisfactory manner.

Mechanical plant DDC controllers to be a modular, programmable direct digital type with a high level LAN communications manager for facilities management systems. The operating software to utilise a high level, non-proprietary programming language that ensures reliability, operator independence, compatibility with future system enhancements without reliance on specialist vendors. These controllers are intelligent, programmable direct digital controllers, designed as stand-alone controllers or networked into a system to precisely monitor and control any device in the Mechanical/Electrical services.

The system shall be suitable to link with similar systems at other sites such that several sites can be controlled from any one site with appropriate access rights.

### BMCS Control Functions

The new BMCS shall: -

1. Start and stop the air conditioning plant, toilet exhaust fans, ventilation fans and all associated equipment.
2. Provide controls including all sensors, damper motors, valve actuators and all components necessary to complete the control functions.
3. Measure the temperature in each zone and send appropriate signals to the VAV damper motor using proportional plus integral action (PI) control. Include an adjustable "dead band" between heating and cooling mode to minimise energy use.
4. Allow complete closing of VAV boxes in unoccupied areas and disable the heating and cooling calls from closed boxes to allow energy savings. Closing the boxes to be by manually selecting the areas on the BMCS computer.
5. Measure and control the off coil temperature from a cooling coil by modulating the 3-way valve to maintain the correct off coil temperature using PI control with provision to reset temperatures to suit cooling load.
6. Control and reset the zone supply air temperatures using face and by-pass dampers and off coil temperature in response to signals to/from the VAV dampers (if some VAV dampers are fully open then a lower supply air temperature is required, if non fully open and some fully closed then a higher supply air temperature should be used). If additional heating required energise electric heaters in VAV boxes.
7. Control the outside and return air dampers to maintain minimum fresh air regardless of VAV supply air quantity.
8. Measure outside and return air temperature and modulate outside and return air dampers for economy cycle operation based on outside air and return air temperatures. Enthalpy/humidity control is not relevant for Broken Hill.

9. Measure the static pressure at representative points (as shown on the drawings) in selected supply air zones and control the variable speed drives on the supply air fan. Reset pressure control to suit VAV box requirements.
10. Interlock the variable speed drive for return air fan with the supply fan to proportion the supply and return air accordingly.
11. Operate the chiller and chilled water pump.
12. Interface with the chiller to allow the BMCS to control chiller stop start, set leaving water temperature, limit maximum load, and display actual return and leaving chilled water temperatures, % full load and all fault signals.

### **BMCS Monitoring Functions**

The new BMCS shall monitor the following: -

1. Correct operation of fans and pumps using pressure switches or other suitable means.
2. The differential pressure across air filters.
3. Fault alarms from the chiller.
4. Monitor the fire trip signal on the switchboard and suppress equipment alarms during a fire trip.
5. Monitor phase failure on the mechanical switchboard.
6. Monitor current draw on mechanical switchboard and log energy use.
7. Monitor all sensors to indicate a fault if the sensor indicates outside the normal control value or if a value which would normally be expected to vary, such as outside air temperature, stays at a constant amount for an extended period.

### **Energy And Cost Saving Functions**

The BMCS shall incorporate the following energy and cost saving features.

Outside air economy cycle as noted above.

Provision for night purge.

Chilled water temperature reset based on cooling load.

Heating and cooling lockouts based on outside air temperature.

Optimum stop start time based on outside temperature.

Provision for load shedding and load limiting, to limit maximum demand load.

Reset leaving coil temperatures as noted above.

Reset the supply fan air pressure in response to VAV requirements.

After hours air conditioning to be selectable on an area basis initiated from the internet. Air conditioning to operate temperature sensors and VAV boxes in occupied areas with VAV boxes fully closed in unoccupied areas and their temperature sensors disabled.

Provision to allow future integration with lighting and security to enable lighting, security access and air conditioning of an area as a single operator interface.

### **Other BMCS functions**

The BMCS shall provide an orderly restart of plant when power is restored after a power failure, including provision for handling a momentary power failure, or when plant is restarted

after a fire trip. Interface with variable speed drives to allow safe restarts of variable speed drive motors which may not have completely stopped.

## 1.3 CROSS REFERENCES

### General

General: Conform to the *General requirements* worksection.

### Associated worksections

Associated worksections: Conform to the following:

- *Mechanical electrical.*

## 1.4 STANDARDS

### General

Building automation system protocol: BACnet® to ANSI/ASHRAE 135, including Annex J. (Referred to in this worksection as BACnet.)

LAN technology: To ISO/IEC 8802-3.

## 1.5 INTERPRETATIONS

### Abbreviations

General: For the purposes of this worksection the abbreviations given below apply:

- AI: Analogue input.
- AO: Analogue output.
- AV: Analogue value.
- BI: Binary input.
- BO: Binary output.
- BV: Binary value.
- I/O: Input-output.
- PID: Proportional plus integral plus derivative.

### Definitions

General: For the purposes of this worksection the definitions given below apply:

- High level interface: Systems transfer information in a digital format using an open system interface.
- Low level interface: Systems transfer information via terminals and voltage free contacts.

## 1.6 SUBMISSIONS

### Documentation

Submit documentation including:

An outline functional specification containing a list of standard software modules used in the system and a brief summary of function and location.

- Schedule of all input and output points cross-referenced to the functional specification.
- For each software module:
  - A detailed functional description. Provide flow charts if necessary:
  - The sequence of operation.
  - Decision points.
  - Calculations performed.
  - Action in the event of a fault condition.
  - Instructions for manual control.
  - Start-up sequence and shutdown sequence under normal conditions.
  - Start-up sequence and shutdown sequence under fault and power failure.
  - A schedule of inputs and outputs for the module including details of the source.
- Conventions:
  - Proposed naming conventions for BACnet objects.
  - Proposed description properties for BACnet objects and their formats.
  - Proposed non-standard BACnet assignments
  - Proposed assignment of priority levels not assigned in BACnet.
  - Proposed conventions for network numbering.
  - Proposed device object identification convention.
  - Proposed convention for the use of text for the inactive and active properties of binary objects.
  - Proposed convention for the use of text for multistate objects.

### **Drawings**

Submit drawings including:

- Schematic diagrams of control, communication and power wiring.
- Interface wiring to control system.
- Network riser diagrams of wiring between server and control panels.

### **Inspection and Test Plans (ITPs)**

Provide ITPs for each system and function showing:

- Function to be tested.
- Test method (including hardware required) for on site verification of system prior to changeover.
- List of inputs and outputs.
- Acceptance criteria.
- Name and signature of person verifying test.



### **Manuals**

Submit manuals including:

- Draft operators manual.
- Draft training manual.

### **Prototypes**

Submit prototypes of the following:

- Graphical symbols.
- Graphical displays.
- Reports.
- Trend graphs.

### **Product data**

Submit product data for each hardware component including:

- Web server.
- Monitors.
- Keyboards.
- Power supplies.
- Battery backups.
- Interface equipment between server and control panels.
- Operating System software.
- Operator interface software.
- Colour graphic software.
- Third-party software.

### **Technical data**

Submit technical data including:

- BACnet Protocol Implementation Conformance Statement (PICS) for each component.

### **Qualifications**

Installers: Submit evidence of successful completion by installers and operators employed on the installation of control system manufacturer's training for installers and operators. Provide course outlines.

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## **2 PRODUCTS**

### **2.1 OPERATOR INTERFACE PROPERTIES**

#### **BACnet web server**

General: Provide web server with demonstrated interoperability during at least one BMA interoperability workshop.

Requirement: Conform to BACnet operator workstation (B-OWS) device profile to BACnet Annex L.

Operator access: Provide operator access to the BMS via:

- Any standard web browser connected to the web server using a standard internet connection.
- PDA and WAP phone over GPRS, 3G and wireless networks.

### System security

Users: Provide user name and password access system to define viewing, editing, adding and deleting privileges in each system, application, editor and object.

Logs: Automatically log out each operator if no keyboard or mouse activity is detected. Provide adjustable automatic log out delay.

Retention: Store system security data including operator passwords in an encrypted format. Operator passwords: Do not display.

Access to logs: Provide authorised operators with the facilities to view a list of operators with system access and permissible functions they can perform while logged in. Enable operators to:

- Add operators.
- Delete operators.
- Edit operator function authorisation.
- Authorise each operator function separately.

### Graphics

General: Provide graphically based operator interface using point-and-click navigation.

Requirement: Provide at least one graphic for each of the following:

- Building floor plans.
- Building elevations.
- Floor plant layouts.
- Plant room physical layouts.
- System detailed schematics.
- Individual plant items details.

Graphics screen: Hierarchical in arrangement to enable point and click navigation between the above screens in a logical manner.

Thermal conditions: Indicate thermal conditions on every floor plan summary graphics using dynamic colours to represent zone temperature relative to zone set point.

Status: Provide operators with the facilities to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment and to edit set points and other documented parameters.

Animation: Include animation to display different image files for changed object status.

Alarms: Indicate areas or equipment in an alarm condition using colour or other visual indicator.

Graphic file format: Industry-standard format such as BMP, JPEG or GIF.

Web-based system graphics: Viewable on browsers compatible with World Wide Web Consortium browser standards.

Web graphic format: Viewable on browsers either without the need for a plug-in or with widely available, no-cost plug-ins.

Tools: Provide graphically based tools and documentation to enable editing of system graphics, to create graphics and to integrate graphics into the system. Arrange to permit the operator to add analogue and binary values, dynamic text, static text and animation files to a background graphic using a mouse.

Graphics library: Provide a complete library of standard building services equipment graphics in file formats compatible with graphics generation tools.

New library objects: Provide tools to enable the operator to create new graphic library objects based on standard dwg and dxf CAD file formats.

#### **Standardized Graphics**

Requirement: The appearance of screen graphics and the method of operation is to be standardised with other similar projects for this client which are expected to be constructed at a similar time. Obtain details of screen graphics from the other projects and provide a similar appearance. Where this project is the first of a group provide information to others to enable them to produce similar layouts.

#### **Additional Graphics Requirements**

Provide additional graphics describing the system operation including energy saving strategies to aid building managers and technicians.

Provide check pages which include trend logs of important values to indicate the correct operation of the system. This is to include simultaneous heating and cooling loads, outside air and return air temperature and humidity, economy cycle operation and fan speed.

Provide graphics of each floor to indicate and allow VAV boxes to be turned off to unoccupied areas.

#### **Object properties**

Display: Provide operators with the facilities to display at any time the properties of all devices on the BACnet network and to adjust operating properties and parameters such as set points, PID gains, on and off controls and sensor calibration.

Properties: Display object properties by object type, physical location and building system, and by menu, graphically or through custom programs.

Change of value reporting: Provide to update real time graphic displays.

Modifications: Support the following for modification by an authorised operator:

- Time of day functionality.
- Backup and restoration of any device on the network.
- Establishment or termination of a connection to any device on the network.

#### **Operating schedules**

General: Provide activities in the BACnet operating schedules.

Viewing: Provide operators with the facilities to:

- View and modify scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display.
- Select and adjust each schedule and time period and to simultaneously schedule related equipment.

Exceptions display: Clearly show exception schedules and holidays on the schedule display.

## Alarms

General: Provide documented alarms using BACnet alarm services.

Viewing: Provide operators with the facilities to view system alarms and changes of state chronologically or by user defined category, to acknowledge and delete alarms and to archive closed alarms to the web server hard disk.

Remote workstations: Provide facilities to display alarms on remote workstations.

Status: Configure input and status objects to alarm on departing from and on returning to normal state. Provide facilities to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states and alarm reactions for each system object. Configure and enable alarm points.

Alarm messages: Use an English language descriptor without acronyms or mnemonics to describe alarm source, location and nature.

Alarm reactions: Provide operators with the facilities to configure the actions of the web server on receipt of each alarm. As a minimum, provide the workstation or web server with facilities to log, print, start programs, display messages, send e-mail, pager messages, send page and audibly annunciate.

Linking: Link alarms of specific priorities to respective graphic screen. Provide each alarm annunciation with a link to a related graphic so the graphic can be manually called up with the alarm status indicated on the graphics.

Alarm reports: Provide intrinsic reporting when considered sufficient to meet the functional requirements.

Inhibiting transmission: Provide authorised operators at any workstation with the facilities to temporarily inhibit the transmission of event or alarm notifications.

## Trends

General: To be BACnet trend objects.

Graphs: Provide trend graphs for BACnet objects.

Viewing: Provide operators with the facilities to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Enable operator to create custom trend graphs to display on the same page data from multiple trended points.

Configuration: Provide operators with the facilities to configure trend sample or change of value (COV) interval, start time and stop time for each system data object and able to retrieve data for use in spreadsheets and standard database programs. Arrange controllers to sample and store trend data and to archive data to the hard disk.

## Reports

General: Provide operators with the facilities to:

- Run preconfigured reports, to view report results and to customise report configuration to show data of interest.
- Select, modify, create and print reports and logs.

- Store report data in a format accessible by standard spreadsheet and word processing programs.
- Display reports in pdf or Microsoft Excel format within the web browser.

Standard reports: Provide the following reports of system objects and current values filtered by:

- object type, or
- status (in alarm, locked, normal), or
- equipment, or
- geographic location, or
- a combination of filter criteria.

Alarm summary including current alarms and closed alarms: Retain closed alarms records for an adjustable period.

Custom reports: Provide operators with the facilities to create custom reports that retrieve data, including archived trend data, from the system, that analyse data using common algebraic calculations and that present results in tabular or graphical format. Launch reports from the operator interface.

### Logs

General: Provide BACnet logs for the following to a database or text file and retain data for an adjustable period:

- Provide trend logs of energy consumption by air conditioning system and outside air temperature.
- Alarm History.
- Trend Data. Provide operators with the facilities to select trends to be logged.
- Operator Activity including date and time stamp logged activity: As a minimum log:
  - Operator log-in and log-out.
  - Control parameter change.
  - Schedule changes.
  - Alarm acknowledgment and deletion.

### Server operating system

Operating system: Microsoft Windows.

Functionality: Provide the following functionality to authorised operators as an integral part of the operator interface via tools available from the web browser:

- System configuration.
- Automatic system database configuration: Automatically store on \hard disk a copy of the current system database, including controller firmware and software. Automatically update stored database with each system configuration or controller firmware or software change.
- Controller memory download: Provide operators with the facilities to download memory from the system database to each controller.
- Online help: Provide context-sensitive online help for each tool to assist operators in operating and editing the system.

- System diagnostics: Automatically monitor controller and I/O point operation. Annunciate controller failure and I/O point locking (manual overriding to a fixed value).

### **Control system hardware**

General: Provide operators with the facilities to view controller status, to restart (reboot) each controller and to download new control software to each controller.

### **Priorities**

General: Allocate processes command priorities in accordance with the standard BACnet assignments and with priority levels.

Adjustment: Provide operators with the facilities modify priorities.

### **Time synchronisation**

General: If controllers and equipment have real-time clocks use the BACnet Time Synchronisation service. Automatically synchronise system clocks daily from an operator-designated controller via the Internet. Automatically adjust for local daylight saving and standard time.

## **2.2 HARDWARE**

### **General**

Web server and workstations: Conform to *Building IT components*.

### **Routers**

General: Provide BACnet routers as necessary to achieve the documented performance and functionality.

### **Operator Workstation**

Provide an operator workstation comprising a general purpose personal computer in accordance with the following features:

Intel Core 2 Duo (Conroe) E6600 or equal

2GB Ram

500 GB Hard Drive

16 x Dual Layer DVD-RW Drive

Minimum 4 USB ports with at least 2 at the front.

Minimum 2 spare expansion slots

Speakers and On board Audio System

Windows XP Professional

## **2.3 NETWORK ARCHITECTURE**

### **System requirement**

General: Provide communications using a telecommunications network of fibre and copper circuits.

### **Network protocol**

Web server and control network backbone: To ISO/IEC 8802-3 (Ethernet) Data Link/Physical layer protocol and to BACnet/IP, ASHRAE/ANSI 135 and BACnet Annex J.

Speed:  $\geq 100$  Mb/sec.

### System communication

General: Provide communication services over the BACnet communications network that results in operator interface and value passing that is transparent to the Internet architecture as follows:

- Provide facilities to enable an operator interface device connected to any one controller on the BACnet communication network to interface with all other controllers as if that interface were directly connected to the other controllers. Make data, status information, reports, system software, custom programs, etc. for all controllers available for viewing and editing from any one controller on the BACnet communication network.
- Make all database values (e.g. objects, software variables, custom program variables) of any one controller readable by any other controller on the BACnet communication network. Automatically perform value passing by a controller when a reference to an object name not located in that controller is entered into the controller's database. Perform inter-network value passing without the need for operator installed software to set up any communication services.
- Make all objects and object properties easily viewed and shared on a system wide basis.

## 2.4 DATA SHARING

### General

General: Provide object properties to be shared across the system.

Data values: Make binary and analogue data values from any networked device available for concurrent use in real time. Selected sampling rates to match the system response.

Monitoring: Provide operators with the facilities to monitor the value of any property, including required properties, supported optional properties and proprietary extensions of every object of every networked device at the operator interface.

Modification of values: Provide for modification of operating set points and parameters available via BACnet services.

### Analogue objects

Change of value: Provide all analogue objects with the capability of using the Change of Value reporting mechanism and the COV\_Increment property writable using BACnet services.

### Binary objects

Text: Conform to the respective worksection or, if not defined, to the text convention proposed in Submissions.

Change\_Of\_State\_Count properties: Writable for reset purposes.

Elapsed\_Active\_Time and Time\_Of\_Active\_Time\_Reset properties: Implement for all systems incorporating run time requirements as nominated in the respective worksection.

### Out of service

Out Of Service property: Required.

### Calendar objects

General: If a device provides scheduling capability provide also at least one Calendar object with a capacity of at least 10 entries. Provide operators with the facilities to view the Calendar object and make modifications from any operator interface.

### **Loop objects**

General: Provide the system with the capability of incorporating loop objects. Loop objects will not be required in the initial installation

### **Multistate objects**

Text: Conform to the respective worksection or, if not defined, to the text convention proposed in Submissions.

Change\_Of\_State\_Count properties: Writable for reset purposes.

### **Schedule objects**

General: Provide operators with the facilities modify schedule objects from any operator interface.

### **Dynamic object creation**

General Provide operators with the facilities to dynamically create averaging, calendar, event enrolment, group, notification class, schedule and trend log objects from any operator interface.

### **Maintenance system**

General: Provide data sharing with the maintenance system including:

- Signalling of regular maintenance required based on hours run or time since last service.
- Integration with the equipment data reports and maintenance manuals.
- Signalling of breakdown or fault requiring remedial action against the specific plant item so that work order can be generated.
- Maintenance of a record for each item monitored and controlled. Provide output sufficient to permit generation of work orders for the respective item.

### **High level interface**

General: Provide high level interface to the functions and systems.

### **Low level interface**

General: Provide low level interface to monitoring points on equipment.

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## **3 EXECUTION**

### **3.1 PROGRAMMING**

#### **Operator interface**

Standard Graphics: Provide dynamically updating point information on graphics as documented. Show on each equipment graphic related input and output points and relevant calculated points.

Interface software: Provide operator interface software and functions including but not limited to: operating system software, operator interface database and third-party software installation and integration required for successful operator interface operation.



## 3.2 SOFTWARE DEVELOPMENT

### Test facilities

Provide each software module or logical set of modules with a Test Mode (set by internal flag), software Test Module or similar means which permits simulation of all inputs both digital and analogue and visual representation of module outputs.

### Inspection and test plans

For each software function in the control system produce, as part of the software development phase, an Inspection and Test Plan for testing the correct operation of the function.

Identify, in the detailed Inspection and Test Plans, the criteria declaring the performance of software module or group of modules. Design the detailed test cases to test every alternative path through a module and to exercise all boundary conditions for values i.e. maximum and minimum cases and all extreme conditions that could ever be presented to the module.

## 3.3 SOFTWARE OWNERSHIP AND ACCESS

### Ownership:

At the date of Practical Completion transfer ownership of all software and supporting documentation produced under this contract to the Principal.

Licences

- Operator interface and related software: Unlimited licences.
- Other software: A minimum of three (3) concurrent licences.

## 3.4 PRE-COMPLETION TESTS

### Software testing

General: Test all software using inbuilt test modules and connected to test panel. Test against the documented functions to simulate all normal and fault conditions.

### System testing

Scope: Test every point, function and system. Provide all hardware and software required for the testing process.

Records: Submit results of testing on Inspection and Test Plans and certify correct operation of all aspects of the Functional Specification.

### System performance

General: Test system performance using manufacturer's recommended hardware and software for web server and web browser.

## 3.5 COMPLETION

### Training

General Provide training to enable operators to accomplish the following objectives:

- Proficiently operate the system.
- Understand automatic control system architecture and configuration.
- Understand automatic control system components.
- Understand system operation, including automatic control system, control and optimising routines (algorithms).

- Operate workstation and peripherals.
- Log on and off system.
- Access graphics, point reports and logs.
- Adjust and change system set points, time schedules and holiday schedules.
- Recognise common HVAC system malfunctions by observing system graphics, trend graphs and other system tools.
- Understand system drawings and Operation and Maintenance manual.
- Understand job layout and location of control components.
- Access data from automatic control system controllers.
- Create and change system graphics.
- Create, delete and modify alarms, including configuring alarm reactions.
- Create, delete and modify point trend logs (graphs) and multi-point trend graphs.
- Configure and run reports.
- Add, remove and modify system's physical points.
- Add operator interface stations.
- Add a new controller to system.
- Maintain software and prepare backups.
- Interface with job-specific, third-party operator software.
- Add new users and understand password security procedures.

Divide presentation of objectives into three sessions. Participants will attend one or more of sessions, depending on knowledge level required.

- Day-to-day operators.
- Advanced operators.
- System managers and administrators.

Materials: Provide course outline and training materials. Provide one copy of training material per student.

Hardware: Perform classroom training using a network of working controllers, representative of installed hardware.

## 4 SELECTIONS

### 4.1 SCHEDULE OF BMS POINTS

#### System

ITEM	POINT SCHEDULE				
	AI	AO	DI	DO	HLI
CHILLER START				1	

### 3. TECHNICAL SPECIFICATION

CHILLER STATUS			1		
CHILLER FAULT			1		
CHILLER LEAVING TEMPERATURE	1				
CHILLER RETURN TEMPERATURE	1				
CHILLED WATER PUMP START				1	
PUMP STATUS			1		
CHILLED WATER VALVE (3-WAY)		1			
SUPPLY FAN STATUS			1		
SUPPLY FAN START				1	
SUPPLY FAN VSD		1			
SUPPLY FAN VSD FREQUENCY	1				
SUPPLY FAN VSD FAULT			1		
RETURN FAN STATUS			1		
RETURN FAN START				1	
RETURN FAN VSD		1			
RETURN FAN VSD FREQUENCY	1				
RETURN FAN VSD FAULT			1		
ZONE PRESSURE SENSOR	7				
VAV BOXES TEMP.	31	31			
VAV BOXES ELECTRIC HEATER		31			
ZONE FACE AND BYPASS DAMPERS		11			
COOLING COIL OFF COIL TEMPERATURE	1				
OUTSIDE AIR FLOW RATE	1				
OUTSIDE AIR DAMPERS		1			
RETURN AIR DAMPER		1			
SPILL AIR DAMPER		1			
MISCELANEOUS FANS START				3	
MISCELANEOUS FANS STATUS			3		
PHASE FAILURE RELAY			1		
FIRE TRIP RELAY			1		
OUTSIDE AIR TEMPERATURE	1				
OUTSIDE AIR HUMIDITY	1				
COMMON RETURN AIR TEMPERATURE	1				
COMMON RETURN AIR HUMIDITY	1				
MECH. SWITHBOARD CURRENT	3				

The above indicates the minimum number of points required; provide any additional points necessary to achieve the specified control functions.

High limit thermostats if required by the code are to be hard wired and therefore not listed in BMCS schedule.

## 4.2 OPERATIONAL MAINTENANCE FOR BMCS

### Requirement

As specified in OPERATIONAL MAINTENANCE - MECHANICAL SERVICES GENERALLY and the Building Management System supplier to maintain the BMS.

### Generally

Fine tune controls as necessary to maintain comfortable conditions in all areas and to maximise energy savings. Check temperatures independently of the BMS sensors and compare with BMS readings. Adjust sensors as required.

### Monthly service for first 3 months:

- Measure and record all conditioned space dry bulb temperatures adjacent to sensors together with all wet bulb temperatures in areas with humidity control; check and record all readings of outside air; record on a prepared log sheet for presentation with the service report sheet;
- Simulate conditions to enable control functional checks to be carried out ensuring that operation is satisfactory and within specified limits;
- Maintain and upgrade all software and backup off site;
- Continue fine tuning of systems and assist the operators with any changes to programs or parameters;
- Check communication functions between the Operator workstations (central computer) and all communication gateways/controllers and remote units;
- Check operation of filter alarm switches and water flow elements;
- Inspect the systems generally and perform all necessary service work not listed above and carry out backup of system; store backup media on site and additional backup media to be held off-site.

### Quarterly Service

- In addition to the normal monthly service carry out the following:
- Continue fine tuning of systems and assist the operators with any changes to programs or parameters required;
- Check and recalibrate and repair as necessary all analogue sensors including humidity controllers;
- Check all pressure switches, settings and adjustment;
- Simulate economy cycle operation and check the operation of all outside air economy cycle control dampers.
- Check that all automatic control valves shut off tight when closed;
- Test and verify all alarm system output signals and readjust as necessary;
- Maintain and upgrade all software, all software records and carry out backup of system; store backup media on site additional backup to be held off-site.

- Carry out routine cleaning and overhaul of the printer/s, keyboards, monitors and ensure that toner / ink cartridges and paper supplies are in place and equipment is operating satisfactorily;
- Diagnostic check on all electronic components;
- Check for correct functions of and clean all alarm contacts, relays and similar equipment;
- Check all batteries, power supplies and associated equipment and maintain or replace as required to operator workstation/s and ISFSs;

### **Annual Service**

In addition to the normal monthly and quarterly service carry out the following:

- Clean and check all controls; simulate operations of all economy cycle, face and by-pass and other volume control dampers; simulate operation of all heating, cooling, humidification and limit controls.
- Carry out a complete control service including calibration; check the response to the various systems to changing temperature requirements by raising or lowering the relevant set points; note the length of time to stabilise.
- Test and service all control equipment.
- Carry out final contractual upgrade of software to latest version and reprogram to include any fine tuning improvements.
- Back up all system software, return any off site-copies to Engineering Management staff.
- Provide a full report on the condition of all controls, and final actuators including any suggestions of economy improvements which could be implemented.
- Provide "as installed" I/O sheets for software and hardware points for manuals and to be installed in ISFSs.

## N. MECHANICAL COMMISSIONING

### 1 GENERAL

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#### 1.1 AIMS

##### Responsibilities

General: Provide commissioning of all mechanical systems. Recommission the plant at the specified intervals.

Provide a detailed commissioning program, indicating how the plant is to be commissioned and how it is proposed to prove to the principal that the system meets the specified requirements. Fully document method and values to allow the plant to be retested or recommissioned later.

#### 1.2 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

- *Mechanical piping.*

#### 1.3 STANDARDS

##### General

Measurement of fan and duct air quantities > 1000 L/s: To ISO 5802.

Testing, balancing and commissioning except fan and duct air quantity measurement: To ASHRAE Standard 111 or CIBSE Commissioning Codes A, B, C, R and W.

Statistical analysis: To ASHRAE Guideline 2 (RA 96) – Engineering Analysis of Experimental Data.

Orifice plates and venturi meters: To BS 1042.

Microbial control: To AS/NZS 3666.1.

#### 1.4 INTERPRETATIONS

##### Definitions

General: For the purposes of this worksection the definitions given below apply.

- Accuracy: The closeness of the agreement between the result of a measurement and the true value of the particular quantity being measured.
- Error: The measured value minus the true value of the particular quantity being measured.
- Resolution: The smallest difference between indications of a displaying device that can be meaningfully distinguished.

## 1.5 COMPLETION PROGRAM

### General

Submissions: Provide a program consistent with, and forming part of, the construction program. Set out the proposed program for completion, commissioning, testing and instruction. Identify related works and timing of the works pre-requisite to successful and timely completion of the works.

Revisions: Revise the program as the project proceeds.

Running in period: Include time in the program for the running period prior to Practical Completion.

## 1.6 RELATED TESTS

### Retesting

General: Failure to meet specified performance under test: Identify and correct cause of failure and repeat test.

### Statutory authorities

General: Provide demonstrations and tests for witnessing by the statutory authorities. Complete testing of systems before witness testing by the statutory authorities.

### Other trades

General: Provide assistance to other trades for testing related non-mechanical systems.

## 2 EXECUTION

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### 2.1 COMMISSIONING

#### General

General: When the installation is complete, commission the installation. Make the adjustments necessary to achieve the designated performance under continuous operating service conditions, including balancing, setting the controls, checking the operation of overload and safety devices, and correcting malfunctions.

#### Reports

General: Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

#### Notice

General: Give sufficient notice for inspection to be made of the commissioning of the installation.

#### Starting up

General: Coordinate schedules for starting up of various systems and equipment. Give 5 working days notice before starting up each item.

Checks: Before starting, verify that each piece of equipment has been checked for proper lubrication, drive rotation, belt tension, control sequence, circuit protection or for other conditions which may cause damage.

Tests: Verify that tests, meter readings, and specified electrical characteristics agree with those required by the manufacturer.

Wiring: Verify wiring and support components for equipment are complete and tested.

Manufacturers' representatives: Have authorised manufacturers' representatives present on site to inspect, check, and approve equipment or system installation before starting up, and to supervise placing equipment and operation.

Starting up: Execute starting up under supervision of manufacturers' representative and appropriate contractors' personnel, in accordance with manufacturers' instructions.

Report: Submit a report demonstrating that equipment has been properly installed and is functioning correctly.

## 2.2 RECOMMISSIONING

### General

Recommissioning: The partial or full repeat of the work specified as commissioning but conducted after the system has been completed during or after the maintenance period.

### Recommissioning frequency

General: Annual.

### Recommissioning instructions

General: Provide the following in the mechanical maintenance manuals in addition to that specified in the *General requirements* worksection:

Instructions for recommissioning the system.

Recommended tasks to be conducted when recommissioning.

Schedules to be used for recording recommissioning data so that changes in the system over time can be identified.

## 2.3 INSTRUMENTATION

### Calibration and certification

General: Use only instruments that have been calibrated by a Registered testing authority. Provide copies of certification if requested.

Maximum period since last calibration: As recommended by manufacturer but  $\leq 12$  months, except as noted below.

### Air quantity at diffusers, outlets and grilles

Refer to *Commentary* for more information.

Hood adjustment factors: Determine adjustment factor for each hood and associated anemometer by one of the following methods:

Certified by a Registered testing authority for the type of diffuser or grille and direction of air flow being measured.

Determined by duct pitot traverse for the particular type of diffuser or grille and direction of air flow being used on the project.

Instruments:

- Accuracy: Better than  $\pm 5\%$  of measured value.
- Resolution: Better than 1% of measured value.



- Range: Minimum measured velocity for instrument not more than 50% of measured velocity.

### **Total system air flow**

General: For systems handling over 1000 L/s measure total system air quantity to ISO 5802.

### **Air pressures and differential pressures**

Instrument specifications:

Pressures  $\leq 50$  Pa: Electronic meter or inclined manometer with 50 Pa full scale, accuracy better than 5% full scale.

Pressures  $> 50$  Pa: Electronic meter, mechanical meter or inclined manometer with full scale not more than 400% measured value, accuracy better than 2.5% full scale.

### **Temperature**

Air temperature instruments specifications:

- Accuracy:  $\pm 0.2$  K or better at measured value.

Chilled water and condenser water temperature instrument specification:

- Accuracy:  $\pm 0.2$  K or better at measured value.

Instrument specifications for other temperature applications:

- Accuracy:  $\pm 0.5$  K or better at measured value.
- Scale divisions (mercury-in-glass): 1.0 K or better.

### **Electrical**

Instrument specifications:

- Voltage  $< 600$  V ac: Accuracy  $\pm 3\%$  of full scale.
- Voltage  $< 30$  V dc: Accuracy  $\pm 3\%$  of full scale.
- Currents  $< 100$  A: Accuracy  $\pm 3\%$  of full scale.
- Maximum period between calibration: As recommended by manufacturer but not more than 6 months.

### **Rotational speed**

Instrument specifications:

Accuracy:  $\pm 5\%$  of measured value.

Maximum period between calibration: As recommended by manufacturer but not more than 24 months.

### **Recording instruments**

Specifications for instruments collecting measured values over time:

- Accuracy: At least equal to that specified for the corresponding physical parameter above.
- Type: Electronic data logger with appropriate sensors or thermo hydrograph.

Thermo hydrographs: Charge sensing element before use as recommended by the manufacturer.

## 2.4 SOUND PRESSURE LEVEL MEASUREMENTS

### General

Sound pressure level measurements: Provide the following:  
One sound level reading at a typical point in each zone.

### Sound pressure level measurements

Internal: To AS/NZS 2107.

External: To AS 1055.1.

Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

Sound pressure level analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions.

Correction for background noise: To AS/NZS 2107 Table B1.

Measurement positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls.

## 2.5 AIR BALANCING

### General

General: Balance each air handling system.

Completion: Balancing is complete as follows:

All air quantities are within the tolerances in **Air quantity tolerance table**.

Each air quantity measured is within the instrument tolerance of the previous reading on the same component with the same instrument.

Resistance across the cooling coil bank (if present) is equal to the wetted coil resistance.

Resistance of the filter bank (if present) is equal to that of the filter when fully loaded with dirt.

- For fans with variable speed drives, the frequency to the motor is  $\leq 50$  Hz.
- At least one outlet on each branch has its damper at the minimum pressure drop position.
- At least one sub-branch damper is at the minimum pressure drop position.
- At least one branch damper is at the minimum pressure drop position.
- The fan speed or pitch angle is at the lowest value consistent with the above.

### Air quantity tolerances

General: Balance air handling systems to the designated air quantities within the tolerances in the **Air quantity tolerance table**. For the purposes of the **Air quantity tolerance table** the following definitions apply:

Terminal: A supply, return or exhaust diffuser, grille or equivalent device discharging air into, or drawing air from, a space.

Sub-branch: A duct connected to one or more terminals.

Branch: A duct with no terminals connected to it.

Total air quantity: The sum of air flows to the connected terminals, branches or sub-branches under the conditions of measurement.

#### Air quantity tolerance table

System type	Terminal air quantity tolerance	Branch air quantity tolerance	Total air quantity tolerance
Low velocity supply, return or exhaust system where all terminals on any one sub-branch serve the same space	+20% -0%	+10% -0%	+10% -0%
Low velocity supply, return or exhaust system where the terminals on any one sub-branch serve more than one space	+15% -0%	+10% -0%	+10% -0%
Supply systems for induction units	+5% -0%	+5% -0%	+10% -0%

#### Diversity

General: For variable air volume (VAV) and other systems where the sum of the design terminal air quantities is greater than the design fan air quantity, adjust the system as follows:

The flow rate at the terminals is within tolerance for all possible load situations.

The fan flow is within the tolerance limits for total air quantity in the **Air quantity tolerance table**.

#### Measurement methods

Total and branch air quantities > 1000 L/s: Measure to ISO 5802.

Other air quantities: Use balancing and measurement methods recommended by ASHRAE or CIBSE.

Do not use the following methods for air quantity measurement:

Coil, damper or filter traverse using any kind of instrument.

Measurement using an instrument operating with air flow in the reverse direction to that for which it has been certified.

Air quantity measurement derived from fan curves or fan performance tables.

#### Preparation for air balancing

General: Before starting air balancing make sure that:

- All building work that may affect the air balance is complete. Make sure that:
  - All ceiling tiles are in place.
  - All doors are hung and door grilles (if applicable) are installed.
  - All doors and windows are open or shut consistent with their normal state.
  - The building is airtight.
  - The builder's work ducts, shafts and ceiling plenums are sealed airtight.
- All ductwork complete and clean.

- There are no air leaks that can be felt. Check for leaks through doors, access panels, penetrations and joints in air handling units.
- Flexible duct is installed as specified and has not been damaged.
- All fire and balancing dampers are open.
- All interrelated air handling systems are complete and operating concurrently.
- Fans, coils filters and other mechanical components are complete and operating correctly.
- All electrical components including overloads and safety devices are complete and operating correctly.
- All other related work is complete and operating correctly.

#### **Additional adjustment of air quantities**

General: Notwithstanding that air quantities may have been measured and are within tolerance. If so directed, adjust space air quantities to:

- Minimise drafts.
- Achieve temperatures in individual rooms or parts of rooms that are within the stated design conditions.

This is provided to permit trimming of air quantities, particularly in rooms that do not have temperature sensors located in them.

Resubmit reports: If air quantities are altered after submission of air balance reports, resubmit reports showing new values.

#### **On completion of air balancing**

General: When air balancing is complete:

- Mark final position of dampers.
- Seal test holes in ductwork.
  - Duct pressure class  $\leq 500$ : Rubber or plastic plugs.
  - Duct pressure class  $> 500$ : Cover plates of same material as the duct.
- Set system into normal operation.
- Submit air balance reports.

## **2.6 AIR BALANCE REPORTS**

### **General**

General: Include the following on the air balance reports:

- Date, time and place of test.
- Instrumentation used and its date of calibration.
- Name, position and signature of person responsible for test.
- Ambient temperature and/or other relevant factors.
- For each terminal grille and diffuser:

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- Grille or diffuser reference number as shown on the shop drawings. List outlets on a branch by branch basis.
- Design air quantity.
- Measured value (e.g. L/s, m/s).
- Hood or instrument factor.
- Grille or diffuser manufacturers area factor if applicable.
- Site measured air quantity in L/s calculated from the above.
- Measured air quantity as a percentage of design air quantity.
- Sum of measured branch and system air quantities and percentage of design.
- For each fan:
  - Fan designation and location.
  - Total air quantity measurement method.
  - Location of measurement point.
  - Simulated wet cooling coil pressure drop and dirty filter pressure drop.
  - Design air quantity.
  - Pitot readings (if used) or other measured values used to independently determine total fan air quantity.
  - Site measured air quantity in L/s calculated from the above.
  - Measured air quantity as a percentage of design air quantity.
  - Measured air quantity as a percentage of the sum of the individual diffuser and grille air quantities.
  - Blade pitch and/or fan speed as applicable.
  - Variable speed drive frequency
  - Measured motor current and name plate full load current.
  - Show the final operating point on the fan characteristic curve.
- Static pressure differentials across:
  - Each filter bank when clean.
  - Each cooling coil.
  - Each fan.
- Duct static pressure at:
  - Entry to filters.
  - Entry to each fan.
  - At duct discharge from air handling unit.
  - At each riser connection for supply and return systems serving multiple floors.

## 2.7 AUTOMATIC CONTROLS

### General

General: Test all controls hardware and software for correct operation.

### Sensor calibration

General: Calibrate all sensors to within the specified accuracy of the sensor.

## 2.8 SAFETY CONTROLS

### Testing

General: Test each safety control and facility by simulating the unsafe condition that the control is intended to protect against.

Monitoring: Ensure that adequate monitoring and safety measures are in place for the test.

## 2.9 HANDOVER PERIOD

### General

General: Provide a handover period after the installation has passed completion tests and before Practical completion.

Handover period:  $\geq 5$  days.

Plant Operation: Operate the mechanical systems continuously during the handover period provide one or more experienced operators in constant attendance in working hours and on call at other times to monitor the plant operation and make necessary adjustments to keep it operating properly.

## 2.10 COMPLETION TESTS

### General

General: Carry out completion tests.

### Heating and air-conditioning performance tests

General: In addition to balancing and commissioning, test performance of air conditioning systems during the maintenance period.

Instrumentation: Electronic data logger with temperature and humidity sensors or thermo hydrograph. Conform to **Instrumentation**.

Automatic control system: If the automatic control system has been specified to have facilities for logging sensed values, provide trend logs of sensor values over the same periods.

Performance: Record dry-bulb and relative humidity at each location continuously for 2 separate periods of at least 24 hours.

Reports: Provide graphical printout of values recorded by instrument together with control system log graphs where this facility is provided.

### Motors

Motor-driven equipment performance tests: Test for performance. Adjust thermal overloads for actual current and record measured current and overload settings.

## 2.11 CERTIFICATION

### General

Contract documents: Provide certification that the installation complies in all respects with the contract documents.

Statutory requirements: Provide certification of compliance with the relevant statutory requirements.

## O MECHANICAL MAINTENANCE

### 1 GENERAL

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#### 1.1 AIMS

##### Responsibilities

General: Provide maintenance of the mechanical systems. This includes the equipment, system and work included in this contract as well as the existing air conditioning, heating and ventilation systems in the building that are to be retained. The contractor is required to take over the maintenance responsibility of the building, at the commencement of the contract, as per the contract schedule. For existing plant which is to be replaced under the contract maintain the plant in satisfactory working order until it is replaced.

##### Regulatory Requirements

Include all regulatory requirements, annual certification and associated costs such as testing of pressure vessels and certification of smoke control systems.

#### 1.2 CROSS REFERENCES

##### General

General: Conform to the *General requirements* worksection.

##### Associated worksections

Associated worksections: Conform to the following:

- *Mechanical commissioning.*

#### 1.3 STANDARD

##### General

Provide maintenance in accordance with:

The Australian Institute of Refrigeration, Air-Conditioning and Heating – Applications Manual – HVAC & R Maintenance. Where Australian Standards or mandatory requirements indicate a higher level of maintenance the higher level shall take precedence.

Air handling system maintenance: Maintain to AS 1851.6.

Microbial control: Maintain to AS/NZS 3666.2 and AS/NZS 3666.3.

Pressure equipment: Maintain to AS 3873.

Respiratory protective devices: Maintain to AS/NZS 1715.



## 2 EXECUTION

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### 2.1 MAINTENANCE REQUIREMENTS

#### General

General: Provide all labour and material necessary to maintain the mechanical installation including, but not limited, to filter media, belts, refrigerants, lubricants, cleaning equipment and all items commonly referred to as consumable.

Maintenance will consist of the following parts.

- Programmed preventive maintenance of existing plant during the construction period and the defects liability period..
- Breakdown maintenance of existing plant during the construction and defects liability period
- Maintenance of all plant during the defects liability period.
- Maintenance of all plant after the defects liability period.
- Annual certification of plant including fire safety statements as required by regulatory authorities.

General: Report to the principal's designated representative on arriving at and before leaving the site.

### 2.2 MAINTENANCE DURING CONSTRUCTION

#### General

General: During the construction period and until all maintenance and operation manuals have been completed and submitted and all operator instruction is complete, provide all maintenance including but not limited to:

- Daily operation including starting and stopping of the plant if not automatic.
- All routine service tasks.
- Emergency visits.
- The labour costs for emergency visits and repairs to existing plant will be at the rates listed in the schedules. Where the repairs are due to the contractor's negligence the costs are to be met by the contractor. Repairs to new plant supplied or installed by the contractor during the construction period and the defects liability period are at the contractor's expense.

### 2.3 CLEANING

#### General

General: Progressively clean the interior of pipework, ductwork and air handling components as they are installed. Inspect the interior of dampers and valves on installation and remove obstructions.

At practical completion:

- Clean all parts of the installation.
- Clean interior of switchboards, switchgear, contactors and other electrical contacts.
- Clean interior or air handling plant.

- Clean strainer baskets.

## 2.4 PROGRAMMED PREVENTIVE MAINTENANCE

### General Requirements

1. Provide a program of works for effective preventive maintenance to all plant, equipment and systems listed in Equipment Schedules as detailed on Maintenance Schedules. Include all plant not specifically mentioned but necessary for the correct operation of the air conditioning, heating and ventilation systems.
2. Provides all labour and miscellaneous materials, filters, replacement sacrificial anodes, gaskets and consumables required to perform the programmed preventive maintenance.
3. Provide a monthly completed schedule to the Principal's Representative which records the maintenance work undertaken, materials used, test results obtained, advice of work required to be done and any major repairs identified as required to be done.
4. Undertake programmed preventive maintenance and all repair work on equipment on days and at times mutually agreed by the Contractor and the Principal's Representative and/or by advanced scheduling.
5. Provide a scheduled inspection, maintenance and reporting of all plant, equipment and systems.

## 2.5 BREAKDOWN MAINTENANCE AND URGENT REPAIRS

### Breakdown Calls - Generally

Provide a 7 days a week breakdown service between the hours of 7.30 am to 5.00 pm with a 24 hour service to facilitate lodgement of breakdown calls.

Where the Contractor is contacted by persons other than the Principal's Representative to carry out a service call, the Contractor shall immediately and prior to any action being taken, contact the Principal's Representative with the exception of the provision of Clause 2.8 - EMERGENCY SERVICE.

Any breakdown or equipment malfunction which in the opinion of the Principal's Representative has been caused through negligence of the Contractor or by failure to perform the detailed services, shall be rectified by the Contractor at no additional cost to the Principal.

### Breakdown Calls – Preventive Maintenance Contract

Where service calls are required, other than the normal service visit, authority to carry out any work shall be given by the Principal's Representative.

Breakdown services shall be quoted as separate charges in accordance with the rates stated in the Schedule of Rates and shall include:

1. A base charge to include all site establishment costs including travelling time and mileage charges. Only one base charge per call-out will be permitted.
2. On site labour charge which is to be the rate for each hour (parts of hours are to be apportioned accordingly) spent on site performing the necessary work.
3. Materials charge for required replacement parts.
4. Where a call-out is within 30 days of a programmed service visit the Contractor shall certify on the service docket that it was unrelated to or caused by work carried out at the service visit.

## 2.6 DEFECT LIABILITIES

During programmed preventive maintenance, if it can be reasonably shown that the defect could not have occurred as a result of the programmed preventive maintenance work, the repair will be treated as an ordinary breakdown. Any breakdown or equipment malfunction, which in the opinion of the Principal's Representative has been caused through negligence of the Contractor or by failure to adequately perform the scheduled services, shall be rectified by the Contractor at no cost to the Principal.

## 2.7 RESPONSE TIME

### Requirement

On receiving a breakdown call-out the Contractor shall attend the site as soon as practicable. The maximum response time, i.e. time for Contractor to arrive at the site, is:

- a. For maintenance calls: **Two hours** during working hours and **four hours** after hours, unless otherwise approved by the Principal's Representative.
- b. For urgent repairs: **One hour** during working hours and **two hours** after hours, unless otherwise approved by the Principal's Representative.

## 2.8 EMERGENCY SERVICE

### Requirement

In the event of a major failure occurring which could result in danger to personnel or damage to the building and it is necessary to effect urgent repairs, endorsement of the action taken must be obtained not later than the next working day. In all other cases payment will not be made for repairs unless such repairs are the subject of an official order issued by the Principal's Representative.

## 2.9 UNCOMPLETED WORK

Where the works cannot be repaired immediately, and are left inoperative or partly inoperative the Contractor shall, before leaving site, advise and fully inform the Principal's Representative as to the condition or status of the works, the possible subsequent consequences, and the extent of work and the estimated time required to place the works into full service.

The works shall be left safe at all times.

If work cannot be completed in the normal working hours the Principal's Representative may instruct the Contractor to continue the work until it is completed. For breakdown call-out work required to be completed outside normal working hours, the "outside normal working hours" rate shall apply to that part of the work completed outside normal working hours. Where the Principal's Representative has directed that programmed maintenance work be carried out, an additional payment will be made for each hour on-site outside normal working hours, equal to the difference between the "normal working hours" and the "outside normal working hours" rates for breakdown service at that site.

## 2.10 OPERATION AND MAINTENANCE MANUAL

### Additional information

General: Provide the following in the mechanical maintenance manuals in addition to that specified in the *General requirements* worksection:

- Installation description: General description of the installation.
- Systems descriptions: Technical description of the systems installed, written to ensure that the principal's staff fully understand the scope and facilities provided. Identify function, normal operating characteristics, and limiting conditions.

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### 3. TECHNICAL SPECIFICATION

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- Systems performance: Technical description of the mode of operation of the systems installed.
- Equipment descriptions:
  - Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
  - Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
- Operation procedures:
  - Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.
  - Control sequences and flow diagrams for systems installed.
  - Legend for colour-coded services.
  - Schedules of fixed and variable equipment settings established during commissioning and maintenance.
  - Procedures for seasonal changeovers.
- Maintenance procedures:
  - Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40 000 hours. Include lubricant and lubrication schedules for equipment.
  - Schedule of maintenance work including frequency and manufacturers' recommended tests.
  - Instructions for use of tools and testing equipment.
  - Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding.
  - Material safety data sheets (MSDS).
- Certificates:
  - Copies of test certificates for the mechanical installation and equipment used in the installation.
  - Test and balancing reports.
- Drawings:
  - Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications.
  - Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- Recommissioning instructions.
- Prototype periodic maintenance and performance report.
- Schedules to be used for recording recommissioning data so that changes in the system over time can be identified.

- Instructions and schedules for complying with AS 1851.6, AS/NZS 3666.2 and AS/NZS 3666.3.

## 2.11 SERVICE REPORT

### Requirement

At the completion of each programmed maintenance, repair or emergency visit the contractor must complete a service report, setting out the date of the visit, time of arrival, time of departure, details of work done, the service persons signature, and the signature of a person in authority in the building. Provide a folder and leave a copy of the service report on site in the folder together with any subcontractor's reports. Keep all reports for the period of the contract. A copy of the signed service report must accompany the invoice submitted for payment.

Invoices may not be accepted by the Principal's Representative without a completed and signed service document.

Provide a binder on site to hold service reports securely. Leave a copy of the services reports and any subcontractor's reports on site in the binder. Reports will be retained by the Principal's Representative after completion of the contract.

### Log Book

Provide a bound log book to be retained at the site. At each programmed service or breakdown call-out the Contractor shall enter complete details of the work so as to provide a full history of the plant. Details are to include inspections, defects, operating problems, work and tests carried out, parts replaced, metered hours run, time on site, date, service person's name (printed). The log book must be kept clean with records neat and legible. The names and signature of persons trained to carry out weekly tests are to be entered in the log book.

## 2.12 ANNUAL REPORT

Immediately following each annual service visit provide an annual report for the site. The complete report is to be submitted to the Principal's Representative. A copy of the report for the site is to be submitted to the relevant Principal's Representative. **The annual report is to be forwarded together with the service report and invoice for the programmed annual service.**

The annual report is to include the following:

1. a Schedule of Equipment revised to incorporate missing, incomplete or changed details.
2. a condition report for each item of equipment and system included in the contract.
3. a summary of work history on equipment to allow assessment of future expenditure.
4. a summary of outstanding issues on equipment and system noting remaining life, replacement cost, and replacement program based on projected economic life.
5. a list of short term repair works and its estimated cost that is recommended to retain the equipment and systems at an effective, economic and reliable level of service. An explanation of and reason for the recommendation is to be given for major item of work.
6. a prepared budget for long term replacement program and/or capital investment requirement.
7. a list of details and quantities of all belts, filters and refrigerant used during the preceding 12 month period.
8. the results of the application of the Contractor's Quality Assurance System as described in Clause PRELIMINARIES – QUALITY ASSURANCE.

**Payment for the annual service may only be made when this report is received.**

## **2.13 EQUIPMENT SCHEDULES**

The equipment schedules list the majority of component items of the engineering services. The list indicates the extent of the works however it may not include all items or contain complete information for an item. All associated equipment, fittings, instrumentation, controls, etc. whether listed or otherwise is to be maintained as part of this contract.

## **2.14 TRADE QUALIFICATION**

All work shall be carried out by trades persons fully qualified for the particular work.

Any person or persons carrying out air conditioning and refrigeration work shall hold relevant licences such as a Contractor's licence issued by the Building Services Corporation of NSW either as an individual or a Company/Partnership, Licences for using, handling refrigerants in NSW, and/or other statutory requirements.

Any person or persons engaged in carrying out electrical work shall hold a current electrical contractor's license or an electrician's licence, issued under the current Building Services Corporation Act or carry out such work under the personal supervision of a person so licensed. A person so licensed shall be on the site of the works at all times during which any such work is being performed.

## **2.15 SUB-CONTRACTOR**

Engage sub-contractors for work where the Contractor's employees do not have experience to undertake any specialist work. The Contractor and/or sub-contractor may be required to give proof of relevant experience to the Principal's Representative and if unsatisfactory the Contractor shall engage an experienced sub-contractor at no additional cost to the contract.

Only sub-contractors who have been identified to the Principal's Representative shall be engaged on any work under the Contractor.

## **2.16 CLEANING OF LOUVRES, GRILLES, REGISTERS AND DIFFUSERS**

### **Requirement**

Inspect, maintain and clean all air handling plant air intakes and exhaust outlets at regular intervals in accordance with the requirement of the regulations under the Public Health Act.

Inspect, maintain and clean all supply and exhaust air grilles, registers, louvres and diffusers together with the building surface areas immediately adjacent to them at the twelve monthly intervals. Avoid discolouring or staining the building surface. Restore surfaces if damaged during cleaning.

Where possible, vacuum cleaners are to be used.

Air handling plant is to be shut down during the cleaning process.

The initial clean is to be carried out within one month after Defect Liability Period of the construction contract.

Inspect the outside air filters monthly for cleanliness and for air by-passing the filter system. Clean filters if necessary. Adjust filter frames and media as necessary. Advise the Principal's Representative of air by-pass through the building fabric.

## **2.17 CONTRACT EXCLUSIONS**

### **Generally**

- a. Electrical mains and distribution to mechanical, electrical and fire services switchboards.
- b. Cold water supply from mains to items of mechanical plant.

- c. Domestic hot water supply and circulation piping and fittings (other than valves which are included in the contract) downstream of the hot water heaters and circulating pumps.
- d. Routine starting, stopping or operation of plant.

## 2.18 PLANT AUDIT

### Generally

The Contractor shall put in place a system of self auditing of the maintenance work carried out. The self auditing form shall be forwarded to the Principal's Representative for his consensus before being used.

The plant and systems included in this Contract may be randomly audited at any time by an independent organisation nominated and arranged by the Principal's Representative.

During the audit, any defects deficiencies or omissions in the Contract works due to inadequate scheduled or breakdown maintenance shall be listed by the Principal's Representative in a defects notice.

The Contractor shall rectify the defects deficiencies and omissions listed in the defects notice. All costs associated with their rectification are to be borne by the Contractor and are to be completed in the time stated in the defects notice.

Failure to rectify such defects within the stated time may result in the Principal's Representative issuing a 30 day notice to terminate the Contract.

If the Contractor is served with a total of two defect notices during random plant audits and/or if breakdowns of the same component, plant or system occur more than three times in any 12 month period due to inadequate or omission of maintenance, the Contractor may be given 30 days notice to terminate the Contract.

## 3 SCHEDULES

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### 3.1 EQUIPMENT LIST

Major equipment and system included as follow:

- One air cooled cooled chiller
- One chilled water pump
- One cooling coil
- All variable air volume boxes
- The automatic control system including all sensors, actuators
- The building management system (BMS)
- Supply and return fans
- Air filters
- Mechanical switchboard
- Water treatment system
- All associated piping valves, piping and fittings
- All ductwork and associated components.

Minor equipment and systems included as follow:

- Toilet exhaust system
- PABX supply system
- PABX exhaust system

### 3.2 MAINTENANCE SCHEDULES

Refer to attached Appendix to the following Maintenance Schedules as per AIRAH Application Manual – HVAC&R Maintenance.

5-20	Air distribution
5-30	Air Handling Plant
5-40B	Automatic and Safety Controls - Electric and Electric Controls
5-70	Chillers
5-70A	Chillers - Centrifugal
5-80A	Coils – Cooling
5-130	Dampers
5-130A	Dampers - Automatic
5-130B	Dampers – Manual
5-130C	Fire Dampers
5-150	Drives
5-160	Ductwork
5-170A	Electrical Components – Duct Heaters
5-170B	Electrical Components - Switchboards & Wiring
5-180	Electric Motors
5-200	Fans
5-210	Filters
5-250	Insulation
5-250A	Insulation – Duct
5-250B	Insulation - Pipes & Pressure Vessels
5-270	Pipework
5-280	Plant Rooms
5-290	Pumps
5-340	Vibration Isolation
5-360	Water Treatment

### END OF TECHNICAL SPECIFICATION SECTION



### *3. TECHNICAL SPECIFICATION*

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## APPENDIX TO MAINTENANCE SCHEDULES

AIR CONDITIONING AND MECHANICAL SERVICES	MAINTENANCE SCHEDULE – 5-20
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### AIR DISTRIBUTION

Requirements	Service Visit Required
	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-20	
1. Carry out random airflow check. Where airflow quantities are found to be out by more than the tolerance of +/- 10% adjust the relevant items or systems and record the final result. (ie filters, coils, mixing boxes branch ducts etc.)	X
2. Check total airflow to each system.	X
3. Confirm that there have been no amendments to the use of the areas supplied.	X
4. Check airflow from 33% of air diffusers and record results.	X
5. Check minimum outdoor air quantities and record results.	X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-30</b>
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**AIR HANDLING PLANTS**

Requirements	Service Visit Required		
	Monthly	6-monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-30			
1. In units with sprayed coils clean out algae and slime.	X	X	X
2. Inspect drain trays, ensure drains are clear, trays are clean and drains have a water trap in them.	X	X	X
3. Check panels, doors and fastenings for security. Repair leaks.		X	X
4. Remove rubbish from conditioner housing.		X	X
5. Ensure insulation is secure, repair as necessary.		X	X
6. Replace defective lights.		X	X
7. Inspect flexible connections and repair as necessary.		X	X
8. Check for leaks in coils and piping connections.		X	X
9. Lubricate damper linkages with recommended lubricant.		X	X
10. Inspect the casing for corrosion and leaks, repair as necessary.			X

**AIR CONDITIONING AND MECHANICAL SERVICES****MAINTENANCE SCHEDULE – 5-40B****AUTOMATIC & SAFETY CONTROLS - ELECTRIC AND ELECTRONIC CONTROLS**

Requirements	Service Visit Required			
	Monthly	3-monthly	6-monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-40				
1. Check temperatures on floors, in rooms or in any areas requiring special conditions.	X	X	X	X
2. Attend to any reported problems, check and adjust as necessary.	X	X	X	X
3. Check location of thermostats, ensure correct location relative to controlled area.		X	X	X
4. Check controls for physical damage.		X	X	X
5. Check operation of control linkages.		X	X	X
6. Check, clean and lubricate with approved lubricant, spindles & linkages.			X	X
7. Check & adjust, as necessary, the calibration of control sensors.			X	X
8. Check action and settings of time switches.				X
9. Inspect all controls for operation & cleanliness.				X
10. Check operation of each thermostat for response.				X
11. Check drive motor mountings for security.				X
12. Check linkages for tightness.				X
13. Check that step controllers function correctly and plant items respond as called.				X
14. Prove correct operation of any safety controls.				X
15. Check, clean and lubricate with approved lubricant, spindles & linkages.				X
16. Inspect all DDC systems and data gathering panels.				X

**AIR CONDITIONING AND MECHANICAL SERVICES****MAINTENANCE SCHEDULE – 5-70A****CHILLERS - CENTRIFUGAL**

Requirements	Service Visit Required	
	6-monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-70		
1. Test refrigerant and oil.	X	X
2. Remove refrigerant and replace after service.		X
3. Remove float chamber cover, clean out and inspect float.		X
4. Remove oil pump, clean oil reservoir and filter, change oil.		X
5. Visually inspect gear teeth.		X
6. Clean volute and refrigerant filters.		X
7. Inspect, purge compressor valves, check operation of purge float. Clean strainer.		X
8. Inspect inlet guide vanes and check the operating control system		X
9. Pressure test machine and evacuate.		X
10. Start machine and check operation.		X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-80A</b>
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**COILS - COOLING**

Requirements	Service Visit Required		
	Monthly	6-monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-80			
1. In units with sprayed coils, clean algae and slime.	X	X	X
2. Inspect drain trays and test drains.	X	X	X
3. Check for leaks on coils and connections.		X	X
4. Vent water coils.		X	X
5. Inspect coils for dirt build up and clean as necessary.		X	X
6. Inspect coils for fin damage and comb if necessary.			X
7. Examine coil to ensure internal sections are not blocked.			X
8. Check temperatures across coil, adjust as necessary. Record result.			X
9. Inspect feed and expansion tank and piping.			X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-130</b>
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**DAMPERS**

Requirements	Service Visit Required	
	6-monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-130		
<u>Automatic</u>		
1. Check and service all controls, motors etc. as per appropriate instruction sheet.	X	X
2. Check all dampers for freedom of operation.	X	X
3. Check all damper linkages.	X	X
4. Check that dampers are sealing tight when closed.	X	X
5. Check damper linkages, lubricate as required.		X
6. Check for undue noise or vibration.		X
<u>Manual</u>		
1. Inspect and clean dampers.		X
2. Check position of dampers. Check air flow at 33% of dampers in the system and record results.		X
<u>Fire</u>		
1. Inspect fire damper packing on 20% of dampers.		X
2. Inspect 20% of fire dampers for obstructions.		X
3. Confirm fire damper position is correct.		X
4. Check fire damper for corrosion.		X
5. Check fire damper mounting is sound.		X
6. Check integrity of firewall.		X
7. Check correct operation of fire damper.		X
8. Restore fire damper to correct position.		X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-130A</b>
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**DAMPERS - AUTOMATIC**

Requirements	Service Visit Required	
	6-monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-130		
1. Check and service all controls, motors etc. as per appropriate instruction sheet.	X	X
2. Check all dampers for freedom of operation.	X	X
3. Check all damper linkages.	X	X
4. Check that dampers are sealing tight when closed.	X	X
5. Check damper linkages, lubricate as required.		X
6. Check for undue noise or vibration.		X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-130B</b>
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**MANUAL DAMPERS**

Requirements	Service Visit Required
	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-130	
1. Inspect and clean dampers.	X
2. Check position of dampers. Check air flow at 33% of dampers in the system and record results.	X



<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-130C</b>
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**FIRE DAMPERS**

Requirements	Service Visit Required
	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-130	
1. Inspect fire damper packing on 20% of dampers.	X
2. Inspect 20% of fire dampers for obstructions.	X
3. Confirm fire damper position is correct.	X
4. Check fire damper for corrosion.	X
5. Check fire damper mounting is sound.	X
6. Check integrity of firewall.	X
7. Check correct operation of fire damper.	X
8. Restore fire damper to correct position.	X

4. MAINTENANCE SCHEDULES

AIR CONDITIONING AND MECHANICAL SERVICES		MAINTENANCE SCHEDULE – 5-150				
DRIVES						
Requirement		Service Visit Required				
		Monthly	3-monthly	6-monthly	Annual	3-yearly
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-150						
<u>Belt Drives</u>						
1. Check Belt Tension.		X		X		X
2. On multi-belt drives check belts have same tension.		X		X		X
3. Check belts and pulleys for wear or damage, replace as necessary.		X		X		X
4. Ensure belt guards are firmly in place.		X		X		X
5. Units with ball bearings. Check bearings.				X		X
6. Replace belts with matched belts having the same section as the pulley.						X
7. Check pulley alignment.						X
<u>Direct Drives</u>						
1. Check coupling for alignment.			X	X	X	X
2. Check coupling bolts for tightness.			X	X	X	X
3. Inspect buffer material and replace as necessary.			X	X	X	X
4. Ensure coupling guards are firmly in place.			X	X	X	X
<u>Gear Drives</u>						
1. Check for undue noise or vibration.		X	X	X	X	X
2. Check oil level in drive and top up as necessary.		X	X	X	X	X
3. Check security of all bolts and fittings.			X	X	X	X
4. Check security of drive and shaft assemblies.			X	X	X	X
5. Check condition of oil in drive, change as necessary.				X	X	X
6. Change oil in drive.					X	X
7. Treat all shafts for corrosion prevention.						X

NEWCASTLE GOVERNMENT OFFICE BLOCK - AIR CONDITIONING UPGRADE

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**AIR CONDITIONING AND MECHANICAL SERVICES****MAINTENANCE SCHEDULE –5-150****DRIVES**

Requirement	Service Visit Required				
	Monthly	3-monthly	6-monthly	Annual	3-yearly
<u>Variable Speed</u>					
1. Check for undue noise or vibration.	X	X	X	X	X
2. Check oil level in drive and top up as necessary.	X	X	X	X	X
3. Check Belt Tension.	X	X	X	X	X
4. On multi-belt drives check belts have same tension.	X	X	X	X	X
5. Check belts for wear or damage, replace as necessary.	X	X	X	X	X
6. Ensure belt guards are firmly in place.	X	X	X	X	X
7. Check security of all bolts and fittings.		X	X	X	X
8. Check security of drive and shaft assemblies.		X	X	X	X
9. Check condition of oil in drive, change as necessary.			X	X	X
10. Change oil in drive.				X	X
11. Replace belts with matched set.					X

**AIR CONDITIONING AND MECHANICAL SERVICES****MAINTENANCE SCHEDULE – 5-160****DUCTWORK**

Requirements	Service Visit Required
	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-160	
1. Check for air leaks [audible or observed].	X
2. Inspect all flexible connections for tears, delamination or loose connections.	X
3. Inspect for physical damage.	X
4. Observe for undue noise, whistling or rattles.	X
5. Inspect outdoor ducts for rain ponding.	
6. Inspect for any electrolysis or corrosion.	X
7. Observe for drumming on fan start up [particularly High Pressure/High Velocity systems].	X
8. Inspect components for UV damage.	X
9. Inspect insulation and examine for loss of vapour seal and deterioration.	X
10. Where ductwork is associated with kitchen exhaust, clean down the hood and ensure that the filters are clean and that no grease has entered the ducts.	X
11. Inspect adjacent to wet equipment (humidifiers) and selected access points [AS3666].	X
12. Inspect and clean registers, grilles and dampers.	X
13. Inspect duct hangers for support and security.	X
14. Inspect and test flashing at external penetrations.	X

**AIR CONDITIONING AND MECHANICAL SERVICES****MAINTENANCE SCHEDULE – 5-170A****ELECTRICAL COMPONENTS - DUCT HEATERS**

Requirements	Service Visit Required		
	Monthly	6-monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-170			
1. Check to ensure no heaters have cut out on high limit.	X	X	X
2. Test high limit thermostat and pressure switch to ensure heaters turn off. Check settings.	X	X	X
3. Check all electrical connections for tightness.	X	X	X
4. Switch off fan, ensure elements switch off.		X	X
5. Inspect electric heating elements for combustible rubbish, dust, and electrical operation.		X	X
6. Test individual elements and record current draw.			X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-170B</b>
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**ELECTRICAL COMPONENTS - SWITCHBOARD AND WIRING**

Requirements	Service Visit Required		
	Monthly	3-monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-170			
1. Check for signs of burnt, hot connections and burnt contacts on starters and relays. Clean tighten and rectify.	X	X	X
2. Replace any faulty indicator lights.	X	X	X
3. Examine general condition of conduits, connectors switches and wiring, especially in damp and outdoor areas.	X	X	X
4. Check operation of each item of equipment.	X	X	X
5. Check and inspect for faulty meters.		X	X
6. Inspect and clean or replace contacts or faulty relays.			X
7. Check overload ratings against motor nameplate.			X
8. Check connections to (a) motors, (b) switchboards, or (c) equipment subject to vibration.			X
9. Examine external switches for damage to seals.			X
10. Test operation of all time switches.			X
11. Check all time delays.			X
12. Check all fuses for correct rating.			X
13. Replace any labels that have fallen off or been removed.			X
14. Check, and rectify where necessary, condition of exposed cable insulation.			X
15. Vacuum clean interior of all switchboards.			X
16. Check that conduits are securely fixed.			X
17. Examine and rectify panel seals.			X
18. Check for existence of Switch Board card.			X
19. Check and report where wiring diagrams are considered to be incorrect.			X
20. Lubricate all pivot points (use pure petroleum jelly).			X

**AIR CONDITIONING AND MECHANICAL SERVICES****MAINTENANCE SCHEDULE – 5-180****ELECTRIC MOTORS**

Requirement	Service Visit Required				
	Monthly	3-monthly	6-monthly	Annual	3-yearly
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-180					
1. Check motor bearings for noise and temperature. Run all motors.	X	X	X	X	X
2. Lightly lubricate motor bearings to manufacturers recommendations.		X	X	X	X
3. Check all connections and associated wiring.		X	X	X	X
4. Check maximum duty amps against nameplate, report any overload.			X	X	X
5. Megger test all motors over 1 kW, preferably when cold.				X	X
6. Remove bottom bearing plugs and pump until fresh grease evident.					X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-200</b>
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**FANS**

Requirements	Service Visit Required			
	Monthly	6-monthly	Annually	3-yearly
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-200				
1. Check fan operates.	X	X	X	X
2. Check for vibration, bearing noise or overheating.	X	X	X	X
3. Adjust belt tension as necessary, check for wear.	X	X	X	X
4. Check mounts and holding down bolts for security.	X	X	X	X
5. Check drive and drive shaft guard firmly in place.	X	X	X	X
6. Lightly lubricate bearings to manufacturers recommendation.		X	X	X
7. Spray or coat belts, where fitted, with commercial compound to reduce pulley slip.		X	X	X
8. Check that impeller and drive are tight on shafts.			X	X
9. Check drive alignment.			X	X
10. Remove corrosion, repair paintwork and lightly grease bright steelwork.			X	X
11. If accessible, clean fan blades and scroll or casing.			X	X
12. Check access panels for air leakage and seal.			X	X
13. Replace flexible drive components.				X



<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-210</b>
<b>FILTERS</b>	

Requirement	Service Visit Required				
	Monthly	3-monthly	6-monthly	Annually	3-yearly
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-210					
<u>Dry Media and Panel Filters</u>					
1. Clean washable filters when resistance exceeds 125 Pa.	X	X	X	X	
2. Clean dry media regenerable filters when resistance exceeds 125 Pa.	X	X	X	X	
3. Replace flat disposable panel filters when resistance exceeds 125 Pa. or as recommended by manufacturer.	X	X	X	X	
4. Advance roll filters when resistance exceeds 125 Pa.	X	X	X	X	
5. Replace extended surface panel filters, sock or deep bed filters when resistance is more than 125 Pa above initial resistance.	X	X	X	X	
6. Replace High Efficiency and Absolute filters when resistance is more than 250 Pa above initial resistance.	X	X	X	X	
7. Check roll filters have adequate media.	X	X	X	X	
8. Order new filters or filter media if required for next service.	X	X	X	X	
9. On units less than 500 l/s, visually inspect filters. Clean as specified and as necessary (at least every three months).		X	X	X	
10. On plants over 500 l/s take pressure reading across filter		X	X	X	
11. Check for air leakage around media, ensure that media edge is in the channel provided.		X	X	X	
12. Vacuum filter chamber and inlet screens after each filter change.		X	X	X	
13. Ensure that media is not disintegrating or delaminating.		X	X	X	
14. Lightly lubricate filter drives and check operation.			X	X	

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-250</b>
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**INSULATION**

Requirements	Service Visit Required		
	Monthly	6-monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-250			
<u>Duct</u>			
1. Visually inspect ducts for areas where external insulation has fallen away or is obviously damaged.	X		X
2. Check for condensation on ducts, ensure continuity of insulation over cold ducts.	X		X
3. As for 2. above, where internally insulated, ensure that insulation is not saturated.	X		X
4. Ensure that all cover strips and peripheral bands are in place and that duct tape is not peeling off.			X
<u>Pipes &amp; Pressure Vessels</u>			
1. Visually inspect all insulation for areas where insulation is obviously damaged.	X	X	X
2. Inspect and make good to metal sheathing on all pipes and pressure vessels.	X	X	X
3. Inspect all insulation for condensation. Replace all wet insulation and repair damaged vapour seals.		X	X
4. Check isolation at pipe hangers, repair as necessary.			X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-270</b>
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**PIPEWORK**

Requirements	Service Visit Required		
	Monthly	6-monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-270			
<u>Compressed Air Pipework</u>			
1. Inspect for physical damage or loose supports. Make good and check for leaks.	X		X
2. Check operation of all valves, repair or replace as necessary.			X
3. Inspect all drain and scale pockets, remove moisture and scale as necessary.			X
<u>Gas Pipework</u>			
1. Inspect for physical damage or loose supports. Make good and check for leaks.	X		X
2. Check operation of all valves, repair or replace as necessary.			X
3. Inspect all drain and scale pockets, remove moisture and scale as necessary.			X
<u>Medical Gas Pipework</u>			
1. Inspect for physical damage or loose supports. Make good and check for leaks.	X	X	X
2. Inspect room fittings for damage or leaks.		X	X
3. Check operation of all isolating valves, repair or replace as necessary.			X
4. Inspect and test pressure regulators.			X
<u>Oil Pipework</u>			
1. Check pipes for leaks, make good as necessary.	X		X
2. Check operation of all valves, repair or replace as necessary.			X
3. Check and drain all sludge traps and strainers.			X
4. Check operation of pipe electric heater tracing, repair or adjust as necessary.			X
<u>Refrigeration Pipework</u>			
1. Check for frosting, adjust gas charge or TX control valve setting if necessary.	X	X	X
2. Check temperature and pressure drop across refrigerant drier.	X	X	X
3. Check operation of solenoid valves and TX valves.	X	X	X

**AIR CONDITIONING AND MECHANICAL SERVICES****MAINTENANCE SCHEDULE – 5-270****PIPEWORK**

Requirements	Service Visit Required		
	Monthly	6-monthly	Annually
4. Check all pipes and valves for leaks using a detector.		X	X
5. Check that pipes and gauges are securely fixed.		X	X
6. Check operation of all manual valves. Ensure that all valve caps have copper seal rings fitted.			X
7. Test and reset TX valve superheat settings.			X
8. Check operation of solenoid valves.			X
9. Clean all strainers.			X
<u>Water Pipework</u>			
1. Inspect pipework for leaks.	X	X	X
2. Check operation of all manual valves.		X	X
3. Check all vents or scale pockets, vent or drain as necessary.		X	X
4. Check that all hangers and brackets are secure.			X
5. Check Strainers.			X
6. Check insulation is secure (see Insulation Maintenance Schedule).			X
<u>Steam Pipework</u>			
1. Inspect pipework for leaks.	X	X	X
2. Check operation of all manual valves.		X	X
3. Check all vents or scale pockets, vent or drain as necessary.		X	X
4. Check that all hangers and brackets are secure.			X
5. Check insulation is secure (see Insulation).			X
6. Check all steam traps.			X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-280</b>
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**PLANT ROOMS**

Requirements	Service Visit Required	
	Monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-280		
1. Remove all waste materials, rags, old media and the like.	X	X
2. All machinery to be wiped down and left in clean and tidy condition.	X	X
3. Maintain floors in clean state by occasional mopping with detergent.	X	X
4. Replace lamps as necessary and maintain fittings in clean condition.	X	X
5. Ensure all drains are clear.	X	X
6. Check that fresh air inlets are not blocked with stored materials and that cleaning equipment, and other odorous materials are not stored in fresh air plenums.	X	X
7. Advise on remedial painting or other building work required.		X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-290</b>
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**PUMPS**

Requirement	Service Visit Required				
	Monthly	3-monthly	6-monthly	Annual	3-yearly
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-290					
1. Check pump and motor for vibration and bearings for noise or overheating. Repair as necessary.	X	X	X	X	X
2. Change over duty pump, where fitted.	X	X	X	X	X
3. Adjust belt tension as necessary, check for wear.	X	X	X	X	X
4. Inspect pump gland and adjust if necessary.	X	X	X	X	X
5. Operate pump suction and discharge valves stop any gland leaks.	X	X	X	X	X
6. Check that gland well and drain are clear.	X	X	X	X	X
7. If pressure gauges fitted, check operating pressures to ensure strainer is clear and pump vented.	X	X	X	X	X
8. Check guards are securely in place.	X	X	X	X	X
9. Vent Pump.	X	X	X	X	X
10. Visually inspect pump coupling.	X	X	X	X	X
11. Where fitted, check operation of automatic float switch, adjust as necessary.	X	X	X	X	X
12. With pump running lightly lubricate bearings of pump and motor.		X	X	X	X
13. Lightly grease bright steel.		X	X	X	X
14. Clean and, as necessary, reseal check valves.			X	X	X
15. Clean pump strainer.				X	X
16. Check coupling bushes for wear, if worn replace. Check motor for alignment.				X	X

<b>AIR CONDITIONING AND MECHANICAL SERVICES</b>	<b>MAINTENANCE SCHEDULE – 5-290</b>
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**PUMPS**

Requirement	Service Visit Required				
	Monthly	3-monthly	6-monthly	Annual	3-yearly
17. Inspect exposed surfaces for corrosion, repair paintwork as necessary.				X	X
18. Replace packing or mechanical seal to manufacturer's recommendation.				X	X
19. Replace belts and check motor alignment and couplings as applicable.					X
20. Disassemble and inspect pumps internally.					X

**AIR CONDITIONING AND MECHANICAL SERVICES****MAINTENANCE SCHEDULE – 5-340****VIBRATION ISOLATION**

Requirements	Service Visit Required	
	3-Monthly	Annually
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-340		
1. Inspect vibration isolators.	X	X
2. Check for damaged isolators and incorrect settings on jacking bolts.	X	X
3. Check that machine isolators are not short-circuited by electrical conduits, guards, debris etc.	X	X
4. Ensure mounts are clear of oil or water.	X	X
5. Check that flexible connections are installed correctly.	X	X
6. Check that pipe flexible connections are not short-circuited by other pipes, electrical trays, debris, etc.	X	X
7. Check pipe flexibles for damage.	X	X
8. Dismantle 20% of pipe isolators made of rubber compound, inspect to ensure clear full diameter bore passage.		X
9. Check the pressure in air springs.		X



**AIR CONDITIONING AND MECHANICAL SERVICES****MAINTENANCE SCHEDULE – 5-360****WATER TREATMENT**

Requirements	Service Visit Required
	Monthly
Maintenance is to be carried out specifically in accordance with The Australian Institute of Refrigeration, Air-Conditioning and Heating – Application Manual – HVAC & R Maintenance Table 5-360	
1. Test water for correct level of corrosion inhibitor, pH and Total Dissolved Solids.	X
2. Measure and record dosage and bleed-off rates.	X
3. Top up dosage tanks.	X
4. Slug dose corrosion inhibitor where level is too low.	X
5. Slug dose biocide.	X
6. Make adjustments to dosage and bleed rates as indicated by test results.	X
7. Remove all empty chemical containers.	X