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SPECIFICATION

ROYAL BRISBANE HOSPITAL

QUEENSLAND INSTITUTE OF MEDICAL RESEARCH

AIR CONDITIONING AND MECHANICAL SERVICES INSTALLATION

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**DEPARTMENT OF WORKS
100 GEORGE STREET,
BRISBANE QUEENSLAND**

1979-454



DEPARTMENT OF WORKS, QUEENSLAND
EXECUTIVE BUILDING, 100 GEORGE STREET, BRISBANE

POSTAL ADDRESS: G.P.O. BOX 2457, BRISBANE 4001
TELEPHONE: 224 0515 TELEX: QWORKBN AA 41506

IN REPLY PLEASE GIVE OUR REFERENCE:

REFERENCE:

REFER TO:

DATE: 12th December, 1977.

Dear Sir,

Re: QLD INSTITUTE OF MEDICAL RESEARCH
AIR CONDITIONING & MECHANICAL SERVICES

Enclosed herewith is one (1) copy of Addendum No. 1
for the above project.

Please insert the Addendum into the Tender Documents and
state in your tender that the tender makes the necessary
allowance for this advice.

Please acknowledge receipt of this Addendum by returning the
enclosed duplicate letter with signature and date.

Yours faithfully,

D. K. Houston

DIRECTOR OF WORKS
AND UNDER SECRETARY.

per [signature]

RTI Release

PLACE: ROYAL BRISBANE HOSPITAL
 BUILDING: QUEENSLAND INSTITUTE OF MEDICAL RESEARCH
 WORK: AIR CONDITIONING AND MECHANICAL SERVICES

ADDENDUM NO. 1

ADD to Clause 13.0 - (Arrangement of Microscope Cooling Unit Piping) -
 the following :-

Within the Main Air-conditioning plantroom provide, for the main cold water and the microscope cooling water circuits, In-line water filter assemblies complete with the following :-

- (i) Isolating valves to isolate the filter body (before changing the filter media).
- (ii) Pressure tapplings on the inlet side of the filter body (for test purposes).
- (iii) Red lined pressure gauges on the outlet side of the filter body (to indicate the need to change the filter media).

Water filters shall be specially selected to suit the media they work in and filter bodies shall be of the in-line type with chrome plated finish.

The performance shall be as stated below :-

Mains Cold Water

Filtration - 30 Microns
 Capacity - 3 litres/minute
 Pressure drop - 21 kPa

Microscope Cooling Water

Filtration - 6 Microns
 Capacity - 3 litres/minute
 Pressure drop - 21 kPa

Firm.....

Address.....

Signature,.....

Date.....

Witness.....

ENGINEERING BRANCH

The Director of Contracts,
Department of Works,
Executive Building,
100 George Street,
BRISBANE. 4000.

QUOTATION FORM - NOMINATED SUB-CONTRACT TO BUILDING
CONTRACT
Accompanying SPECIFICATION NO. P. 780/77

Sir,

We CARRIER AIR CONDITIONING PTY LIMITED.

do hereby quote to perform as a Nominated Sub-Contractor
the Works for AIR CONDITIONING AND MECHANICAL SERVICES INSTALLATION

at ROYAL BRISBANE HOSPITAL - QUEENSLAND INSTITUTE OF MEDICAL RESEARCH

agreeably to the Plans and Specification and subject to
the Conditions of Quoting and Special Conditions of Sub-
contract attached hereto, for the sum of

THIRTY EIGHT THOUSAND, EIGHT HUNDRED AND THIRTY FOUR DOLLARS ONLY.

Total amount of Quotation \$ 38,834.00

and to commence the work within (14 days unless otherwise
stated)

and complete the same in accordance with the Building
Contract time stated herein.

The number of ~~my~~ our Workers' Compensation policy
is AW8838 and the premium has/~~has not~~ been paid
for the current year.

Dated this NINETEENTH day of DECEMBER 19.77

Signature of Quoter: *[Signature]*

Witness: *[Signature]*

Note: When the Quotation is in the name of a firm, the
names in full of each member and their and each
of their respective addresses must be given
(Condition 2.)



MEMBER
AIR CONDITIONING
FEDERATION
OF
QUEENSLAND

Carrier Air Conditioning Pty. Limited

(INCORPORATED IN NEW SOUTH WALES)

BRANCHES AT
MELBOURNE
ADELAIDE
SEVEN HILLS
SYDNEY
PORT MORESBY
DARWIN

26 ANNERLEY ROAD, WOOLLOONGABBA, QUEENSLAND, 4102

HEAD OFFICE: SEVEN HILLS ROAD, SEVEN HILLS, N.S.W.

Please address
all correspondence
to The Manager.

Our Ref.
Your Ref.

DKS:JBH 78B-014
Spec. No. P780/77

19th December, 1977

The Director of Contracts,
Department of Works,
Executive Building,
100 George Street,
BRISBANE.....4000.

Dear Sir,

Subject : Tender for Specification No. P780/77.

Thank you for your invitation to tender for the supply, installation, testing and maintenance of Air Conditioning, Mechanical Ventilation & Services for the proposed Election Microscope Rooms and the Standby Generator Room of the Queensland Institute of Medical Research Building at the Royal Brisbane Hospital.

This tender is generally in accordance with your Specification No. P780/77 and accompanying Drawing Nos. P6849 to 51 inclusive.

The equipment involved is more fully described in the Schedule of Technical Data attached.

WORK BY OTHERS.

The contents of Clause 3.00 on Page 1 of the Specification are noted, and no allowance has been made in our tender for the stated work which will be carried out by others at no cost to the Air Conditioning Contractor.

RELATIONSHIP TO BUILDER.

It is agreed that our Company become a Nominated Sub-Contractor to the Main Contractor, whose name is unknown at the date of tender, provided that we can reach agreement on any conditions forming part of the Sub-Contract Document that may be prepared for our acceptance.

RISE & FALL ADJUSTMENT.

The Rise and Fall conditions in the Specification are generally acceptable to us, and our tender is submitted subject to adjustment. A completed Schedule 'R' form based on \$141.20 per week is attached.

../2

TIME FOR COMPLETION & LIQUIDATED DAMAGES.

It is noted that the Main Contract completion time is not nominated, and that no mention is made of Liquidated Damages in the Specification.

We are confident that our Company can schedule the work and co-ordinate our activities with those of the Main Contractor to complete the work within the agreed time, provided that fair and reasonable access was available to the required areas of the site as the installation proceeds. Provided also that a reasonable period was available between the acceptance date of our tender and the required completion date and subject to equipment and material availability during the fabrication and erection periods.

It is also agreed that Liquidated Damages be passed on to us, if these form part of the agreement with the Main Contractor, and in the event of our failure to complete the work within the agreed time, provided also that delays, if any, are caused solely and directly by us, and not for reasons beyond our control, and that equivalent damages are also applied to the Main Contractor in the first place.

CONDITIONS OF CONTRACT AND TERMS OF PAYMENT.

Except as varied herein, we accept the specified Conditions of Contract and Terms of Payment in lieu of all clauses shown on the rear of our quotation form.

However, we would prefer to be paid one hundred percent of progress payments, and in lieu of any retention monies, would submit an irrevocable Banker's Guarantee for the amount of the specified retention fund. This guarantee would be in favour of either the Principal or Head Contractor and would remain in force until the end of the warranty period, so that full payment of the contract sum can be made to us at the date of practical completion. We also elect to provide a similar Banker's Guarantee in lieu of any security deposit that may be required.

OVERTIME.

Allowance is made for all work to be carried out only during normal working hours. Should additional overtime be specifically requested, other than that worked by the Air Conditioning Contractor of his own accord, then the extra expense for this overtime shall be paid for by the party requesting it.

CONCLUSION.

We hope that the information contained herein is sufficient to enable you to adequately assess this tender, but should any further details be required, please do not hesitate to contact the writer.

In the meantime, you may be assured of our continued interest and service, and we now look forward to receipt of your further instructions.

Yours faithfully,
CARRIER AIR CONDITIONING PTY LIMITED.

D. R. Scott
D. R. Scott,
Sales Manager - Contracting Division.

P.S. Schedule of Tech. Data to 661

NOTES ON SPECIFICATION.

1. When the Air Conditioning & Ventilation Services to be installed in accordance with this Contract have been designed and specified by others, this Contractor will guarantee the capacity and performance of individual items of plant and equipment to be as specified and that installation and workmanship is in accordance with the Specification but will not guarantee the overall system performance and design or resultant levels of noise and vibration.

However, should our tender be favourably considered, we would carry out detailed design and noise calculations, after being awarded the contract, and before accepting any responsibility for performance of the overall system.

2. We will connect to the existing 1" valves at the end of the supply and return chilled water headers in the plant room and provide new spare 1" valves. This will avoid inconvenience to staff and animal rooms which would occur if the plant was shut down and the system drained so that the connections could be made as indicated on the drawings.
3. We have not allowed for a chilled water trough in the dark room. We understand that this is provided by the builders.
4. We have allowed a Magnahelix filtrometer on the air conditioning unit filter.
5. Water filters on the dark room unit are plastic bodied not chrome plated.



MEMBER
AIR CONDITIONING AND
MECHANICAL CONTRACTORS
FEDERATION
OF
QUEENSLAND



TELEX: AA42181
TELEPHONE: 391-4011*

Carrier Air Conditioning Pty. Limited

(INCORPORATED IN NEW SOUTH WALES)

28 ANNERLEY ROAD, WOOLLOONGABBA, QUEENSLAND, 4102

HEAD OFFICE: SEVEN HILLS ROAD, SEVEN HILLS, N.S.W.

BRANCHES AT
MELBOURNE
ADELAIDE
SEVEN HILLS
SYDNEY
PORT MORESBY
DARWIN
PERTH
CANNBERRA
TOWNSVILLE

DKS:JBH

Estimate No. 78B-014

TO The Director of Contracts,
Department of Works,
100 George Street,
BRISBANE...4000.

ON BEHALF OF

Q'ld Institute of Medical Research
Royal Brisbane Hospital.

QUOTATION 19th December, 1977

Subject to the Conditions printed on back hereof, unless specifically stated to the contrary, and in accordance with the accompanying specification.

For the supply, installation, testing and maintenance of Air Conditioning, Mechanical Ventilation & Services for the proposed Election Microscope Rooms and the Standby Generator Room of the Queensland Institute of Medical Research Building at the Royal Brisbane Hospital, generally in accordance with Spec. No. P780/77, accompanying Drawings and as per the attached proposal.....\$ 38,834.00

PRICE NETT EXCLUDING SALES TAX.

Subject to confirmation
before acceptance of order

Carrier Air Conditioning Pty. Limited

per

J. McCoth
Manager

SPECIFICATION

APPENDIX (SUB-CONTRACT)

This Appendix forms part of the Specification.

PLACE: ROYAL ERISBANE HOSPITAL
 BUILDING: QUEENSLAND INSTITUTE OF MEDICAL RESEARCH
 WORK: AIR CONDITIONING AND MECHANICAL SERVICES INSTALLATION

1. WARRANTY

Works for which a warranty is required	Period of Warranty	Percentage of Sub-Contract value as security for Warranty
Q.I.M.R. - Air Conditioning and Mechanical Services Installation	12 Months	5

Reference also to Clause S15 of Special Conditions of Contract (Building).

2. The Sub-Contractor is to carry out the following works:-
 (a) A Service Visit every ...3... months (Clause).
 (b) A Filter Cleaning Service every ...3... months.
3. The Sub-Contractor to provide skilled operators for Nil... days (Clause).

Sub-Contractor to complete:-

4. SERVICE VISITS

- (a) The sum of \$400.00 has been allowed in the Total Quotation Price for the above Services as follows:

<u>Item</u>	<u>Cost per Service</u>	<u>No. of Services</u>	<u>Total Cost of Item</u>
(i) Service Visits	\$50.00	4	\$200.00
(ii) Filter Cleaning	\$50.00	4	\$200.00
Sum as allowed in Total Quotation Price			\$ 400

- (b) If Service Visits are not to be undertaken directly by the Sub-Contractor, the name and address of the nominated local representative of the Sub-Contractor is to be stated hereunder:

Name
 Address

CARRIER AIR CONDITIONING PTY. LIMITED
 Firm
 Address 26 Annerley Rd., Woolloongabba, Q. 4102
 Signature *[Signature]*
 Date 19 DEC 1977

Witness *[Signature]*

ME. - SC. - 5.75.

SCHEDULE I

This Schedule forms part of the Specification

PLACE: ROYAL BRISBANE HOSPITAL

BUILDING: QUEENSLAND INSTITUTE OF MEDICAL RESEARCH

WORK: AIR CONDITIONING AND MECHANICAL SERVICES INSTALLATION

Schedule of amounts allowed for labour and materials.

This Schedule must be completed and the amounts shown may be used for the calculation of preferences.

	Goods and Materials	Work by Contractor	Totals
Queensland:			
(a) Brisbane Statistical Division	\$ 15,977	\$ 10,202	\$ 26,179
(b) Outside Brisbane Statistical Division	\$ —	\$ —	\$ —
Any place in Australia outside Queensland	\$ 12,435	\$ —	\$ 12,435
Any place outside Australia.	\$ 220	\$ —	\$ 220
Quotation Price ..			\$ 38,834

Firm CARRIER AIR CONDITIONING PTY. LIMITED

Address 26 Annerley Rd., Woolloongabba, Q. 4102

Signature *[Handwritten Signature]*

Date 19 DEC 1977

SCHEDULE III

This Schedule forms part of the Specification

PLACE: ROYAL BRISBANE HOSPITAL

BUILDING: QUEENSLAND INSTITUTE OF MEDICAL RESEARCH

WORK: AIR CONDITIONING AND MECHANICAL SERVICES INSTALLATION

NAMES OF SUB SUB-CONTRACTORS

Electrical Installation:

Ductwork Installation:

Insulation Installation: ACTION OR APPROVED

Pipework Installation:

Acoustics Installation:

Equipment Suppliers -

..... CARRIER AIR CONDITIONING

..... WOODS OF COLCHESTER

..... D. RICHARDSON & SONS

..... BROWN & FREE

..... BROOMWIDE

..... LINDLE & MATH

Note: If Schedule III is not completed and supplied with the Quotation, the Quotation may be rejected.

Firm: CARRIER AIR CONDITIONING PTY. LIMITED

Address: 26 Annuley Rd, Weelbongatha, Q. 4100

Signature: *[Signature]*

Date: 10 DEC 1977

Witness: *[Signature]*

SCHEDULE IV

This Schedule forms part of the Specification

PLACE: ROYAL BRISBANE HOSPITAL
BUILDING: QUEENSLAND INSTITUTE OF MEDICAL RESEARCH
WORK: AIR CONDITIONING AND MECHANICAL SERVICES INSTALLATION

PRICING SCHEDULE

Table with 2 columns: Description and Price. Includes items like 'Supply and installation of A/C System', 'Fume Cupboard', 'Stairwell Press.', etc. Total Quotation Price: \$38,834.

Reference - Maintenance/Service:-

NOTE 1. If regular service has not been carried out and a clearance has not been presented to and signed by the Officer in charge of the Building, then the Department reserves the right to deduct such costs from the security for the performance of the Warranty.

NOTE 2. The Security of 5% will only be considered for release upon certification that all service/maintenance has been performed.

NOTE 3. If Schedule IV is not completed and supplied with the Quotation, the Quotation may be rejected.

CARRIER AIR CONDITIONING, PTY. LIMITED
Firm:
Address: 26 Ansonby Rd., Wetherill Park, N.S.W. 2150
Signature: [Handwritten Signature]
Date: 19 DEC 1961

Witness: [Handwritten Signature]

ME. - SC. - 5.75.

(d) Air Conditioning Installation

The Rates set forth in this Schedule are the rates applicable to the relevant Awards stated therein at 22.8.77 (Date) If any Award stated in the Schedule is not applicable to the Tenderer's tender or if there is any change in the rate stated in the Schedule between the date stated above and the Adjusted Tender Date, the Tenderer shall (1) alter any such item so affected (and initial every such alteration), so that the Awards and rates stated in the Schedule submitted by the Tenderer shall be those applicable to his tender at the Adjusted Tender Date; or (2) submit a separate Schedule completed by him to the same effect.

1. Classification of Labour	Sheet Metal Worker (1st Class) (Air Conditioning Industry)
Title of Award	Metal Industries Award (Federal)
3. Weekly Hours	40
4. Weekly Award Wage	\$141.20
5. Weekly Air Conditioning Allowance	10.60
6. Weekly Multi-Storey Building Allowance	9.75
7. Sub-Total, being the addition of Lines 4, 5, 6.	\$151.80
8. Extra payment of Annual Leave + $\frac{a \times b}{52}$ % of Line 7	2.04
$\frac{n}{260 - n} \times$ line 7 and 8 # Sick Leave, Annual Leave and Statutory Holiday Loading	26.33
10. Sub-Total being the addition of Lines 7, 8, and 9	\$180.17
11. Weekly Fares Allowance	7.00
12. Pay Roll Tax % of lines 10 and 11	9.36
13. Worker's Compensation % of line 10	7.78
14. Loaded Weekly Wage being the addition of lines 10, 11, 12 and 13	\$204.31

* If the Weekly Award Wage already has allowed for the factors in lines 5 and 6

then line 7 shall not be completed in respect of the relevant allowance

+ a represents the percentage 'loading' on pay for Annual Leave.

b represents the number of weeks Annual Leave per year.

n represents the total number of working days per year allowed for statutory holidays, annual leave and sick leave entitlement under the relevant Award.

Materials Index as defined in Sub Clause 2 (b)(ii) of Clause S. 49 shall be -

The Group Index Number for Brisbane under the heading "Mechanical Services Components" in Table 3, Price Index of Materials used in Buildings other than House Building (ref. 9, 6)

X (Labour factor) = 35
Y (Material factor) = 55

..... *J. K. Scott* Signature of Tenderer
..... 1.9 DEC. 1977 Date

SPECIFICATION

ROYAL BRISBANE HOSPITAL
QUEENSLAND INSTITUTE OF MEDICAL RESEARCH

AIR CONDITIONING AND MECHANICAL SERVICES INSTALLATION

SPECIFICATION NO. P780/77

NOTICE TO PROSPECTIVE QUOTERS :

All enquires should be directed to -
Telephone 224-5008

ALL QUOTATIONS SHOULD BE FORWARDED TO :

The Director of Contracts,
Department of Works,
Executive Building,
100 George Street,
BRISBANE....Q. 4000

I N D E X

PLACE : ROYAL BRISBANE HOSPITAL

BUILDING : QUEENSLAND INSTITUTE OF MEDICAL RESEARCH

WORK : AIR CONDITIONING AND MECHANICAL SERVICES INSTALLATION

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NOTICE.

CONTRACT DOCUMENTATION PROCEDURE.

Where the terms "Under Secretary", "Minister" or "Inspecting Officer" are used in any document or correspondence referring to the Contract they shall be deemed to mean "Superintendent", "Principal" and "Superintendents Representative".

RTI Release

ME.- Q.T.SC. - 7.77.

1.0 GENERAL

The work of this Sub-contract relates to the air conditioning, mechanical ventilation and mechanical services for the proposed Electron Microscope Rooms and the Stand-by Generator Room of the Queensland Institute of Medical Research Building located within the grounds of the Royal Brisbane Hospital.

2.0 EXTENT

The supply, delivery, installation, testing, commissioning, servicing and maintaining for a period of twelve (12) months of :-

- 2.1 Air conditioning system with associated fan coil unit, filter, ductwork, outlets, intakes, electrical wiring and controls, chilled water and steam piping.
- 2.2 Dark room exhaust system with exhaust fan ductwork, intake, electrical wiring and controls.
- 2.3 Fume Cupboard with exhaust fan, ducting, electrical wiring and controls.
- 2.4 Stairwell Pressurisation system with associated ductwork, outlets, pressure relief system, electrical wiring and controls.
- 2.5 Generator Room Ventilation System. The provision of a ventilation system with associated exhaust fan, ductwork, sound attenuators, electrical wiring and controls.
- 2.6 Mechanical Services. The provision of hot water and town gas reticulation systems complete with necessary valves and fittings etc. on the ground floor and hot water piping only on the fifth floor.
- 2.7 Compressed Air System complete with after-cooler, receiver, safety valve and all necessary interconnecting wiring and stand-by bottled air manifold system.
- 2.8 Electrical Work. Modifications to the existing air conditioning controls and switchboards, to bring on selected items of equipment under stand-by power.
- 2.9 Microscope Cooling Unit piping. The provision of piping, for the conveyance of cooling water, between the Electron Microscope and the Cooling Unit.
- 2.10 Dark Room water chilling and mixing system. The provision of a water cooling unit with necessary piping, controls, valves, pressure reducing valves, mixing valve, filters and temperature indicator.
- 2.11 Additional Work. Any additional work necessary to provide a complete operative installation in accordance with the performance guarantee requirements.
- 3.0 WORK BY OTHERS
- 3.1 Refer to "Special Conditions of Sub-contract between Contractor and Nominated Sub-contractor".

071177

3.0 Work by Others (Cont'd)

3.2 Cold Water

Cold water shall be provided by the Contractor to the points listed below :-

- (i) Microscope Cooling Unit
- (ii) Dark Room water chilling unit
- (iii) Dark Room developing trough piping system.

Connections shall be by the Sub-contractor unless stated otherwise on the drawings.

3.3 Drain Points

A drain point shall be provided in the Soiled Linen Room by the Contractor. The Sub-contractor shall connect to this drain point the condensate wastes (chilled water and steam) from the air conditioning unit.

Drain points for the Microscope Cooling Unit and the Dark Room water chilling unit shall be provided by the Sub-contractor.

3.4 Electrical

The provision of permanent electrical services for powering components of the installation as stated in Clause 25.0.

3.5 Building Work

Making of any joints or gaps in building work (other than holes and openings specifically for air conditioning equipment) air-tight or sound proof where necessary for the proper operation of the installation.

3.6 Openings

The forming of openings in ceilings, walls, and floors for air-outlets, grilles, air ducts, and piping etc. as follows :-

Location of Opening	Not by Air-conditioning Sub-contractor	By Air conditioning Sub-contractor (additional to work elsewhere specified)
In <u>ceilings</u> for air outlets, return air and exhaust intakes	forming of framed hole or a hole formed to suit the ceiling provided	-
In <u>internal walls</u> (a) for air outlets and return air and exhaust grilles	forming of framed hole	-
(b) for passage of air ducts	forming of framed hole	Making good between frame and duct as elsewhere specified
(c) for pipes and conduits	forming of hole	

3.0 Work by Others (Cont'd)

3.6 Openings (Cont'd)

<u>In external walls</u>	Forming hole and supply and installation of discharge or intake grille with flashing; grille frame shaped suitably for duct connection where appropriate. Also supplying and installing bird wire backing to grilles except over areas to which ducts are connected or over which blanking off panels are fixed by the Air conditioning Sub-contractor.	Installing ducting and connecting to grille where appropriate; supplying and fixing bird wire to grilles over areas to which ducts are connected; supplying and fixing blanking off panels behind grilles where shown on drawings.
--------------------------	---	--

NOTE: The Sub-contractor shall supply drawings showing the position, size and other relevant details of all openings required.

3.7 Drip Tray

The provision of a permanent drip tray located below the services pipes passing through the Electron Microscope Room. The drip tray shall be drained to waste.

3.8 Self Closers

The provision of doors with self closers so that there are no permanent openings between air conditioned and un-air conditioned spaces.

3.9 Acoustic Lining

The provision of acoustic lining to the stand-by generator room (by future contractor).

3.10 Stairwell Pressurisation Fan Support Frame

The provision of a suitable structural frame, spanning the gap between the building and the retaining wall, to mount the stairwell pressurisation fan upon. Additional framing to suit the fan quoted shall be provided by the Sub-contractor.

3.11 Safety Mesh

The provision of a suitable safety mesh spanning the gap between the building and the retaining wall.

3.12 Generator Room Exhaust

The provision of a hole in the structural roof of the stand-by generator room.

3.13 Generator Room Intake and Exhaust

Air Intake

The provision of weatherproof louvres and suitable brick enclosure to house air-intake attenuators as shown on the drawings.

Air Exhaust

The provision of weatherproof louvres and suitable brick enclosure over the air exhaust attenuators as shown on the drawings.

071177

3.0 Work by Others (Cont'd)

3.14 Stairwell Windows

Removing the existing windows and frames and leaving an aperture suitable for the installation of the supply and return air grilles, shown on the drawings.

3.15 Bench Top Services

The forming of holes in bench tops, and elsewhere, for the fitting of outlets for town gas and any other services outlet.

3.16 Outlet Fittings

The supply and installation of hot water outlet fittings and all pipework to these fittings from and including the isolating valves shown on the drawings. Procedure shall be as follows :-

- (a) For all hot water outlets the Contractor shall supply and install the following :-
 - (i) the outlet fitting
 - (ii) a valve to isolate the outlet fitting
 - (iii) piping between the isolating valve and the fitting.
- (b) The Sub-contractor shall run piping to the indicated position of the fitting isolator. This shall be connected to the isolator by the Contractor.
- (c) The Sub-contractor shall be responsible for making all necessary arrangements with the Contractor so that the length of piping left by him is sufficient for ready connection to the isolator.

3.17 Making the stairwell fire isolated and sealed to allow pressurisation in accordance with Local Authorities requirements.

3.18 The provision of personnel/access doors, to the stand-by generator room, with acoustical properties to suit the remainder of the treatment to the stand-by generator room.

4.0 DRAWINGS

The drawings attached to the specification are as listed in Annexure 1. It is the responsibility of the quoter to obtain any additional information or plans considered necessary to enable a quotation to be submitted.

5.0 STANDARDS

The following Department Standards set out the Departments requirements for design, quality of materials and standards of construction and are applicable to this installation. All work shall be carried out in accordance herewith.

- SM1 - Standard Requirements for Mechanical Installations.
- SM2 - Supply and Installation of Low Pressure Ductwork
- SM5 - Insulation and sound absorption treatment of ductwork and air handling equipment.
- SM6 - Surface preparation and coating for corrosion protection.

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6.0 ARRANGEMENT

6.1 Existing Installation Arrangement

The existing air conditioning installation is arranged as a fully automatic and unattended installation controlled, in general, from a central control station located on the ground floor where shown on the drawings.

The switching on of any conditioner or number of conditioners brings the conditioner, or conditioners, into fully automatic operation.

Certain conditioners run for 24 hours a day whilst the remainder run for normal working hours. To guard against the latter being left running overnight, should the staff forget to turn them off, a time clock actuated switch briefly interrupts the supply to the central control station at approximately the following times :-

5 p.m., 8 p.m., 10 p.m., and 11 p.m.

With this arrangement it is necessary for the staff to start the systems at the beginning of the day, and again after each of the times stated above, if work continues after normal working hours.

By means of a "stop" switch each system can be stopped at an earlier time if required.

6.2 New Installation Arrangement

(a) Controls

The air conditioning unit and dark room exhaust fan shall run simultaneously and be controlled as described in Clause 6.1. for normal working hours.

All control wiring shall be run from the main air conditioning switchboard to the new switchboard located in the Soiled Linen Room. All necessary control equipment for the new installation shall be mounted on the new switchboard unless stated otherwise elsewhere in the specification or on the drawings.

The air conditioning unit shall be of the single zone type with space temperatures being maintained by controlling the flow of chilled water and steam through modulating valves under the control of a remote temperature sensor. Controls shall be of the electronic type with the sensor remote from the controller. The controller shall be mounted on the new switchboard and shall be fitted with a gauge, calibrated in °C., to indicate the temperature being maintained.

Provisions shall be made for set-point adjustment at the controller only.

(b) Control Panel

A control panel shall be provided and located alongside the existing control panel in the existing air conditioning plantroom. To avoid confusion of operation, by the staff, the new control panel shall match the existing control panel as closely as possible with regard to such items as layout, type of switches used, clear panel in door, engraving and colouring etc.

6.0 Arrangement (Cont'd)

6.2 New Installation Arrangement (Cont'd)

(b) Control Panel (Cont'd)

The new air conditioning unit shall be designated AC/G to conform with existing conditioner coding.

Refer elsewhere in the specification for other items of equipment to be included on the control panel and unit designation.

(c) Fire Shut Down

The existing arrangement for automatically shutting down certain components of the installation, upon the detection of a fire, shall be extended to include the new air conditioning and ventilation installation :-

(i) On receiving a fire signal all supply air fans powered through the board receiving the signal shall be shut down.

(ii) Exhaust fans shall not be shut down. They shall be kept running to assist in keeping the various areas clear of smoke.

(d) Installation Protection and Testing

(i) Overload protection for all motors shall be provided.

(ii) Test switches shall be provided to permit any motor to be run on test.

(e) Fault Indication

Provide on the fascia of the new switchboard red fault lights, consisting of neon type lights, connected across the contacts of all protective devices to assist in making clear the reason for plant stoppages. On the control panel described in Clause 6.2 (b) provide a flashing red light to be alight if any fault registers.

(f) Chilled Water Supply

This shall be provided by connecting into the existing piping at the location shown on the drawings.

Flow temperatures are :-

Supply water temperature = 6.1°C

Return water temperature = 11.7°C

(g) Steam and Condensate Supply

Steam shall be provided by connecting into the existing piping at the location shown on the drawings.

Steam pressure is 275 kpa

Condensate shall be drained to waste.

(h) Motor Starting

Automatic starting current limiting devices shall be provided to limit motor starting currents to values acceptable to the Supply Authority. Subject to this all equipment shall start O.O.L.

7.0 ARRANGEMENT OF FUME CUPBOARD

The fume cupboard shall be built to a proven and developed design and be of a type in regular current production. The cupboard shall be of the approximate dimensions :-

Width - 900 mm

Depth - 600 mm

Height - 1800 mm

The cupboard shall be box like in external appearance with vertical rectangular side and front panels. The cupboard shall rest on a bench provided by others and the floor of the cupboard shall be arranged so that it is at the required height above the finished floor level.

The fume cupboard shall be fabricated from rigid P.V.C., welded throughout. Side and front vertical members shall be in one piece to give a smooth, well finished appearance. The cupboard shall be arranged so that it finishes neatly against the false ceiling, which is at a height of 2700 mm (approximately) above the finished floor level.

The cupboard shall be complete with :-

- (i) Stainless Steel bench top
- (ii) fluorescent lighting fitting
- (iii) built in, single phase, P.V.C. axial flow fan.
- (iv) On/off switches and running light

Baffles are not required.

The door shall be of the sash type and of clear acrylic sheet. It shall slide vertically in a special P.V.C. extrusion and shall be carefully balanced for easy operation

8.0 ARRANGEMENT OF STAIRWELL PRESSURISATION SYSTEM

The Stairwell Pressurisation system shall start up automatically upon the detection of a fire anywhere within the building. A separate sub-board shall be provided for this system and shall be located within the Soiled Linen Room. Cables for powering the system shall be provided by others, see Clause 25.0. Cables for starting the system shall be arranged as described in Clause 6.2 (c).

Sub-mains and all wiring to the system fan shall be carried out in M.I.M.S. cabling and shall be installed according to best practice and as recommended by the cable manufacturer.

Provide test buttons so that the system fan can be run on test.

On the control panel described in Clause 6.2 (b) provide a red light, labelled STAIRWELL PRESSURISATION FAN RUNNING, to be alight whenever the system is called upon to run. Upon receiving a start signal the fan shall run continuously until manually stopped by a switch located on the control panel.

8.0 Arrangement of Stairwell Pressurisation System (Cont'd)

The system shall be arranged so that the increase in pressure, within the fire stair with all doors shut and the fan running, shall not exceed 50 Pa. For this purpose supply and carefully adjust sets of balanced automatic dampers set to open when the pressure at the dampers reaches 50 Pa.

8.1 Stairwell Pressurisation System Ducting

As shown on the drawings the Stairwell Pressurisation System is located externally to the building and in full view of the public.

The Sub-contractor shall take special care to ensure that all supply and return ducting required for this system is installed in such a manner that is acceptable to an observer. Where possible stiffening and support angles shall be concealed from view and all duct sections and cross-broken panels shall match.

9.0 ARRANGEMENT STAND-BY GENERATOR ROOM VENTILATION SYSTEM

9.1 Ventilation System

The stand-by generator shall be provided in the near future as work under a separate Contract.

The following arrangement shall be so installed that upon the installation of the future stand-by generator the "then-installed" arrangement can easily be completed to give the required performance.

The ventilation fan shall be arranged to start up automatically when the stand-by generator starts up. A separate sub-board shall be provided for this system and shall be located near the fan.

A 24 V. direct current supply shall be run by the future Standby Generator Contractor to the Sub-board where it shall be connected to a relay supplied and installed under this Sub-contract. The relay shall be energised whenever a call is being made for the standby generator to run and so start the ventilation fan.

For the purpose of completing the work under this Sub-contract (i.e. testing and commissioning etc.) the ventilation fan shall be operated by a remote switch connected to the relay described above.

Provide a separate temperature sensor located within the generator room, with wiring etc. to raise an alarm should the room air temperature exceed 40°C. The alarm shall consist of a gong type bell located within the garage and an indicating light on the control panel.

Provide a normal-off-test switch by means of which the fan can be turned off or made to run for test purposes. In the normal position the fan shall be under the control of the relay described above.

9.2 Sound Attenuators

The Sub-contractor shall supply and install sound attenuators to suit the layout shown on the drawings. The performance of the attenuators shall be as stated in Annexure 2. Care shall be taken to ensure that all attenuators are sealed air tight against the surface with which they abutt. Attenuators SA2 and SA3 shall be supported, at one end, from the floor as shown on the drawings.

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10.0 ARRANGEMENT OF MECHANICAL SERVICES

Mechanical services shall be supplied and installed in accordance with the arrangements shown on the drawings.

Note that new hot water services shall be provided within the Radio-Activity Suite on the 5th Floor (refer to the drawings for details).

General installation details shall be in accordance with Clause 24.0.

11.0 ARRANGEMENT OF COMPRESSED AIR SYSTEM

The Sub-contractor shall supply and install a fully self contained, packaged type air compressor unit suitable for delivering air at "instrument standard".

The capacity, pressures, components etc. shall be as set out in Annexure 2.

The compressor shall be of the oil free, self lubricating carbon ring type mounted on a horizontal receiver.

The installation shall be complete with, safety valve, motor starter, control equipment, interconnecting wiring, water lines and drains and all other equipment, whether especially mentioned or not, necessary for the effective and efficient running of the installation.

11.1 Manifold System

Along side the air compressor unit provide a manifold system capable of giving compressed air from bottles provided by Q.I.M.R. This system shall be used in the event of the air compressor unit being off-line for prolonged periods of time due to failure or shortage of spares etc.

The manifold system shall incorporate the following :-

- (i) Provision for the connection of one cylinder via flexible tubing.
- (ii) Provision for pressure reduction.
- (iii) Manual change-over by means of isolating valves.
- (iv) Pressure gauge points to indicate the pressures in the manifold and the connection point to the reticulation.

12.0 ARRANGEMENT OF MODIFICATIONS TO EXISTING AIR CONDITIONING SWITCHBOARDS

12.1 Existing Arrangement

The existing installation is made up generally as described in Annexure 4 and the whole installation is able to run on normal electrical supply only.

12.2 New Stand-by Generator

It is proposed that a Stand-by generator be installed in the near future as work under a separate Contract.

12.3 Modifications to Existing Arrangement

The existing switchboards serving the installation described above shall be modified to bring on most items of equipment under stand-by electrical supply conditions.

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12.0 Arrangement of Modifications to Existing Air Conditioning Switchboards (Cont'd)

12.3 (Cont'd)

As described in Clause 25.0 the Electrical Services Sub-contractor shall provide two, 240V, two wire control circuits. One to indicate that normal supply is available and one to indicate that stand-by supply is available.

The required air conditioning switchboards shall be modified so that upon the indication that stand-by power only is available the whole of the existing (and new) air conditioning and mechanical services installation shall continue to run EXCEPT for the following items :-

- (i) Water Chillers
- (ii) Primary chilled water pumps
- (iii) Secondary chilled water pumps
- (iv) Condenser water pumps
- (v) Cooling Towers
- (vi) Electric zone heaters - All air conditioners.
EXCEPT CONDITIONER AC/7 (b)
- (vii) Heating, cooling and humidity control circuits -
All air conditioners
EXCEPT CONDITIONER AC/7(b)
- (viii) Ground Floor Plantroom Vent system V2.
- (ix) Workshop Exhaust system V3.

Under this arrangement air conditioning units will serve to ventilate only - except AC/7 (b) which shall heat and humidify.

12.4 Start-up Under Stand-by Power Conditions

The present arrangement for manual starting shall be maintained for both 'normal' and 'stand-by' conditions. Manual starting whilst under stand-by power conditions shall prevent the stand-by generator from being overloaded and give the staff the facility to leave off unnecessary conditioners if they so desire.

12.5 AS Installed Drawings

As installed drawings for power and controls schematics and equipment locations are available for inspection at the office of the Consulting Engineer. Quoters shall give adequate notice of their intention to inspect the drawings.

12.6 Stand-by power Indication

On the control panel described in Clause 6.2 (b) provide indication lights, of approved colour, and engraved instructions as set out on the drawings.

The engraving shall generally be in accordance with the rest of the control panel except that the framing and main title shall be coloured red. Proportions shall be arranged to suit the layout of the control panel.

12.0 Arrangement of Modifications to Existing Air conditioning Switchboards (Cont'd)

12.7 Fault Alarm System

At present a fault alarm system exists where-by a fault in the following systems raises an alarm in the main Royal Brisbane Hospital, P.A.B.X. room :-

AC/1 (a), AC/1 (b), AC/2, V4, V6, V7, V8 and AC/7 (b).

This system shall be utilised so that upon the change over from normal to standby supply the same alarm is raised. This arrangement shall have the benefit of bringing attention to the fact that the generator is running, say over the weekend period, and initiating action before the generator runs out of fuel.

13.0 ARRANGEMENT MICROSCOPE COOLING UNIT PIPING

The Electron Microscope cooling unit shall be unpacked and moved into its location within the Ground Floor air conditioning plantroom by the Sub-contractor.

Ventilation ducting, cold water and drain connections shall be made, by the Sub-contractor, as shown on the drawings.

The closed-loop cooling system piping, between the Electron Microscope and the Cooling Unit, shall be provided by the Sub-contractor and arranged as shown on the drawings.

The piping shall be in 15 mm copper with at least 150 mm high pressure hosing at each end. The lengths of copper piping shall be insulated in accordance with the specification.

The drain connection shall consist of copper piping with 150mm flexible piping and shall be 1000 mm long overall (maximum) and arranged as shown on the drawings. Care shall be taken to prevent the drain pipe from sagging and thus creating an increase in back pressure which will cause the water tank to overflow.

All necessary recommended external accessories shall be supplied and fitted within the cooling unit by the manufacturer. The mains cold water service shall also have a 150 mm length of high pressure hosing and be connected in a similar manner to the cooling water piping.

It shall be the full and final responsibility of the Sub-contractor to closely liaise with the manufacturer of the Cooling Unit to ensure that the installation is in accordance with their requirements.

The Electron Microscope shall be unpacked and moved into its location within the Electron Microscope room by the manufacturer, PHILIPS-Scientific and Industrial Equipment.

All connections to the Electron Microscope shall be by Philips.

14.0 ARRANGEMENT OF DARK ROOM WATER CHILLING AND MIXING SYSTEMS

The overall arrangement shall be as shown on the drawings.

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14.0 Arrangement of Dark Room Water Chilling and Mixing Systems
(Cont'd)

14.1 Water Chilling Set

The water chilling set shall consist of a mains pressure operated water chilling unit of the capacities stated in Annexure 5.

The set shall be located within the existing Ground Floor air conditioning plantroom and consist of an insulated pressure tank mounted on an angle iron frame with the refrigeration compressor mounted below it.

A drain shall be run to waste by the Sub-contractor and all interconnecting piping shall be insulated in accordance with the specification.

14.2 Wall Mounted Temperature Control Panel

Outlet water temperature, into the developing trough, shall be controlled by means of an adjustable thermostatic mixing valve, with dial temperature indicator gauge, and six isolating valves all mounted on a stainless steel 1200mm x 450 mm x 100 mm deep semi-recessed wall panel. All valve bodies and piping shall be hidden from view and the valve hand wheels shall be chrome plated.

Service identification shall be suitably engraved on the panel and coloured in black.

The valve arrangement shall enable the operator to choose the water source to suit the time of year as follows :-

- (i) Chilled water and hot water - summer
- (ii) Mains cold water and hot water - winter
- (iii) Any other combination to achieve the exacting temperature requirements for photographic developing.

14.3 Pressure Regulating Valves

So as to ensure balanced mixing at the thermostatic mixing valve provide pressure regulating valves, for each service, and mount these valves as close to the mixing valve as possible.

The regulating valves shall be selected to give the highest possible outlet pressure and all outlet pressures shall be equal.

14.4 Water Filters

Provide water filters in the locations shown on the drawings and to meet the performance stated in Annexure 5.

Filters shall be specially selected for the media they work in and filter bodies shall be of the in-line type with chrome plated finish.

15.0 SCHEDULE OF DESIGN CONDITIONS AND CAPACITIES

The design inside and outside conditions, loadings, minimum equipment capacities etc. shall be as stated in Annexures 6 and 7.

15.0 Schedule of Design Conditions and Capacities (Cont'd)

Each tenderer whose tender remains under consideration after preliminary examination shall be so advised and shall, within one week from the date of such notice, advise whether or not the guarantees called for in Standard Specification SM1, Clause 4, and Clause 16.0 of the Work Specification are given. To assist the tenderer in carrying out any checks that he wishes to make, the calculations of the Consulting Engineers shall be made available for his inspection.

16.0 INSTALLATION GUARANTEE

The Sub-contractor shall be understood to give a performance guarantee in respect of the installation in three parts as follows :-

PART 'A' - A guarantee of the adequacy of the capacity and size of all components; the test of this being the ability, or otherwise, of the installation to produce the required conditions as set out in the Annexures.

PART 'B' - A guarantee that the control system shall have adequate performance and be sufficiently well set up (with the system balanced) so that the required conditions are maintained.

PART 'C' - A guarantee that sound pressure levels due to components of the installation shall not exceed the following :-

air conditioned areas - NC35
other ventilated areas - NC60

All capacities, sizes, air quantities, arrangement of equipment, controls and sound insulation etc. are minimum provisions only and the Sub-contractor shall make all such further provisions, as are necessary, to meet all the guarantee requirements.

17.0 ADJUSTMENTS AND SETTINGS

The Sub-contractor shall make all adjustments and settings necessary.

See Standard Specification SM1, Clause 7.0.

18.0 DEFECTS LIABILITY AND MAINTENANCE AND SERVICE

See Standard Specification SM1, Clause 8.0.

19.0 EXAMINATION AND TESTING

See Standard Specification SM1, Clause 8.0, and also Special Conditions of Sub-contract, particularly Clause S8 - Examination and Testing.

20.0 OPERATING INSTRUCTIONS

See Standard Specification SM1, Clause 6.0.

21.0 DUCTWORK, AIR OUTLETS, INTAKES, GRILLES

21.1 Low Pressure Ductwork

See Standard Specification SM2.

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21.2 Insulation and Sound Absorption Treatment of Ductwork
See Standard Specification SM5, Type 2, Type 3 and Type 4.

21.3 Air Outlets Intakes and Grilles

- (a) See Standard Specification SM2 and the grille schedule on the drawings.
- (b) Outlets to which temperature sensors are attached shall be suitably shaped :-
 - (i) for the neat attachment of such sensors.
 - (ii) for permitting the tubing, from the sensor, to be run so as to be unobtrusive from below.
 - (iii) for permitting damper setting through the outlet face without disturbance to the sensor.

22.0 CONDITIONERS AND ASSOCIATED EQUIPMENT

22.1 General

Each conditioner shall be an assembly incorporating or having associated with it the following items :-

- Centrifugal fan with motor and drive
- Chilled water cooling coil with valves
- Steam heating coils with valves
- Air filter
- Equipment housing and connections

The conditioner assembly shall be to an established and proven design.

22.2 Fan, Motor and Drive

All fans shall be robustly constructed and stiffened. Fans shall be of makes and types that have been previously and successfully used in similar applications and that are in regular quantity production.

Each fan shall be of the centrifugal type and may be either of the forward or backward curved plate types. The fan outlet velocity shall not exceed 8.25 m/s.

(a) Housings
The housing shall be adequately stiffened to prevent vibration of the side plates and scroll. Inlets shall be curved to give an efficient air entry.

(b) Impellers
The following minimum gauges shall apply :-

<u>Runner Diameter</u>	<u>Minimum Thickness</u>
up to 300 mm	1.2 mm
Over 300 mm to 450 mm	1.6 mm
Over 450 mm to 750 mm	2.0 mm
Over 750 mm to 1000 mm	2.5 mm
Over 1000 mm to 1250 mm	3.0 mm
Over 1250 mm to 1500 mm	4.0 mm
Over 1500 mm to 2000 mm	5.0 mm

22.0 Conditioners and Associated Equipment (Cont'd)

22.2 Fan, Motor and Drive (Cont'd)

(c) Shafts

The shaft shall be amply designed so that the first critical speed is at least 130% of the normal operating speed of the fan. All changes in section of the shaft shall be carefully filleted to minimise stress.

(d) Bearings

Bearings shall be of the self aligning rolling element type selected for a life of 100,000 hours; this life to be attained or exceeded by 90% of all bearings.

(e) Finishes

The fan housing, impeller and shaft shall have surface treatment consisting of the following :-

- (A) Mechanical cleaning to give a bright metal surface free of mill scale, rust, etc.
- (B) A first coat of approved zinc rich paint
- (C) Two coats of approved tar epoxy enamel to a minimum total thickness of 0.18 mm.

Alternatively the housing may be constructed of galvabond and the impeller of steel with an approved enamel finish applied after surface preparation by bonderizing by an approved industrial process.

(f) Balancing

Each fan shall be balanced so that the dynamic out-of-balance after installation does not exceed .030 metre-grams per kg of rotor weight for rotational speeds up to and including 1,500 r.p.m. or .015 metre-grams per kg weight for rotational speeds in excess of 1,500 r.p.m.

(g) Drive

Each fan shall be driven through vee belts and grooved pulleys. Matched sets of not less than two belts shall be used; and the drive shall be designed for a horsepower not less than 150 percent of the rating of the driving motor.

(h) Motor

Each motor shall be a 415 volt 3 phase 50 Hz. squirrel cage electric motor running at not more than 1,440 r.p.m.

The fan motor shall be of the "commercially quiet" type having the next larger frame size to that specified for its rating.

Alternatively, motors of standard frame size may be employed provided that a certificate is given that the sound power levels of the motors do not exceed those set out in Annexure 8.

The motor shall be mounted on the fan casing or base and approved means shall be provided for adjusting belt tension. Guards shall be provided for all belts and pulleys.

22.0 Conditioners and Associated Equipment (Cont'd)

22.3 Cooling Coil and Valves

See Clause 6.2 (f)

The water pressure drop through any cooling coil shall not exceed 45 kPa.

The cooling coil face velocity shall not exceed 2.5 m/s.

Each cooling coil shall be of all copper or copper alloy construction with copper tubes, copper fins and brass end and side plates. The coil shall be circuited so that both flow and return connections are at the one end of the coil.

Provision shall be made for the withdrawal from the conditioner casing of all cooling coils for service, if necessary.

For controlling the flow of water through the cooling coil provide the valves, strainers etc. shown for each coil in the schematic in the drawings.

In the event of service being necessary to the motorised control valve, it is proposed that it be replaced by a short length of pipe, the flow rate being controlled manually under these circumstances. The arrangement of piping etc. shall be such as to facilitate this; and in particular provision shall be made so that the motorised valve can be removed as part of a section of piping that turns through 90°.

Provide also for each cooling coil the following:-

- (a) a 6 mm valved air vent discharging visibly into the condensate drain.
- (b) a 19 mm valved coil drain suitable for hose connection. Provide a screwed cap with washer for hose connection to prevent the possibility of water leakage from coil drain on to the floor.

Provide under the coil a copper or stainless steel tray sufficiently extensive to catch all moisture from the coils and associated valves etc. Insulate this tray externally with 25 mm expanded polystyrene or equal approved, sheet metal covered where exposed to view. From the tray run, to a trapped drain point provided where shown in the drawings by others, a 20 mm copper condensate drain insulated with 10 mm thick flexible foamed plastic pipe insulation; the drain to discharge visibly into the floor waste through a turned down elbow.

The foamed plastic pipe insulation shall be encased in 0.60 mm zinc anneal as specified for chilled water reticulation piping.

22.4 Heating Coils and Valves

See Clause 6.2 (g)

The heating coil face velocity shall not exceed 5.0 m/s.

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22.0 Conditioners and Associated Equipment (Cont'd)

22.4 For long life each heating coil shall be of high pressure construction (rated to 2,000 kPa, and 230°C and shall consist of copper finned cupro-nickel tubes within a double flanged heavy thickness galvanised steel casing. The coil shall be pitched to ensure proper condensate drainage.

Provision shall be made for the withdrawal of all heating coils for service through an opening in the side of the conditioner or duct, normally sealed with a coverplate.

To prevent sweating of the sections of ducting housing heaters (during the cooling season) all such sections shall be externally insulated; the insulation being sheet metal covered for appearance purposes.

For controlling the flow of steam to each cooling coil provide the valves, strainers and traps etc. shown for each coil in the schematic in the drawings.

Make provision for replacement of the motorised steam control valve with a length of piping (to permit this valve to be serviced) as specified in the case of the cooling coil.

In the base Quote allow for heating coils having the following features:-

- (a) floating core construction in which the coils are free to expand and contract without the tubes moving in relation to tube sheets or other tube supports.
- (b) construction that does not incorporate return bends.

An alternative may be submitted for heating coils having tube sheets with formed collars to protect tubes from wearing and cutting as they expand and contract and with return bends made by a process that does not reduce the wall thickness of the tubes.

23.0 WATER CIRCULATION AND RETICULATION SYSTEMS

23.1 Chilled Water System

(a) General

The maximum water velocity through piping shall be 2.75 m/s. All piping, pipe fittings, etc., forming this system shall be suitable for a working pressure of 1,000 kPa. Steel piping cylinders, etc., shall be suitable for a working pressure of 1,000 kPa after making an allowance of 1 mm for corrosion.

(b) Piping and insulation

Chilled water piping shall be installed in black steel tested heavy duty tubing with welded joints.

Dark Room chilled water and Microscope Cooling Unit water shall be insulated as for chilled water. All chilled water piping shall be insulated with expanded polystyrene (self extinguishing type) applied in moulded sectional form, and joints staggered; one half section overlapping the next opposite half section by at least 75 mm so that complete circumferential joints are avoided.

23.0 Water Circulation and Reticulation Systems (Cont'd)

23.1 Chilled Water System (Cont'd)

(b) Piping and Insulation (Cont'd)

Sections shall be adhered to the pipe and to each other with an approved waterproof adhesive compound formulated for the particular material, suitable for the service temperature and containing only non-flammable solvents.

The insulation shall be secured by 13 mm wide by 0.5 mm straps of galvanised steel or aluminium spaced at not more than 525 mm centres and no strap shall be further than 225 mm from any section joint.

Insulation thickness shall be as follows :-

<u>Nominal Pipe size</u>	<u>Insulation Thickness</u>
less than 30 mm	25 mm
30 mm to 100 mm inclusive	40 mm
over 100 mm	50 mm

All chilled water pipe insulation as above shall have a vapour barrier applied with a permeability not exceeding 0.01 perms. This shall be applied as follows (or equal approved).

After fixing the insulation, all voids in the surface shall be filled with "Foster Foamseal 30-45" plastic filling compound.

The entire surface shall then be sealed with one coat of "Foster Fire Resistive Mastic 65-05" applied by rubber gloving at the rate of not more than 0.61 m²/litre. Into this wet coat a single layer of open weave glass fabric cloth, 0.1 mm thick and weighing approximately 50 g/m², shall be laid. The cloth shall be drawn smooth and tight with all joints lapped not less than 50 mm. A second coat of "Foster Fire Resistive Mastic 65-05" shall then be applied, by gloving, at the rate of not more than 0.30 m²/litre.

NOTE: As this vapour barrier is to be applied over polystyrene insulation, a coat of "Foster Soalfas 30-36" shall be applied, by brushing, at a rate of not more than 1.0 m²/litre before the first coat of "Foster Mastic 65-05" is applied. The "Soalfas" shall be allowed to dry through (approximately 15 hours) before the subsequent coating is applied.

Allow the Foster Mastic 65-05 to dry through (approximately 6 days) before sheathing as specified below.

After application of the insulation and vapour barrier the piping shall be encased in zinc aneal of not less than 0.6 mm with folded joints or secured with stainless steel straps at not more than 450 mm centres, as appropriate. SELF TAPPING SCREWS WHICH MIGHT PUNCTURE THE VAPOUR BARRIER SHALL NOT BE USED. At bends the metal casing shall be cut and formed into lobster back segments.

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23.0 Water Circulation and Reticulation Systems (Cont'd)

23.1 Chilled Water System (Cont'd)

(b) Piping and Insulation (Cont'd)

Where packing pieces are used at pipe support points they shall be of wood of an approved rot-proof species or of hoop pine treated with three brushed on applications of 20% copper naphthanate solution applied at intervals of not less than three days.

The packing pieces shall be sufficiently wide so that the stress on them is within the permitted working stress for the kind of wood used; but they shall be not less than 50 mm wide measured in the direction of the run of pipe. The vapour barrier specified above shall be continuous over the packing pieces. Provide heavy gauge G.I. sleeves to protect the vapour barrier from pressure from the supports; the sleeves bell-mouthed at each end to guard against puncturing of the vapour barrier.

Insulate fittings with expanded polystyrene cut to shape, secured in place and vapour proofed as above; with enclosing sheetmetal boxes.

23.2 Valves

(a) For Isolating, balancing and check valves and valves for vents and drains see clause 25.11.

(b) Motorised control valves

These shall be selected to suit the arrangement described in Clause 6.2 (a). All valves shall be carefully sized so that they exercise control over the full working stroke.

Valves up to and including 50 mm diameter shall have screwed bronze bodies; over 50 mm flanged cast iron bodies.

Valves shall be of a make and type specially designed as motorised control valves. Valve plugs shall be specially shaped to give an equal percentage or other approved characteristics. Valves shall be of the normally closed bronze trimmed type.

23.3 Pipe Strainers

Provide strainers immediately upstream from all automatic control valves. Strainers shall have a dutch weave monel wire filtering screen of a mesh sufficiently fine for collecting all material capable of damaging the seats of these valves; and be fitted with full bore blow-off valves fitted to the screen caps. Provide a termination to the blow-off valve suitable for hose connection with screwed cap and washer.

Make provision for the temporary insertion, during the commissioning period of metal screens at the suction side of all pumps. Each screen shall be capable of arresting all pipe debris large enough to damage the pump and shall be inserted within a sheet section of flanged piping capable of being removed and replaced.

23.0 Water Circulation and Reticulation Systems (Cont'd)

23.4 Provision for Disconnection of Piping from Equipment

To facilitate the disconnection of piping from equipment all connections to equipment shall be made by flanged joints or unions.

23.5 Water Temperature Measurement

Provide pockets in piping for the insertion of glass stem thermometers at the inlet and outlet of the cooling coil.

These shall be designed for a 380 mm long thermometer and shall consist of a 17 mm diameter tube with a screwed end and plastic cap extending at least 50 mm beyond the pipe or its insulation.

They shall be set into the pipe at an angle of 30° to the axis of the pipe suitable for filling with a liquid.

In pipes smaller than 50 mm diameter a 300 mm long section of 50 mm diameter pipe shall be included for the pocket with eccentric reducers to allow draining.

23.6 Pressure Tappings

Provide valves tappings for making water pressure readings on both sides of the following :-

- all cooling coils
- all motorised water control valves

All tappings shall be positioned to give pressure drops over coils, pumps or valves only; excluding the pressure drops over associated valves, strainers, etc.

23.7 Provision for Draining System and Air Venting

For draining the system provide 19 mm valves at low points of the system suitable for hose connection. Provide cap with washer for each valve to prevent possible water leakage from valve .

At the bottom of any riser in which dirt may collect provide 25 mm diameter dirt legs with 19 mm valves suitable for hose connection. Provide screwed cap with washer for hose connection.

All sections of pipework in which air may collect shall be vented with 6 mm vents at high points. Vents shall be valved at hand height and discharges shall be fitted with tundishes drained to waste.

24.0 STEAM, HOT WATER AND CONDENSATE SYSTEMS

24.1 Piping

Refer to Clause 25.5

24.0 Steam, Hot Water and Condensate Systems (Cont'd)

24.2 Insulation

All steam condensate and hot water piping shall be insulated with preformed sectional mineral wool or glass fibre having a thermal conductance (K factor) not greater than -

0.035 W/mK at 24°C

and 0.065 W/mK at 177°C.

Insulation shall be factory bonded to fire resistant reinforced double sided aluminium foil (Sisulation 450 or equal approved) with provision to overlap longitudinal joints of the foil; the overlap stuck down with a 100% coverage of an approved fire resistant adhesive. Cover all circumferential joints with 75 mm wide aluminium foil (as specified above), similarly adhered.

Insulation thickness shall be as follows :-

Condensate lines - 25 mm

Steam and Hot Water Lines

<u>Nominal Pipe Size</u>	
Less than 32 mm	25 mm
32 mm to 100 mm	40 mm
Over 100 mm	50 mm

All insulation shall be encased in 0.6 mm zinc anneal with longitudinal and circumferential joints lapped not less than 40 mm, with the longitudinal laps downward to shed water; the casing held in position with galvanised steel straps and clips at not greater than 450 mm centres or bright zinc plated steel self tapping screws at not greater than 225 mm centres. At bends the metal casing shall be cut and formed into lobster back segments, secured as above.

Valves, flanges and unions shall not be insulated and adjacent insulation shall be neatly coned down.

Approved metal spiders shall be used at all pipe clamps and suspension points of insulated piping; filled with plastic insulation before installation.

24.3 Valves

(a) Isolating valancing and check valves - See Clause 25.11

(b) Motorised control valves

Valves up to and including 50 mm diameter shall have screwed bronze bodies; over 50 mm flanged cast steel bodies.

Valves shall be of a make and type specially designed as motorised control valves. Valve plugs shall be specially shaped to give a modified linear or other approved characteristic.

Valves shall be of the normally closed stainless steel trimmed type.

24.0 Steam, Hot Water and Condensate Systems (Cont'd)

24.4 Steam Traps

These shall be of the balanced pressure thermostatic type of Spirax manufacture or equal approved.

Where necessary for the proper operation of the trap provide a short collecting leg before it.

Provide a union on either side of every trap.

24.5 Strainers

Strainers shall be provided ahead of all pressure reducing valves, motorised control valves, traps, etc.

Strainers shall have approved stainless steel screens.

24.6 Provision for Disconnection of Piping from Equipment

To facilitate the disconnection of piping from equipment all connections to equipment shall be made by flanged joints or unions.

24.7 General

All branches from horizontal steam lines shall be taken from the tops of the horizontal lines.

In general steam lines shall be run with a fall in the direction of flow and shall be drained of condensate at all low points. At such drain points provide either steam separators or pockets; the pocket having a diameter equal to the diameter of the pipe. Steam lines shall also be drained of condensate at the base of each riser.

Provide automatic air vents with isolating valves and unions at the tops of each riser; the air vents connected into the condensate return line vents.

All condensate from heaters and from traps draining steam supply lines shall be collected by the condensate return system which shall be run with a continuous fall to waste as shown on the drawings.

The maximum steam velocity through piping shall be 35.5 m/s. and the maximum pressure loss rate shall be 230 Pa/m. of equivalent pipe length.

Though a steam pressure of 275 kPa is mentioned in Clause 6.2 (g), this pressure may be lowered if considered more satisfactory or better suited taking into account the characteristics of the equipment offered by the Quoter.

25.0 PIPING, VALVES, DIAGRAMS, MARKERS AND INSTRUMENTS

25.1 General

All work shall comply with this Clause unless special requirements are set out in the section covering the relevant part of the installation.

25.2 Piping

(a) General

The drawings indicate the general arrangement and method of running the various systems of pipework only - all

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25.0 Piping, Valves, Diagrams, Markers and Instruments (Cont'd)

25.2 Piping (Cont'd)

(a) General (Cont'd)

work shall be installed in an approved manner to meet structural and architectural conditions, and to avoid interference as far as possible with the work of other trades, all subject to the approval of the Superintendent's Representative. It shall be the responsibility of the Sub-contractor to co-ordinate fully with other trades, and in particular with other trades installing pipework adjacent to the pipework covered in this specification to ensure that the finalised arrangement of pipework is the best possible and that access for future maintenance, etc. is adequate and to the approval of the Superintendent's Representative. Any pipe that cannot be concealed shall be referred to the Superintendent's Representative before installation.

Where pipe sizes are indicated on the drawing these shall be the minimum sizes acceptable. Where pipe sizes are not indicated, determine the size of the pipe so that it will be of adequate size for the duty required. All pipe sizes shall be subject to approval.

All pipework shall be constructed so that it will be free for contraction and expansion so that it will not damage any other work or effect injury to itself.

Special care shall be taken in the arrangement of piping to secure neat and workmanlike appearance and true alignment and grade. Crossovers shall be kept to a minimum. All pipes shall pass through walls at right angles.

Exposed runs of pipework shall be supported so that a clear space of not less than 50 mm is left between the pipe or insulation and the nearest wall, ceiling or other surface.

All pipes and fittings shall be thoroughly cleaned before erection removing all scale, burrs, fins and obstructions and where necessary, blown through internally after erection.

Pipework shall be isolated from vibration by approved flexible connections where necessary.

Small bore pipework shall be protected from mechanical injury by the use of backing boards, conduits or other approved means. Backing boards shall be of first class dressed timber painted or varnished prior to erection of pipework.

The drawings indicate the approximate position only of all outlets. Final position of all outlets, etc., shall be determined on site.

25.3 Grading Venting and Draining

Piping shall be true to grade. Sagging piping that will trap liquid or air will not be accepted.

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25.0 Piping, Valves, Diagram, Markers and Instruments (Cont'd)

25.3 Grading Venting and Draining (Cont'd)

Wherever possible, horizontal piping shall be graded down in the direction of flow; except for pipes carrying water which shall be graded upwards in the direction of flow except where running with other services when, for appearance purposes, water piping shall be run to the same grade as the others.

Wherever possible the grade shall be at least 1 in 200.

- (i) Water Lines - provide air vent at all high points. Where there are branch lines serving outlets these shall be graded upwards to vent through the outlets.
- (ii) Steam Lines - provide steam trap assemblies at all low points.

Branches for connection to equipment and branch lines shall be taken off the top of the steam main.

- (iii) Steam Condensate - lines shall be graded down.

- (iv) Compressed Air Lines - provide automatic or manual valves drain points at all low points.

At all vent and drain points provide risers and pockets respectively to which the vent or drain shall be connected. Each riser and pocket shall have a diameter equal to the diameter of the pipe on which it is formed and shall be not less than 150 mm high in the case of risers and 300 mm deep in the case of pockets. Fit manual or automatic valves to all risers and pockets as specified. Vents and drains shall discharge visibly to tundishes or other waste.

Provide drain cocks at all low points in water systems to permit draining. Each cock shall be suitable for 13 mm hose connection for draining to waste.

All portions of equipment in which water may collect shall be drained to waste. Drains shall be connected to equipment with unions to facilitate cleaning.

25.4 Pipe Supports

Hangers, supports, brackets, etc., shall be of approved design and shall allow for expansion of pipe lines and shall have provision made for adjusting grade and alignment.

Where possible parallel runs of pipes shall be grouped on pipe racks. Racks shall consist of shaped steel frames and the pipes shall be carried in saddles bolted or screwed to the racks. All racks, hangers and other supports shall have inserts on which the pipes shall rest. Inserts shall be of neoprene or other similar approved material where pipes do not get above ambient temperature and of asbestos webbing where they exceed this temperature.

Supports for vertical pipe lines shall be designed so that the weight of the pipe is positively supported in a way that does not depend on a friction grip on to the pipe.

25.0 Piping, Valves, Diagram, Markers and Instruments (Cont'd)

25.4 Pipe Supports (Cont'd)

Brackets shall also be provided as necessary to prevent the piping from swaying and vibrating. The spacing of supports and/or brackets shall not exceed one and a half times the spacings for horizontal piping set out below for piping of the same material and size.

All pipework which remains at about ambient temperature such as compressed air, gases, cold water, drains, overflows, fuel oil, etc., may be clipped to fixed supports or may be supported from flexible hangers. The method of support adopted shall suit the location of the pipes.

All pipework in which significant variations from ambient temperature occurs, such as steam, condensate, hot water pipes, etc., shall be secured at intervals not exceeding 20 m by anchors in the case of both horizontal and vertical pipes. Provision for expansion between anchors shall be made by bends, loops or other approved means. Between anchors, provision shall be made as follows for movement of piping :-

Horizontal Piping

Piping shall be hung from steel rods with pivots at both ends; the rods having diameters as follows :-

<u>Pipe Diameter</u>	<u>Rod Diameter</u>
to and including 50 mm	10 mm
75 mm	13 mm
125 mm	16 mm
150 mm	19 mm
250 mm	22 mm

Where the amount of expansion is excessive for the length of rod that can be accommodated or where support form above is not possible, the piping shall rest on rollers.

Vertical Piping

The piping shall be restrained from moving horizontally by guides which do not restrict its vertical movement caused by expansion. A section of straight vertical pipe so long that vertical support is necessary additional to that given by the section anchor shall be supported by springs or other approved form of flexible support so designed that the maximum expansion due to temperature change does not exceed 25% of the extension of the spring due to its loading.

Springs shall have a minimum additional travel from design deflection to solid of not less than 50% of the design deflection where the design deflection is not more than one inch; and 30% of the design deflection where the design deflection is greater than one inch. Each spring shall have a pointer and scale for indicating the spring deflection. Where the spring diameter is less than 0.8 times the compressed height of the spring at design load, the spring shall be enclosed on all sides by a robust housing.

25.0 Piping, Valves, Diagram, Markers and Instruments (Cont'd)

25.4 Pipe Supports (Cont'd)

Drawings or samples of all anchors, hangers, clips, etc., shall be submitted for approval prior to commencement of erection.

Hangers or other approved supports for horizontal pipe lines shall be spaced at intervals not greater than the following :-

. Steel Pipe -

<u>Pipe Size</u>	<u>Spacing</u>
13 mm	1,800 mm
19 mm - 32 mm	2,400 mm
40 mm - 63 mm	3,000 mm
75 mm - 88 mm	3,600 mm
100 mm - 150 mm	4,200 mm
200 mm - 300 mm	4,800 mm

. Copper Pipe -

<u>Pipe Size</u>	<u>Spacing</u>
6 mm - 10 mm	600 mm
13 mm	1,200 mm
16 mm - 25 mm	1,800 mm
32 mm - 40 mm	2,400 mm
50 mm	2,700 mm
63 mm - 100 mm	3,000 mm
125 mm	3,300 mm
150 mm	3,600 mm
175 mm	4,200 mm
200 mm	4,500 mm
225 mm	4,800 mm

See also Clause 27.0 for piping connected to equipment that is spring mounted or embodies reciprocating or rotating components.

25.5 Materials

These shall be as stated in Annexure 9.

25.6 Joints

(a) Ungalvanised Steel Lines Tested Heavy Duty

All joints shall be welded to S.A.A. Specification by qualified welders. Welding shall be carried out only by persons approved by the Superintendent's Representative who may require the submission, in respect of each person proposed to be engaged, of any or all of the following :-

- . Certificate of Competency
- . Statement of Experience
- . Test pieces as directed.

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25.0 Piping, Valves, Diagram, Markers and Instrument (Cont'd)

25.6 Joints (Cont'd)

(a) Ungalvanised Steel Lines Tested Heavy Duty (Cont'd)

Flanged joints shall be made at all valves and at such other places where necessary for installation purposes in lines over 50 mm nominal diameter. Flanges shall be to the B.S. Table appropriate for the working pressure of the system but not lighter than Table 'E'; and shall be welded to the pipe. Where welded joints are impracticable in lines under 50 mm nominal diameter, approved female unions with double bronze seats may be used.

(b) Galvanised Steel Lines

Joints generally shall be screwed. Screwed flanged joints shall be made at valves and at such other places where necessary for installation purposes in lines over 50 mm nominal diameter. Flanges shall be to the B.S.S. Table appropriate working pressure of the system, but not lighter than Table 'E'; and shall be screwed to the pipe. Where screwed and socketed joints are impracticable in lines under 50 mm nominal diameter, approved female unions with double bronze seats may be used.

(c) Ungalvanised Pipes Tested Medium Tube

Shall conform to (a) or (b) above according to the application and to approval.

(d) Copper Lines

All joints shall be of the socketed type in which the joint is made by the flow of brazing alloy by capillarity along the annular space between the two mating surfaces. For making the joint either an approved capillary fitting shall be used or the end of one of the pipes shall be formed as a socket by heating and the use of approved forming tools.

The brazing alloy shall be of approved type containing not less than 15% silver.

Flanged joints shall be made at all valves over 50 mm and where necessary for installation purposes. Flanges shall be to the B.S. Table appropriate for the working pressure of the system but not lighter than Table 'E' and shall be joined to the piping as specified above.

To facilitate assembly in approved places compression unions of approved manufacture may be used in lines under 50 mm.

(e) General

Joining flanges shall be truly parallel to each other so that bolts are used only to make joints steam or waterproof and not to pull up flanges not true in alignment. All bolts and nuts shall be of materials matching the piping. For black pipe use bright steel bolts and nuts.

25.0 Piping, Valves, Diagram, Markers and Instrument (Cont'd)

25.6 Joints (Cont'd)

(e) General (Cont'd)

Compressed asbestos fibre full faced gaskets shall be used between all flanges with an approved jointing compound, except that insertion rubber full faced gasketed may be used where approved in systems with low working pressures. P.T.F.E. tape shall be used on all screwed joints.

NOTE : Joints between copper and steel piping shall be of the gasketed flanged type to prevent metal contact. All joints to equipment shall be made by flanges or unions. Piping connections to valves with screwed ends shall be made with a union on one side of the valve.

25.7 Bends and Tees

Radiused bends shall be used wherever possible. Unless specifically approved, elbows shall not be used in piping in which flow takes place continuously when the plant is in use.

Bends in steel lines shall have a radius of not less than four times the diameter.

Bends in copper lines shall have a radius of not less than five times the diameter except that a radius of not less than three times the diameter will be permitted provided the wall thickness is increased by 0.6 mm over that specified for straight pipe.

All bends shall be pulled in an approved manner and no appreciable flattening of the pipe discernable.

Tees shall be formed in the manner specified for joints - that is by welding in the case of black steel pipe. In the case of galvanised pipe screwed or flanged tee fittings shall be used - tees formed by welding shall not be accepted.

Tees in copper lines shall be capillary type using silver solder.

25.8 Pipe Sleeves and Coverplates

In all holes for pipes through concrete and masonry, copper pipe sleeves shall be set therein. Pipe sleeves through floors shall project 13 mm above finished floor level.

All holes exposed to view in areas other than plant rooms, pipe ducts and the like shall be fitted with approved chromium plated coverplates.

25.9 Plating of Exposed Piping

All exposed piping leading to fittings in rooms other than plant rooms, pipe ducts and the like shall be heavily chrome plated over nickel plating on electrolytically coppered surfaces for steel pipes and over nickel plating direct on the pipe for copper services.

25.0 Piping, Valves, Diagram, Markers and Instruments (Cont'd)

25.10 Testing

As pipe reticulation proceeds and on the completion of each section the various systems shall be tested as follows :-

As a minimum each section of piping shall be tested with the fluid to be carried or a similar approved one to a pressure equal to its working pressure plus $6\frac{2}{3}\%$ which shall be held for four (4) hours with no discernable loss. The working pressure on which this test shall be based shall be the working pressure specified for the piping system under consideration; or where no working pressure has been specified, the maximum working pressure to which the piping is likely to be subjected in use. The following requirements shall also apply :-

- as a minimum all water piping shall be hydraulically tested to 1,000 kPa which pressure shall be held for four (4) hours with no discernable loss
- all steam pipework to be tested in accordance with the requirements of the S.A.A. Code and the Queensland Division of Occupational Safety and Weights and Measures
- in particular all joints in all pipework shall be exposed at the time the test is carried out, and pipes shall not be insulated prior to testing.
- notification shall be given seven (7) days in advance in writing that tests are to be carried out, so that the persons designated may be present at such tests. The pipework will not be accepted unless this condition is met.

25.11 Valves

Valves shall be of the types set out in Annexure 10. All valves shall be the product of a well-known manufacturer and be of types in common local use. All sizes of valves of the one type shall be the product of the one manufacturer.

All valves shall be suitable for the pressures and fluids carried by the piping in which they are installed.

All valves shall close with clockwise rotation of the handwheel.

All valves shall be placed in accessible positions for operation and repairs. Provide chain wheels and chains in place of handwheels for frequently operated valves located more than 2,000 mm above floor level.

Where throttling is not required, gate or fullway valves shall be used and where throttling is required, globe valves shall be used. Gate valves shall be installed with the stem in a horizontal plane.

25.0 Piping, Valves, Diagram, Markers and Instruments (Cont'd)

25.11 Valves (Cont'd)

Valves over 50 mm diameter shall have flanged ends. Valves 50 mm diameter and under may have screwed ends. Where used in copper piping, screwed valves shall be connected to the pipe with capillary fitting screwed connectors which may incorporate a union.

The connection between each valve and the adjacent equipment shall be made with a flange or union. A union shall be provided on at least one side of every valve with screwed ends.

All valves with glands shall be fitted with gland packing of an approved type and suitable for the duty for which the valve will be used.

Before installation, every valve shall be blown out with air to remove any foreign matter lodged in the valve. All threads shall be coated with graphite and oil (except valves for medical gases including compressed air.)

Threads on all nipples (including those in copper lines) are to be tapered except only for flare compression fittings.

25.12 Pipe Diagrams, Pipe and Valve Marking

(a) In addition to meeting the requirements of Standard Specification SM 1, Clause 6.0, the Sub-contractor shall provide the items described in (b) and (c) below.

(b) Valve Labels

All valves shall have identifying labels numbered to correspond with the plantroom diagrams. Labels shall be engraved traffolyte in metal carriers. Within Plantroom labels shall be screwed or secured in an approved manner to handwheels or valve bodies. In unfinished areas such as pipe ducts, tunnels, roof spaces, etc., the labels shall be securely wired to valves.

(c) Pipemarkers

All piping, whether exposed or concealed shall have permanent pipe markers ("Brady" or "Safetyman" or equal approved) to identify piping and to indicate the direction of flow. Markers and the intervals at which they are applied shall be in accordance with A.S. - CA 21.

25.13 Instruments

(a) Pressure and Altitude Gauges

Pressure gauges shall be of approved manufacture, of the Bourdon type with concentric scales and shall comply with the requirements B.S.S. 1730 - "Bourdon Tube Pressure and Vacuum Gauges".

25.0 Piping, Valves, Diagram, Markers and Instruments (Cont'd)

25.13 Instruments (Cont'd)

(a) Pressure and Altitude Gauges (Cont'd)

Each pressure gauge shall be guaranteed as suitable for use with its respective medium whether :-
air, water, steam, or other fluid or gas.

The Bourdon tube shall be of beryllium bronze

Bezels and flanges of gauges shall be satin-chrome finish.

Gauges shall be fitted with Beryllium-bronze orifice plates to minimise the effect of fluctuating pressure and shock.

The gauge dial diameter shall suit the installation and the scale shall be graduated in kilopascals to not less than 30% above the maximum working pressure.

The accuracy of the instrument shall be such that the error in pressure indication, with either increasing or decreasing pressure, at any point above 10% and below 90% of the maximum scale graduation, shall not exceed 1% of the maximum scale graduation, and for the rest of the scale, 1½% of the maximum scale graduation.

Each gauge shall be clearly and permanently marked with the manufacturer's name or trade mark, B.S.S. 1780 and the material of the Bourdon tube.

Gauges shall be installed in the vertical position, where possible, and in a manner that will prevent the transmission of vibration to the gauge.

A bronze gauge cock, "John Fig. 73" or equal, and suitable for the service pressure and temperature, shall be provided in the pressure line to each gauge.

In addition, gauges used with steam shall be provided with an approved syphon between the tapping point and the gauge to prevent steam entering the gauge.

(b) Dial Thermometers

Dial thermometers shall be provided where shown in the drawings or where specified. They shall be of the mercury in steel type.

The dial diameter shall be as specified. Bezels and flanges shall be satin-chrome finish to match pressure gauges.

The dial thermometers shall be of the remote bulb type with a movement consisting of a direct acting, double coiled Bourdon tube, giving direct drive to the pointer without geared movement or linkages. The

25.0 Piping, Valves, Diagram, Markers and Instruments (Cont'd)

25.13 Instruments (cont'd)

(b) Dial Thermometers (Cont'd)

movement shall be compensated against ambient temperature changes and shall be provided with a zero adjusting screw.

The Bourdon tube shall be of seamless chrome-molybdenum steel tube.

The capillary tube and bulb shall be of stainless steel. The tube shall be of adequate length for the application and shall be protected by semi-flexible copper armour. The accuracy of the instrument shall be within $\pm \frac{1}{2}\%$ of the scale range and calibration shall not change with ageing.

The sensing bulbs shall be enclosed in thermometer pockets of a type which will enable the bulbs to be withdrawn without draining the piping system.

Thermometer pockets shall be of bronze or stainless steel, shall be of the oil filled type, supplied by the manufacturer of the thermometer, of a length recommended by him and shall be installed in accordance with his recommendations.

26.0 ELECTRICAL

26.1 Wiring Rules

All electrical work shall be carried out in accordance with Australian Standard 3000 Part 1 - S.A.A. Wiring Rules, and the requirements of the Supply Authority.

26.2 Supply

Supplies shall be provided by others as set out in Annexure 11. The Sub-contractor shall connect these to the items provided by him and shall supply all materials and do all the work on the load side of these points of connection.

NOTE : If the supplied listed in the Annexure are inadequate for the equipment offered this MUST BE MADE CLEAR IN THE TENDER.

26.3 Conductors

(a) In general, conductors shall consist of P.V.C. insulated stranded copper cables. No joints shall be allowed in any cables, except at approved terminals at switchboards or equipment.

All cables, except where otherwise specified, shall be of 240 volt or 660 volt grade of approved manufacture. Each coil of cable delivered on the job shall bear the maker's label intact, otherwise it shall be liable to rejection.

All wiring shall be looped and no joints whatever will be permitted. All wiring in which kinks or abrasions occur will be condemned and shall be replaced by the Sub-contractor at his own expense.

26.0 Electrical (Cont'd)

26.3 Conductors (Cont'd)

(a) Cont'd.

Distinctive colours shall be used for all conductors throughout the installation.

In the event of any errors occurring the circuit shall be rewired at the Sub-contractor's expense with the correct colour.

Earthing conductors shall be sized in accordance with S.A.A. Rules, and all earth conductors shall be green P.V.C. covered.

For cables to motors, no conductor of less cross section area than $3/.036$ shall be used. All wiring to instruments, controls, etc. shall be run in multi-strand cables, minimum $3/.029$.

Conductors shall be run as follows :-

- In general, all conductors shall be installed in sheet metal duct with removable covers.

Ducts shall be electrically continuous, and covers shall preferably be of the "clip in" type. Covers secured by screws protruding into the cable space will not be accepted. Fit suitable supports within ducts installed on walls or ceilings to retain cables when covers are removed. All edges of duct against which cables can bear, shall be bushed.

In vertical duct runs, support the weight of the cables.

Fix ducts within 100 mm of each end, and at intervals not exceeding 400 mm, so that the entire duct system is rigid.

Note that within plantrooms and other finished areas, rigid P.V.C. duct, or conduits will be accepted. However, all penetrations through fireproof partitions must be in accordance with all Building Acts.

- Flexible plastic conduit shall be used for the final connections to components with moving parts or adjustable components.
- Within ceiling spaces and other non-finished areas of the building, double insulated conductors may be used either run on cable trays or clipped to the building structure at intervals not exceeding 1 m.

- (b) Where approved or specified, M.I.M.S. cables shall be 1000 V rating. Bending radius of M.I.M.S. cables shall be not less than 12 times the diameter of the cable. All glands, fittings and seals shall be those designed by the manufacturer for use on M.I.M.S. cables and shall be properly installed and sealed. The Sub-contractor shall take particular care when

26.0 Electrical (Cont'd)

26.3 Conductors (Cont'd)

(b) Cont'd.

sealing the cable to ensure that the end is perfectly moisture free, and that each individual conductor at the end being sealed is wiped perfectly clean and free from any minute trace of magnesium oxide insulating powder. The cable shall be made off and sealed immediately on cutting to ensure that no moisture is allowed inside the seal or cable. The seals used shall be of cold screw on pot type and the insulating sleeves covering the conductors after the seal shall be made of neoprene.

Seals are not to be screwed right home on to the copper sheath but one thread is to be left remaining.

All coils of cable shall be insulation tested with a 1,000 volt megger before use to avoid installation of low insulation resistance sections, and the Sub-contractor shall, after installation of each section, and before connection to switchboard, test for insulation resistance in accordance with S.A.A. Wiring Rules. Any section of cable which is found unsatisfactory shall be replaced. All cables after the installation shall show 'infinity' reading when tested with 1,000 volt. megger.

Requirements of the S.A.A. Wiring Rules shall be strictly observed in installation of cable.

- (c) Where appropriate, busways may be used. These shall consist of copper busbars run in sheet metal ducting. Busways shall conform to the requirements below and shall be securely fixed on angle iron brackets. Busbars shall be so sized that temperature rise on full load does not exceed 40°C.

26.4 Switchboards

(a) General

Switchboards generally shall consist of cubicle type switchboards mounted as shown on drawings.

The Sub-contractor, before proceeding with the manufacture of any switchboard to which supply is to be given by others shall take steps to ensure that the provision for receiving supply is consistent with the intended method of giving supply.

Each switchboard shall be in accordance with A.S. 1136 - Switchgear and Control Gear Assemblies, and shall be an indoor, stationary, cubicle type, with form 1 segregation and 1 P.12 protection.

Each switchboard shall be so constructed that all portions thereof are capable of withstanding maximum prospective fault current available.

For each section of each switchboard provide a 20 watt fluorescent fitting complete with tube and starter

26.0 Electrical (Cont'd)

26.4 Switchboards (Cont'd)

(a) General (Cont'd)

switched from within the switchboard. Provide also within each switchboard a general purpose outlet.

Each switchboard shall be designed to dissipate the heat generated within it without producing internal temperatures that exceed the rated ambient temperatures of equipment, etc. enclosed by it or that cause inaccurate operation of overload relays, etc. If, for this purpose, ventilation openings are necessary, each such compartment shall be ventilated and pressurized by means of a propeller fan (with cowl and air filter) and an air outlet.

Provide raised concrete plinths under switchboards and bolt framework thereto. Plinths shall be coved to the floor and finished with cement render.

Panels shall be carried down to the plinth, but a clearance of 150 mm shall be allowed between the lowest equipment and the floor.

Before commencing manufacture, submit for review detailed drawings showing cubicle construction and electrical equipment.

All circuits originating on the switchboard shall be protected by H.R.C. fuses.

All switchboard components shall be mounted on 2.0 mm thick steel panels, kept clear of the outer cubicle. No components shall be mounted on the cubicle itself.

Apart from busbars and M.I.M.S. cables all wiring shall be run in multi-strand cables within plastic ducting. All power and control connections to equipment etc. external to the switchboard shall be brought to approved mechanical terminals arranged in rows and provided with approved markers.

Terminals shall be of the type with parallel sliding plated jaws within plastic modules fitted to a shaped metal track.

Indicating lights, meters and switches intended for day to day use shall be grouped together on a fascia forming part of the front panelling of one section of the switchboard.

All indicating and pilot lights shall be neon type lamps with removable bulbs and lenses.

All equipment, lights and switches shall be identified (and in the case of switches have their positions marked) by means of engraved traffolyte labels; labels secured with not less than two screws.

Provide neutral bar and earth bar.

26.0 Electrical (Cont'd)

26.4 Switchboards (Cont'd)

(a) General (Cont'd)

Provide automatic - off - test switches for each item of automatically controlled equipment to permit it to be stopped or made to run for inspection and test purposes.

Provide hour meters for duplicated equipment to record the number of hours run by each unit of the pair.

For each motor with a rating of 25 kW or more provide a voltmeter and ammeter complete with transfer switches to indicate voltages between phases and from phases to neutral and phase currents. The ammeter shall be a B.S.S. - 89 first grade instrument of the moving iron suppressed top scale type with a scale length of 150 mm. The voltmeter shall be a matching instrument. The current transformer supplying the ammeters shall be in accordance with A.S. C388 to meet the application described herein. C.T. primaries shall be bar type, with bolted connections each end for easy removal. Wound primary type C.T.'s will not be accepted.

The equipment mounted on the hinged fascia panel shall be wired in flexible cable bound together into a harness, with a loop formed at the hinge.

No joint will be permitted in any conductor, except at a terminal which forms part of some items of switchboard equipment. All switchboard wiring shall be carried out to a consistent colour code.

Provide and mount on a wall adjacent to the switchboard an approved wiring diagram showing the numbers of all terminals on the switchboard and showing also the size of all conductors. Mount the wiring diagram on a 13 mm thick ply backing under a clear plastic sheet with a metal surround on all four sides.

(b) Cubicle

Each switchboard shall be of the front connected cubicle type.

The cubicle shall be of sheet metal construction of not less than 1.6 mm thick, securely stiffened and reinforced by a sturdy angle iron framework, or alternatively of not less than 2.0 mm thickness, folded for stiffness.

The angle iron framework shall be cleaned down, degreased, painted with a phosphoric acid rust neutraliser, primed and brush enamelled.

The panels and doors shall be of galvanised sheet metal, or zinc anneal and shall be cleaned down, degreased, painted with a phosphoric acid rust neutraliser, primed, spot puttied and rubbed down, sprayed with surfacer and finally rubbed down and sprayed with a first grade enamel and oven baked; or equal approved.

26.0 Electrical (Cont'd)

26.4 Switchboards (Cont'd)

(b) Cubicle (Cont'd)

Interior of cabinets shall be white and exterior as selected.

All cut outs and holes shall be burr free, and painted.

The cubicle shall be fitted with double hinged doors to the front, and hinged indicator section above. All doors shall be fitted with resilient gaskets to ensure exclusion of dust and dirt. To give access to the interior of the switchboard, the doors shall be provided with cylinder locks (minimum 5 pin) operating "night latch" type latches. All locks shall be keyed alike.

All ventilation holes shall be insect and vermin proofed, and shrouded so that dust cannot settle in. All cable entries shall be verim proofed.

The switchboard shall incorporate approved spare parts shelf.

(c) Switchboard Busbars

Where busbars are utilised, the system shall comprise hard drawn high conductivity copper bars, firmly supported by an approved insulating support fitted with secondary insulation where necessary to prevent tracking. All insulating material shall comply with B.S.S. 1137 Type 1.

All busbars shall be fully insulated indicating phase designation, or fully enclosed, and must be completely separated from cabling zones.

The busbar system shall be built to a type tested design, capable of withstanding a faulty level of at least 20 M.V.A. at 415 volts, and the switchboard manufacturer shall supply upon request, a copy of a type test certificate issued by a recognised Australian Testing Authority.

Busbars shall be sized to limit temperature rise to 40 degrees C anywhere on busbars or connections.

(d) Other Conductors

Wiring shall be run in P.V.C. insulated cables as specified above, except in the vicinity of equipment at elevated temperatures where cables of the appropriate temperature rating shall be used.

(e) C.F.S. Units

Combination Fuse Switch Units, shall be of the quick make/quick break type, and the moving contacts shall be spring driven to ensure positive opening and closing actions. In addition all contacts shall be fully shrouded. H.R.C. fuse links shall comply with dimensional standards, B.S.S. 88/1967 and shall be mounted on the moving contact mechanism which shall be isolated from line and load contacts when in the "OFF" position.

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26.0 Electrical (Cont'd)

26.4 Switchboards (Cont'd)

(e) C.F.S. Units (Cont'd)

The fuse switch units shall comply with B.S. 3185, and shall be tested and proved to be capable of closing onto and carrying a through fault as specified for the switchboard. Each unit shall be capable of making and breaking 3 times full load current at 0.3 Power Factor.

Each fuse switch unit itself shall be enclosed within a separate compartment to preclude fault transference and shall be interlocked so that the switch cannot be operated with its door open, or the door opened with the switch in the "ON" position. An over-riding interlock shall be provided for maintenance and inspection purpose.

(f) Contactors

All contactors controlling motors shall comply with Australian Standard 1029, and shall be capable of carrying and switching full load motor current at AC4 duty. They shall incorporate positive single phase protection by means of a dual bar system.

Contactors shall be of the block type, with auxilliary contacts as required.

Contactor coils shall be of the encapsulated type, of long life design. Supply 10% spare coils (rounded off to the next whole coil) of each type used. Spare coils shall be sealed into tough air tight polythene bags. Store these coils on the "spare parts shelf".

(g) Relays

Relays used shall be plug in type enclosed in dustproof cover.

Provide one spare relay of each type used.

Contacts shall be derated, by a minimum factor of 2 - i.e. contact rating shall be at least twice connected load.

(h) H.R.C. Fuses

Where H.R.C. fuses are specified, the carriers shall be of highest grade phenolic mouldings to B.S.S. 771, with brass contacts and brass carrier contacts.

The fuse cartridge shall be to B.S. 88 and approved for duty A.C. 80 Class Q1. Control fuses shall be Class P.

Provide 3 spare H.R.C. fuse cartridges of each type and rating used, mounted in approved clips fixed to the inside of the switchboard doors.

Replace any cartridges used during the maintenance period.

26.0 Electrical (Cont'd)

26.5 Control Panel

Refer to Clause 6.2 (b). This panel shall incorporate the switches and lights etc. described elsewhere in the specification.

The panel shall consist of a sheet metal enclosure constructed and finished in accordance with the provision of Clause 26.4 above to the extent that they are applicable. It shall be arranged for wall mounting and have provision for access to wiring, connections, etc. inside it.

The lights, switches, etc. shall be mounted on the front panel of this box. For the identification of all lights and switches and for other markings, etc. provide a 3 mm thick back engraved perspex panel, screw fixed to the front panel of the box. The engraved lettering shall be filled, and the back of the perspex panel painted to colours as selected.

27.0 NOISE AND VIBRATION

All equipment installed shall be selected, mounted and installed so as to produce no vibration than can reasonably be objected to. The following provisions, however, shall at least be made :-

- (a) All rotating or reciprocating equipment including fans and equipment housing fans shall be mounted on supports incorporating :-
- (i) springs with a deflection designed according to an approved procedure to give first class isolation of vibrating forces, taking into account the type, size and speed of the vibrating equipment and the thickness and span of the supporting floor.

The springs shall be designed with a sufficiently large diameter to give lateral stability; but not less than 0.8 of the compressed height of the spring at design load. Springs shall have a minimum additional travel to solid equal to 50% of the design deflection.
 - (ii) Pads of neoprene in series with the springs, designed for interrupting the passage through the springs of high frequency vibration in the audible range.
 - (iii) Provision for levelling the supported equipment.
 - (iv) Motion limiters where necessary for preventing excessive rocking of the equipment during normal operation or start up.
 - (v) Housings that include vertical limit steps in the case of equipment with an operating weight different from the installed weight and equipment

27.0 Noise and Vibration (Cont'd)

(a) Cont'd.

(v) Cont'd.

exposed to the wind. The housing shall serve as a blocking during erection and the installed and operating heights shall be the same. A minimum clearance of 13 mm shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation.

(vi) Hot dipped galvanising, in the case of mountings used out of doors.

(b) Piping connected to spring mounted equipment shall be laid out so that the piping has sufficient flexibility to allow for movement of the equipment and expansion or contraction of the mains. Such piping shall be hung for a length equivalent to two hundred diameters on supports incorporating steel springs and pads of neoprene in series with the springs designed for interrupting the passage through the springs of high frequency vibration in the audible range. The springs shall have a deflection under operating conditions of at least 25 mm. Spring diameters shall be no less than 0.8 times the compressed height of the spring at design load. Springs shall have a minimum additional travel to solid equal to 50% of the design deflection. Each spring shall have a pointer and scale for indicating the spring deflection.

The spring closest to spring mounted equipment shall be as specified above and additionally shall be capable of holding the piping at a fixed elevation during installation and have a secondary adjustment for transferring the load to the spring whilst maintaining the piping in the same position.

Beyond the length of two hundred diameters all piping shall be isolated from the structure by flexible pads or inserts as specified in Clause 25.0

(c) All air ducts shall be isolated from fans by flexible connections. See Standard Specification SM2.

(d) All electrical conduit and rigid conductors shall be isolated from motors by sections of flexible conduit and wiring as specified in Clause 26.0

(e) Drain lines shall be isolated from vibrating equipment to which they are attached by means of sections of rubber hosing.

(f) The pipework generally shall be supported from beams or other rigid structural elements - not from thin or light weight floor or wall panels.

28.0 MISCELLANEOUS

28.1 Machine Bases

The Sub-contractor shall provide all concrete plinths required under items of his equipment, and any necessary stabilizing blocks or bases.

28.2 Guards

Guards shall be place around all moving or otherwise dangerous parts of the equipment to the satisfaction of the Queensland Division of Occupational Safety and Weights and Measures, and the Superintendent's Representative.

28.3 Fixings

(a) Permitted Types

In general, all fixings shall be by metal expansion devices in pre-drilled prepared holes.

Self-drilling anchors may be used subject to approval if designed using a factor of safety of 10.

Explosive driven fixings may be used subject to the following :-

- . such fixings shall not be used with prior approval of the Superintendent's Representative.
- . such fixings shall not be used in the following circumstances :-
 - . when exposed to view in the finished building
 - . when in tension
 - . for fastening to other than concrete or brick
 - . for fixing to hollow bricks or hollow blocks
 - . for edge fixing to 115 mm brick walls.
- . such fixings shall be sued only for minor support; such as the direct clipping to walls of pipes 13 mm diameter and under.

(b) Design of Fixing

The selection of type, size and number of fixings shall be in accordance with the recommendations of the fixing manufacturer. If required by the Superintendent's Representative the Sub-contractor shall carry out, without cost, tests to substantiate the reliability of the design data being used.

(c) Location of Fixings

To prevent disfiguring the structure and to ensure sound fixings, fixings shall not be made less than 63 mm centre or less than 50 mm from edges or corners.

28.0 Miscellaneous (Cont'd)

28.4 Painting

The Sub-contractor shall paint with an approved preparatory and two finishing coats of selected colour all parts of the installation including fans, motors, pumps, cylinders, guards, hangers, brackets, piping and all other permanent parts of the installation except :-

- (a) brass, bronze or copper parts which shall be left clean, polished and finished with one coat of clear lacquer of approved manufacture.
- (b) chrome plated and stainless steel parts shall be left clean.
- (c) generally aluminium parts shall be left clean.
- (d) items concealed from view above false ceiling or in vertical pipe ducts.

Prior to painting, all surfaces shall be prepared according to best practice. In particular all galvanised or zinc anneal surfaces shall first either have one coat of etch primer or be washed down first with etching solution and then clean water and be dried off.

All materials shall be of first grade quality for the particular environment in which they are to be applied.

All coatings shall be compatible with each other; and should be procured from the one manufacturer.

Identification names and numbers shall be sign written on all equipment in an approved contrasting colour in letters of a size to suit the application, but at least 25 mm, proposed wording and lettering size to be submitted for approval.

29.0 SCHEDULE OF TECHNICAL DETAILS

Quoters shall complete the schedule of Technical Details forming part of the Specification Documents.

DRAWING LIST

DRAWING NUMBER	TITLE
P 6849	Air Conditioning Layout
P 6850	Mechanical Services Layout
P 6851	Details and Sections.

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ANNEXURE 2.

SOUND ATTENUATOR PERFORMANCE REQUIREMENTS

Min. dynamic insertion loss of sound traps - dB re 10^{-12} watt

SOUND ATTENUATOR	OCTAVE BAND CENTRE FREQUENCIES (Hz)							FACE VELOCITY (m/sec.)	MAX. PERMISSIBLE PRESSURE DROP (kPa)	LOCATION	SUGGESTED SIZE TO SUIT DUCTWORK	AIR QUANTITY (l/sec)
	125	250	500	1000	2000	4000	8000					
SA 1	23	32	47	56	56	48	35	4.86	0.137	Generator Room	1220x 915 x Equivalent Length 1525	5420
SA 2	15	26	43	53	53	45	32	4.86	0.105	Generator Room	610 x 915 x Length 1525	2710
SA 3	15	26	43	53	53	45	32	4.86	0.105	Generator Room	610 x 915 x Length 1525	2710

ANNEXURE 3.

COMPRESSED AIR SYSTEM

WORKING PRESSURE OF COMPONENTS

All components shall be suitable for a working pressure of not less than - 690 kpa.

AIR COMPRESSOR

Number off - 1

Free air delivery of compressor when operating at a discharge pressure of 4.15 kPa. - 2.8 litres/sec.

AIR RECEIVER

Number off - 1

Type - Horizontal

Diameter - 450 mm

Length - 915 mm

AFTER COOLER

Description - Unit mounted air cooled.

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GENERAL DESCRIPTION OF EXISTING INSTALLATION

PART 'A' - WATER CHILLING PLANT

- (i) WATER CHILLING UNITS
2 x each with reciprocating refrigerant compressors, direct expansion water chillers and shell and tube condensers.
- (ii) COOLING TOWERS
2 x cross draught induced flow type.
- (iii) CHILLED WATER PUMPS
(a) 2 x Primary pumps.
(b) 2 x Secondary pumps.
All end suction - back withdrawal type.
- (iv) CONDENSER WATER PUMPS
2 x end suction back withdrawal type.

PART 'B' - CONTROL ARRANGEMENT

See Clause 6.1

Annexure 4 (Cont'd)

General Description of Existing Installation (Cont'd)

PART 'C' - AIR CONDITIONING SYSTEMS

SYSTEM NO.	AREA SERVED	LOCATION OF CONDITIONER	NO. OF ZONES	TYPE OF REHEAT
AC/1 (a)	Part Floor 1	Ground Floor	7	Electric
AC/1 (b)	Remainder Floor 1	Ground Floor	8	Electric
AC/2	Floor 2	Floor 2	12	Electric with 1 Zone Steam
AC/3	Floor 3	Floor 3	2	Steam
AC/4	Floor 4	Floor 4	3	Steam with 1 Zone Electric
AC/5	Floor 5	Floor 5	2	Steam
AC/6	Floor 6	Floor 6	2	Steam
AC/7 (a)	Main Area of Floor 7	Roof	2	Steam
AC/7 (b)	Insectary on Floor 7	Roof	3	Electric

General Description of Existing Installation (Cont'd)

PART 'D' - VENTILATION SYSTEMS

SYSTEM NO.	AREA SERVED	LOCATION OF FAN	TYPE OF FAN	NO. OF EQUALLY SIZED FANS	AIR QUANTITY HANDLED BY SYSTEM - C.F.M.
V2	Plant Room	Ground Floor	Diaphragm Mounted Propeller	1	10000
V3	Workshop	Ground Floor	Diaphragm Mounted Propeller	1	2500
V4 (A&B)	Floors 1 and 2	Roof	Single Inlet Centrifugal	2	7300
V5	Ground to Floor 7	Roof	Single Inlet Centrifugal	2	4070
V6	Infected Lab.	Floor 2	Single Inlet Centrifugal	1	420
V7	Infected Animal Room 4	Floor 2	Single Inlet Centrifugal	1	120
V8	Infected Animal Room 5	Floor 2	Single Inlet Centrifugal	1	120
V9	Dark Room	Floor 2	Single Inlet Centrifugal	1	220
V10	Lecture Room	Floor 4	Single Inlet Centrifugal	1	700
V11	Sterile Room	Floor 5	Single Inlet Centrifugal	1	230
V12	Counting Room	Floor 5	Diaphragm Mounted Propeller	1	60
V13	Ambient Room	Floor 7	Diaphragm Mounted Propeller	1	2500/1800
V14	Lift Motor Room	Lift Motor Roof	Mixed Flow Roof Extract	1	1800
V15	External Services Duct	Roof	Diaphragm Mounted Propeller	4	3000 each

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ANNEXURE 5.

DARK ROOM WATER CHILLING SET

Type	-	Mains pressure operated.
No. off	-	1
Capacity	-	7 litres/minute.
Outlet Temperature	-	10°C - 13°C.
Refrigeration Compressor	-	Unit mounted, 1.12 kW. capacity.
Overall size	-	Width - 760 mm Depth - 685 mm Height - 1780 mm

DARK ROOM WATER FILTERS

Type	-	In-line
Filtration	-	30 Microns
Capacity	-	9 litres/minute max.
Pressure drop	-	21 kPa.

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SCHEDULE OF DESIGN INFORMATION

CONDITIONER AC/G	SINGLE ZONE
<u>COOLING :-</u> Required inside conditions Outside air conditions	24°C db, 50% RH 32°C db, 24°C wb
<u>DESIGN DATA :-</u> Occupancy - People Equipment (kW) Sensible Latent Infiltration (litres/s.) Outside Air through equipment (litres/s.)	6 3.40 - 15 110
<u>MINIMUM EQUIPMENT CAPACITIES :-</u> Air Quantity (litres/s.) Apparatus Dewpoint By-pass Factor Total Heat Absorbed by cooling coil (kW)	545 12°C 0.01 10.91
<u>HEATING :-</u> Required inside conditions Outside air conditions	20°C 7°C
<u>DESIGN DATA :-</u> Occupancy - People Lighting (kW) Infiltration (litres/s.) Outside air through equipment (litres/s.)	- - 15 110
<u>MINIMUM EQUIPMENT CAPACITIES :-</u> Rating of heater (kW)	5.65
<u>MINIMUM EQUIPMENT CAPACITIES :-</u> Rating of humidifier (Kg)	-

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ANNEXURE 7.

EXHAUST AND VENTILATION SYSTEMS

UNIT DESIGNATION	DESCRIPTION OF SERVICE	FAN TYPE	AIR QUANTITY (l/s)	NOTES
V16	Dark Room Exhaust	In line Centrifugal	45	Manufactured with fibre glass housing
V17	Stand-by Generator Room Vent.	Aerofoil Axial Flow 760 dia.	5420	-
V18	Stairwell Press. Fan.	Aerofoil Axial Flow 760 dia.	5960	Flame proof

NOTE : Refer Annexure 11 for Electrical supplies to Sub-boards.

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ANNEXURE 8.

MAXIMUM SOUND POWER LEVELS FOR ELECTRIC MOTORS

OCTAVE BAND CENTRE - Hz	MOTOR RATING - kW													
	.75	1.1	1.5	2.2	3	4	5.5	7.5	11	15	18.5	22	30	37
63	54	55	56	58	59	59	60	61	64	66	67	66	67	68
125	51	52	53	55	56	56	57	61	64	67	68	68	69	75
250	47	48	49	51	52	52	53	65	68	70	71	73	74	74
500	50	52	53	54	55	55	57	63	66	69	70	72	73	76
1000	57	59	60	61	62	62	64	64	67	70	71	75	76	75
2000	59	61	62	63	64	64	66	65	68	71	72	74	75	74
4000	54	55	56	58	59	59	60	62	65	68	69	68	69	69
8000	45	47	48	49	50	50	52	52	55	58	59	59	60	61

NOTE 1 : - The above figures are in decibels re 10^{-12} watts.

NOTE 2 :- The above are the maximum values for the average of the figures for all motors produced. No individual figure for a motor supplied under this sub-contract shall exceed the corresponding figure in the table above by more than 4 dB.

ANNEXURE 9.

SCHEDULE OF PIPING MATERIALS

These shall be as follows :-

Service	Material	Specification	
		Number	Type or Grade.
Steam - 75 mm & over	Steel - Black	AS 1074	Tested heavy grade
Steam - under 75 mm	Copper	AS 1432	Type A
Condensate	Copper	AS 1432	Type A
Hot Water	Copper	AS 1432	Type B
Cold Water	Copper	AS 1432	Type B
Chilled Water	Steel - Black	AS 1074	Tested heavy grade
Compressed Air	Copper	AS 1432	Type A
Cooling Unit Water piping and Dark Room Chilled water piping	Copper	AS 1432	Type B
Town gas	Copper	AS 1432	Type B
Vents Overflow Drains Drips Wastes	Copper	AS 1432	Type B

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ANNEXURE 10.

SCHEDULE OF VALVES

REFER TO APPENDIX FOR SPECIFICATION OF VALVES CALLED FOR IN SCHEDULE.

Service	Duty	UPI mm	Valve	UPI mm	Valve	UPI mm	Valve	Over mm	Valve
Steam to 1,034 kPa	I B	25	3.02	40 40	2.01 2.01	75	2.31	75	2.33
Water - hot to 1,034 kPa and 100°C.	I B NR			40 40 40	1.01 2.02 6.03	100 100	1.31 2.32	100	1.34
Condensate									
Water - cold domestic to 1,034 kPa	I NR			40 40	1.01 6.03	100	1.31	100 40	1.34 6.61
Water for hydrant & hose reel systems to 1207 kPa									
Water - cold non domestic to 1,034 kPa (e.g. air condition- ing)	I B NR			40 40 40	1.01 2.02 6.03			40 40 40	4.61 4.61 6.61
Oxygen) for Nitrous Oxide) medical Compressed) purposes Air	I	20	5.81	40	5.01			40	5.31
Vacuum	I			40	5.02			40	5.32
Compressed Air and Vacuum	NR		Suitable for pulsating flow and as recommended by compressor and vacuum pump manufacturers.						
L.P. Gas (non fire safe duty)	I			40	3.02			40	3.31
Fuel Oil	I NR			40 40	5.03 6.04			40 40	5.33 6.61
Drain & Vent Line Valves				40	3.02				
Vacuum Breakers for Steam Heating Coils		40	6.03						

NOTE : in column headed DUTY :-
 I = Isolating Duty Only
 B = Balancing or Throttling Duty
 NR = Non-return

NOTE : UPI = Up To and Including

APPENDIX TO ANNEXURE 10

	Type		Ends
1.00	Gate	.00	Screwed
2.00	Globe	.30	Flanged
3.00	Ball	.60	Plain for clamping
4.00	Butterfly		between line flanges
5.00	Diaphragm	.80	Flare compression
6.00	Non-return		

Code	Body	Typical Valve		Remarks
		Johns	Richards	
1.01	Bronze	59-16		
1.31	Bronze	60-16		
1.32	Cast Iron	316		
1.33	Cast Iron	600		
1.34	Cast Iron	601		
2.01	Bronze	501		
2.02	Bronze	1		
2.31	Bronze	502		
2.32	Bronze	2		
2.33	Cast Iron	201		
2.34	Cast Iron	203		
3.01	Bronze		B15/RP5	
3.02	Bronze		B61/RP4	
3.31	Bronze		B15H/RP5	
3.32	Cast Iron		11125F/RP16	
4.61	Cast Iron	4000		
5.01	Bronze	3001		715 grade diaphragm
5.02	Cast Iron	3001		715/N grade diaphragm
5.03	Cast Iron	3001		701 grade diaphragm
5.31	Bronze	3002		715 grade diaphragm
5.32	Cast Iron	3002		715/V grade diaphragm
5.33	Cast Iron	3002		701 grade diaphragm
5.81	Bronze	-	-	Hudson refrigeration

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APPENDIX TO ANNEXURE 10 (CONT'd)

Code	Body	Typical Valve		Remarks
		Johns	Richards	
6.01	Bronze	521		
6.02	Bronze	551		
6.03	Bronze	4B		
6.04	Bronze	4BE		
6.31	Bronze	522		
6.32	Bronze	552		
6.33	Cast Iron	400 or		
		405		
6.61	Cast Iron	430		

Example

Valve 1.01 = gate valved with screwed ends, bronze body, Johns figure 59-16 or approved equivalent.

Notes :-

- (i) Irrespective of the above nominations it shall be the responsibility of the Sub-contractor to ensure that all valves are suitable for the working pressures and temperatures to which they will be subjected and for the fluids they will handle.
- (ii) Where stems are of copper alloy and are in contact with the fluid conveyed, they shall be of an approved alloy resistant to dezincification.
- (iii) All ball, butterfly, plug and similar valves of sizes 150 mm and over shall have worm and wheel actuators.
- (iv) All valves in lines connected directly to the Supply Authorities mains shall be of types approved by the Supply Authority.

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ANNEXURE 11.

ELECTRICAL SUPPLY

The following electrical supply cables shall be supplied and installed by others to the positions stated in the schedule below. These cables shall be connected by the Sub-contractor, who shall do all work on the load side of these points of connection.

DETAILS OF CABLE	RATING	FUNCTION	FROM	TO
4 x 2.5 mm ²	20 amps/ phase	Power	Local light and Power S/Board (Soiled Linen Room)	New Mechanical Services S/Board (Soiled Linen Rm)
4 x 2.5 mm ²	15 amps/ phase	Power	Main Building Switchboard	Stairwell Pressurisation Fan S/Board
4 x 2.5 mm ²	12 amps/ phase	Power	Main Building Switchboard	Standby Generator Exhaust Fan S/Board.
4 x 2.5 mm ²	20 amps/ phase	Power	Local light and Power S/Board (Soiled Linen Room)	Air Compressor for Electron Microscope
2 x 2.5 mm ²	20 amps 1 phase	Power	Local light and power S/Board (Soiled Linen Room)	Fume Cupboard
ALL POWER AND CONTROL WIRING SHALL BE BY THE ELECTRICAL SUB-CONTRACTOR				Elect. Micro. Cooling Unit.
2 x 2.5 mm ²	-	Control	Low Tension Switchboard	Main Air Condition -ing Switchboard
2 x 2.5 mm ²	-	Control	Low Tension Switchboard	Main Air Condition -ing Switchboard

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SPECIFICATION

APPENDIX

(This Appendix is for the Contractors Information only).

CONVERSION FACTORS RELATING TO S.I. UNITS AND IMPERIAL UNITS

1. Base Units of S. I.

Quantity	Name of Unit	Symbol
Length	Metre	m
Mass	Kilogram	kg
Time	Second	s
Electric Current	Ampere	A
Temperature	Celsius	C

2. Derived S. I. Unit Having Special Names

Physical Quantity	Unit	Symbol	Derivation
Volume	Litre	l	$m^3 \times 10^{-3}$
Frequency	Hertz	Hz	s^{-1}
Force	Newton	N	kgm/s^2
Pressure and Stress	Pascal	Pa	N/m^2
Work, Energy, Quantity of Heat	Joule	J	Nm
Power	Watt	W	J/s

3. S. I. Unit and Imperial Unit Relationship

1 ft.	=	0.305 m	1 m	=	3.28 ft.
1 in.	=	25.4 mm	1 m	=	39.37 ins.
1 ft. ²	=	0.093 m ²	1 m ²	=	10.76 ft. ²
1 ft. ³	=	0.028 m ³	1 m ³	=	35.31 ft. ³
1 ft. ³	=	28.31 l	1 l	=	0.035 ft. ³
1 ft./s	=	0.305 m/s	1 m/s	=	3.28 ft./s.
1 c. f. m.	=	0.472 l/s	1 l/s	=	2.12 c. f. m.
1 in. W. G.	=	0.249 kPa	1 kPa	=	4.016 in W. G.
1 p. s. i.	=	6.89 kPa	1 kPa	=	0.145 p. s. i.
1 lb.	=	0.454 kg	1 kg	=	2.205 lbs.
1 lb/ft. ³	=	16.02 kg/m ³	1 kg/m ³	=	0.062 lbs/ft. ³
1 B. T. U.	=	1.055 kJ	1 kJ	=	0.948 B. T. U.
1 B. T. U. /lb.	=	2.33 kJ/kg	1 kJ/kg	=	0.43 B. T. U. /lb.
1 B. T. U. /ft. ³	=	37.26 kJ/m ³	1 kJ/m ³	=	0.027 B. T. U. /ft. ³
1 BTU/hr/ft. ² /°F.	=	5.68 W/m ² /°C	1 W/m ² /°C	=	0.176 B. T. U./hr/ft. ² /°F.
1 gal.	=	4.55 l	1 l	=	0.219 gal.
1 g. p. m.	=	0.076 l/s	1 l/s	=	13.2 g. p. m.
1 ton of refrig.	=	3.52 kW	1 kW	=	0.284 tons of refrig.
1 C. P. S.	=	1 Hz			
1 ft. /min.	=	0.0051 m/s	1 m/s	=	196 ft. /min.
1 r. p. m.	=	0.017 rev. /s	1 rev. /s	=	60 r. p. m.

MAINTENANCE, SERVICE AND WARRANTY

MAINTENANCE/SERVICE SCHEDULE

The Contractor's attention is drawn to the attached Maintenance/Service Schedule, which is required to be completed and submitted by the Contractor, at the completion of each quarterly service visit, to the Officer-in-Charge of the building in which the work has been carried out.

Attention is particularly directed to Item 5 of such schedule, which requires the submission of details of any replacement of equipment which occurs during the Maintenance/Service/Warranty period, so that amended dates for Warranty Claims on suppliers can be recorded.

Note 1:- The Contractor should ensure that the final service at the completion of the Maintenance/Service/Warranty period should be a complete service in all respects to present the installation in satisfactory working order for the final inspection and clearance by the Inspecting Officer so that consideration can be given expeditiously to the release of the Maintenance/Service retention and/or the security against the Warranty.

Note 2:- Further copies of this schedule may be obtained upon application to the Department of Works.

Note 3:- The Maintenance/Service/Warranty period shall commence from the date of the issue of the "Certificate of Practical Completion".

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MAINTENANCE, SERVICE/AND WARRANTY SCHEDULE

Date Previous Service Date

Name of Department

Building

Address

Work

Name of Contract Order No. Date

Date of Certificate of Practical Completion

1. General Inspection to be carried out at final service date

Remarks

2. Routine Maintenance including lubrication, cleaning and adjustments.

3. Details to be submitted of Repairs/Replacements found necessary.

Serviced Item	Description	Condition	Work Required	Material Used	Remarks

Note:- If Contractor has Standard Service Sheet then this should be attached hereto.

4. Comments including major overhauls/repairs/replacements, as undertaken. Building O/C and Department's Representative to be advised in advance of installation shut/down.

5. Where replacements are installed during Maintenance/Service/Warranty period then dates of Warranty on new equipment to be furnished to Department's representative.

Serviceman

Signature

Contractor

Address

Date of Service

Officer in Charge of Building

Signature

Date

ME. - Q. T. S. C. - 2. 75

DEPARTMENT OF WORKS
ENGINEERING BRANCH

SUB-CONTRACTOR TO CONTRACTOR

INTERPRETATIONS

In this specification, and attached standard specifications and drawings, all references of the term "Contractor" shall be read as "Sub-Contractor", and all reference of the term "Contract" shall be read as "Sub-Contract".

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ME. -SC. - 10. 75

DEPARTMENT OF WORKS,
ENGINEERING BRANCH.

STANDARD REQUIREMENTS FOR
MECHANICAL INSTALLATIONS.

STANDARD SPECIFICATION SMT.

RTI Release

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STANDARD SPECIFICATION SM1

STANDARD REQUIREMENTS FOR MECHANICAL INSTALLATIONS

1.0 SCOPE

This Standard Specification sets out the Department's requirements with regard to Performance Guarantee, Extent of Works, Operating Instructions, Adjustments to Installation, Service and Maintenance, Noise, Vibration and Painting.

The type of installation and items of equipment to be supplied under the Contract shall be as set out in the Work Specification and Drawing/s defining the extent of the work.

2.0 DEFINITIONS

Where the word "Drawing/s" is used, it shall mean the drawing/s included in the standard specification and/or the drawing/s included in the Work Specification.

Where the term "Work Specification" is used, it shall mean the Departmental Specification for a specific project in which reference is made to the Standard Specifications.

Where the term "Inspecting Officer" is used, it shall mean the Department's Officer nominated by the Under Secretary.

Where the term "Permission to use" is used, it shall mean that which is given specific permission to use by the Department's Inspecting Officer.

3.0 DIMENSIONS

All dimensions on shop drawings prepared by the Contractor, representing the final installation are to be the minimum dimensions for the installation.

No change shall be effected to shop drawings unless permission to do so is given by the Inspecting Officer. The final shop drawings with all amendments thereon shall be submitted to the Inspecting Officer at the stage of the issue of the Certificate of Practical Completion.

4.0 PERFORMANCE GUARANTEE

The Contractor shall guarantee that the installation will maintain the required performance.

Notwithstanding any details or information indicated on the drawing/s and/or specification/s, the basis of acceptance of the installation is that performance guarantees as listed in the Work Specification must be met before the issue of the Certificate of Practical Completion by the Inspecting Officer.

Performance guarantee shall be as set out in the Work Specification.

Note: In the case of air conditioning installations, achievement of performance guarantee shall mean that internal conditions specified are maintained for both summer and winter.

5.0 SAMPLES OF WORK

Where samples are submitted to the Department's Inspecting Officer, for permission to use fabrication, or workmanship, or as an example of design, all subsequent work shall be of the same quality as the sample on which the permission to use was given. Permission to use may be withdrawn if the standard of the sample is not maintained.

Note: It is the Contractor's responsibility to ensure that the samples are submitted at a time to suit the job programming, so that adequate time is available for changes as deemed necessary, and any permission to use would be considered without prejudice to the Contract Completion Time; at least seven (7) days notice is required in accordance with the Special Conditions of Contract.

Samples submitted shall be retained until job completion.

6.0 OPERATING INSTRUCTIONS AND SCHEMATIC DIAGRAMS

In addition to drawings required to be supplied under the terms of the General and/or Special Conditions of Contract, the Contractor shall supply two (2) complete sets of manufacturers operating and maintenance instructions for each item of equipment, and two (2) complete set of schematic diagrams covering all ductwork, pipework, electrical equipment and connections. Each diagram shall include all control and isolating points as well as indicating all values of measured quantities representing final settings of the installation.

One (1) copy shall be forwarded to the Under Secretary with the drawings as required under the General and/or Special Conditions of Contract.

The second copy of the above information shall be mounted in a position adjacent to the main control panel in the Plant Room. The instruction sheets and diagrams shall be enclosed in a glass-fronted locking case, mounted on a 25 mm thick dressed and polished timber panel matching the main control panel, complete with matching metal surround. Details of the proposed construction and positions of panels shall be referred to the Inspecting Officer for permission to use in association with the installation, refer to clause 5.0 herein.

In cases where operational instruction is required after completion of preliminary test and adjustments, the Contractor shall provide, at his own expense for a period as specified, a skilled operator to instruct such persons as may be nominated by the Under Secretary in the effective operation of the installation.

Names and addresses of Agents for each item of equipment shall be left on site for the maintenance staff.

7.0 ADJUSTMENTS

The Contractor shall make adjustments and settings necessary for the satisfactory operation of the installation to meet the specified performance guarantee. Adjustments shall include all preliminary adjustments (as set out below) and further adjustments as specified under clause 8.0 herein.

Preliminary adjustments shall be made before the installation is submitted to the Inspecting Officer and deemed to be commercially operative, prior to the issue of the Certificate of Practical Completion, and shall include:-

- (a) The setting of all safety and protective devices.
- (b) The setting of all devices controlling the performance and operation of the installation.

As proof that all necessary work has been carried out, a schedule shall be provided by the Contractor, e.g. For air conditioning installations, the Contractor shall set out on the schedule the measured air quantities from all outlets, and the final settings shall be permanently marked adjacent to all design quadrants.

8.0 DEFECTS LIABILITY OR MAINTENANCE/SERVICE

The Contractor shall make any such further adjustments and settings as operating experience shows to be necessary for the satisfactory operation of the installation to meet the specified performance guarantee.

Where air quantities are varied for seasonal requirements which differ from the initial condition, a further schedule shall be provided of measured air quantities from all outlets.

Details of damper control settings shall also be provided so that first conditions can be re-established with a minimum of interruption to installation operation.

The provision of an "On call" maintenance service to place the installation into working order after a breakdown of any description in the installation shall be provided. Under this service there shall be available adequate technical staff and skilled tradesmen for immediate attendance to the installation as required by the breakdown.

The Contractor shall supply details of the number and designation of technical staff available for maintenance/service together with phone numbers for ordinary and out of hours servicing.

Servicing shall be carried out on the basis of four (4) service visits at three (3) monthly intervals during the twelve (12) months period or as otherwise specified. Service visits shall include attention to lubrication points, adjustments of all controls and electrical equipment, cleaning of filters and all other necessary servicing as specified by the manufacturer and to ensure that the installation is operating at optimum efficiency.

A service report in writing shall be submitted to the Officer-in-Charge of the Building and a dated signature obtained for the purpose of certifying that the service has been carried out. Details of work performed, materials used and installation conditions shall be included in this report.

If service is not performed at the intervals specified and a signature not obtained from the Officer-in-Charge of the Building, then the retention monies may be withheld by the Minister against the defects/liability or maintenance/service period, and any unsatisfactory maintenance/service or failure to maintain the specified performance guarantee condition, may cause the Under Secretary to review the payment of monies at the expiration of such period.

8.1 SEASONAL TESTS (AIR CONDITIONING INSTALLATIONS)

In the case of air conditioning installations, during the twelve (12) months maintenance service period two (2) performance tests (summer and winter) are required; each test is required to take seven (7) consecutive days.

Test Readings shall include -

- (a) Electric current demand of all motors.
- (b) Refrigerant temperature in and out of the condenser and evaporator.

- (c) Air temperature on and off the cooling (dB and wB) and condensing (dB) coils; air flow measurements and a resultant calculation of refrigeration output.
- (d) Daily thermhydrographs, of temperature and humidity of the simultaneous outside and inside conditions of the conditioned areas.

9.0 NOISE LEVELS

The Contractor shall refer to the Work Specification to obtain the noise levels for each area which shall be used as the criteria for performance and basis of acceptance of the installation.

The performance with respect to noise is stated in terms of a "Noise Rating Curve" (abbreviated N.R.) which shall be interpreted from AS 1469.

The installation shall be measured over the full range of octave band centre frequencies from 31.5 Hz to 8,000 Hz. The measured sound pressure levels corresponding to each particular centre frequency shall not exceed (after background correction) that specified by the Performance Guarantee.

The measured sound pressure levels shall be taken with an instrument of certified accuracy and capable of frequency analysis over the spectrum range listed.

The position nominated for sound measurement shall be defined as any position which results in maximum sound pressure levels within the envelope constituted by deleting a marginal space 900 mm all around inside walls and ceilings.

The time of test shall be such that a minimum of background noise exists and is relatively steady and continuous.

A separate test shall be conducted with the installed equipment switched off and the background sound pressure levels recorded over the identical range of frequencies as used for the equipment. The following background corrections shall be applied in assessing noise due to the item of equipment.

<u>Total sound level minus background noise level</u>	<u>Correction: Subtract from total dB to obtain sound level due to equipment</u>
8 to 10 dB	0.5 dB
6 to 8 dB	1.0 dB
4.5 to 6 dB	1.5 dB
4 to 4.5 dB	2.0 dB
3.5 to 4 dB	2.5 dB
3 to 3.5 dB	3.0 dB

9.1 INITIAL NOISE PROTECTION

With respect to the attainment of noise levels specified, the contract responsibilities shall include when necessary:-

- (a) Isolation of all operational equipment to ensure direct transmission of noise does not occur along material constituting the building framework or along ductwork or pipework serving the equipment.
- (b) Isolation of mechanical vibration of the operating equipment to the extent of preventing vibration in other parts of the building or ductwork, causing regeneration of noise.
- (c) Caution in the initial selection of equipment such that resultant operating noise level in the nominated space is within the upper bounds of the sound pressure levels specified.

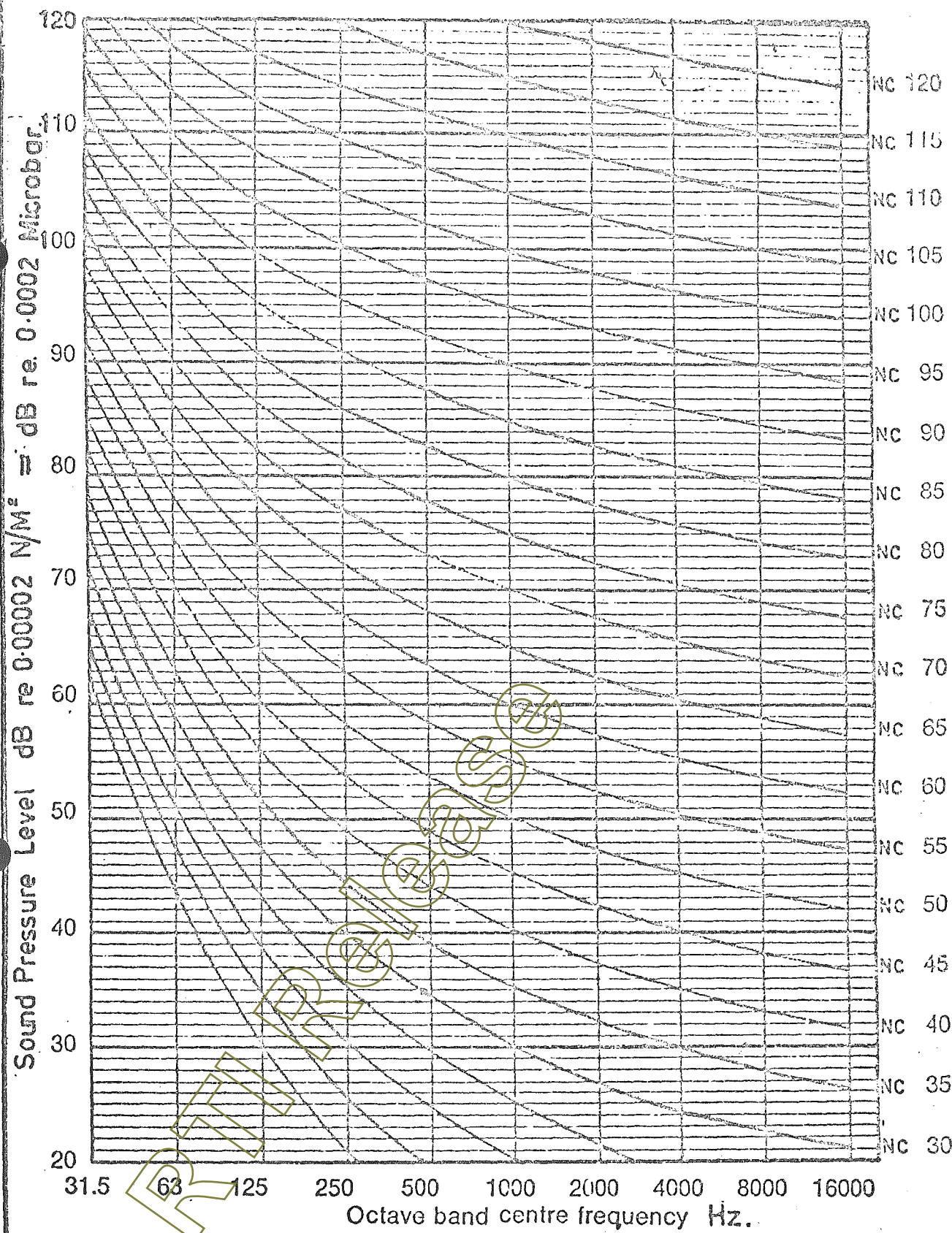
9.2 FURTHER NOISE PROTECTION

In cases where noise generated by the item of equipment offered will not attain the specified levels, the contract responsibility shall include, when necessary:-

- (a) Provision of proprietary made sound attenuators or acoustic lining of ductwork.
- (b) Lining of plant rooms or spaces housing equipment where necessary with sound absorbent materials and/or high density linings which prevent transmission of sound.
- (c) Provision of acoustic baffling at all openings in the space housing the sound source.
- (d) The provision of acoustic air boxes as required for the relief or transfer of air from one area to another. This would particularly apply to occupied areas and corridors where sound or voice transmission is required to be avoided.
- (e) Any other sound treatment deemed necessary by the Contractor for the achievement of the specified Performance Guarantee.

10.0 PAINTING

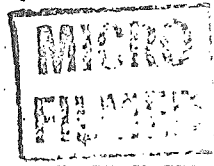
Factory produced items shall be supplied fully painted. All painting shall be in accordance with Standard Specification SM6.



To be read in association with Standard Specification SM1
 "Standard Requirements for Mechanical Installations".

B	S4 reference altered to SM1	J.P.	R. J. G. L. W. E. Y.	15/11/74
A	Metricated	R.J.Y.	E. D. S.	1/3/70
Nº	AMENDMENT.	DRAWN.	APPROVED.	DATE.
DEPARTMENT OF WORKS ENGINEERING BRANCH.			SCALE	---
			DESIGN	---
			DRAWN	E.D.S.
NOISE CRITERIA CURVES.			CHECKED	R.L.L.
			DATE	12/10/74

APPROVED
 R. J. G. L. W. E. Y.
 CHIEF ENGINEER
 P M 3510 B



STANDARD SPECIFICATION SM2.

SUPPLY AND INSTALLATION OF LOW PRESSURE DUCTWORK.

RTI Released

DEPARTMENT OF WORKS,
ENGINEERING BRANCH.

The use of basic material, from the Australian Government's Department of Works Standard Specification "Low Pressure Ductwork", is gratefully acknowledged.

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STANDARD SPECIFICATION SM2

SUPPLY AND INSTALLATION OF

LOW PRESSURE DUCTWORK

1.0 SCOPE

This Standard Specification sets out the Department's requirements for the design, quality of materials and standards of construction which shall be adopted in the manufacture and installation of ductwork and accessories for air conditioning, evaporative cooling, heating and ventilation (supply and exhaust) systems and (mechanical or natural) canopies. (Canopies shall be made from either Galvabond, Aluminium or Stainless Steel Sheet as specified in the Work Specification).

2.0 USE OF THIS STANDARD SPECIFICATION

Where this Standard Specification describes various methods of construction and/or installation under one heading, the method to be used is that described in the Work Specification.

3.0 ASSOCIATED SPECIFICATIONS, STANDARDS AND DRAWINGS

The following specifications, standards and drawings including any subsequent amendments shall apply.

3.1 SPECIFICATIONS

- (a) SM1 - Standard Requirements for Mechanical Installations
- (b) SM5 - Insulation and Sound Absorption Treatment of Ductwork and Air Handling Equipment
- (c) SM6 - Surface Preparation and Coating for Corrosion Protection

3.2 STANDARDS

- (a) AS 1131 - 1973 - Dimensions of hot-rolled structural steel sections.
- (b) AS 1204 - 1972 - Structural steels - Ordinary weldable grades.
- (c) AS 1530 - Fire tests on building materials and structures.
Part 2 - 1973 - Test for Flammability of materials.
Part 3 - 1976 - Test for early fire hazard properties of materials.
- (d) AS 1668 - SAA Mechanical Ventilation and Air Conditioning Code.
Part 1 - 1974 - Fire precautions in buildings with air handling equipment.
- (e) AS 1796 - 1975 - SAA Welding Certificate Code.
- (f) AS H49 - 1972 - Aluminium alloy ingots and castings for general engineering purposes.
- (g) AS K150 - Anodized aluminium
Part 1 - 1969 - Architectural applications.
- (h) Building Acts of 1975.
- (i) Fire and Accident Underwriters Association of Queensland.

3.3 DRAWINGS

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- (cc) PM4929 SUPPLY AIR OUTLETS - CEILING TYPES (ON FLEXIBLE BRANCHES)
- (dd) PM4930 SUPPLY AIR OUTLETS - WALL TYPE
- (ee) PM4931 VOLUME CONTROL DAMPERS
- (ff) PM4932 MULTIBLADE DAMPERS
- (gg) PM4933 MULTIBLADE DAMPER CONSTRUCTION
- (hh) PM4934 MANHOLES AND HANDHOLES
- (ii) PM4935 SERVICE ACCESS FOR U. V. LAMPS
- (jj) PM4936 HANGERS FOR VERTICAL DUCTS
- (kk) PM4937 HANGERS FOR DUCTS
- (ll) PM4938 HANGERS FOR DUCTS
- (mm) PM4939 HANGERS FOR DUCTS - TWO OR MORE DUCTS ABOVE EACH OTHER
- (nn) PM4940 BALANCING POINTS
- (oo) PM4941 WEATHERPROOFING FLEXIBLE CONNECTIONS

4.0 MATERIAL

4.1 SHEET METAL

Ducts shall be constructed from Lysaghts "Galvabond Class 300" galvanised sheet steel, or equal quality, to the base metal gauges tabulated hereunder. Refer to clause 8.0 for Construction details.

<u>DUCT - Longest side dimension</u>	<u>Normal Thickness</u>
Up to 600 mm	0.600 mm
above 600 mm to 1200 mm	0.800 mm
above 1200 mm to 1500 mm	1.000 mm
above 1500 mm to 2100 mm	1.000 mm
above 2100 mm	1.200 mm

4.2 ROLLED STEEL ANGLES

Rolled steel angles shall be of mild steel conforming with AS 1204 and dimensions of the angles shall conform with AS 1131.

4.3 RIVETS

Rivets shall be galvanised tinsmith rivets, or, expanding solid end type rivets of 5% magnesium alloy, "Imex" brand or equal. Rivets fixing sheet metal to sheet metal shall be 3 mm diameter and rivets fixing rolled steel angles to sheet metal shall be 5 mm diameter.

4.4 SELF TAPPING SCREWS

Self tapping screws shall be of bright zinc plated or stainless steel and shall only be used where specified in the Work Specification or, when varied, permission to use should be sought from the Inspecting Officer.

4.5 BOLTS

Bolts shall be bright zinc plated steel, with hexagon head and nuts. Where bolted joints are adopted appropriately sized bright zinc plated steel washers shall be used under nuts and minimum thread section to protrude through the nut.

4.6 DUCT HARDWARE

Duct fittings, e. g. bearing housings, and damper quadrants shall be made from any of the following:

- (a) Galvanised or electric zinc plated Mild Steel.
- (b) Bronze, good quality cast or rolled.
- (c) Aluminium alloy die castings, conform to AS H49.

5.0 RECTANGULAR DUCT CONSTRUCTION

5.1 GENERAL

Duct construction for ducts of various widths shall be as illustrated on drawings PM4910, thru PM4914.

Full sheets shall be used where possible and shall be free of any defects, waves or buckles with all bends machine bent to ensure neat and accurate fabrication. Patched or pieced ductwork shall be rejected.

5.2 CROSS BREAKING

All uninsulated ducts and all ducts insulated externally, shall have all sides over 300 mm wide but not greater than 1800 mm wide cross broken. Ducts shall not be cross broken when internally insulated.

Cross breaking of ductwork shall be in panels between angle flanges and stiffeners where fitted. Where air grilles are to be fitted to ductwork with flanges in contact with the duct side, shall not be cross broken.

Where cross breaking of ductwork is required but is impracticable, the ductwork may be left un-cross broken provided the ductwork sheeting is two (2) thicknesses greater than normal. Refer to Clause 4.1 herein.

5.3 JOINTS

(a) Cross Joints - Shop or Field Assembled

Shop or field assembled cross joints shall be as specified in Clause 6.2 herein and as illustrated on drawings PM4902 and PM4903.

The particular joint or joints acceptable are specified in the Work Specification. Where "Angle flanged" cross joints are specified and access to external flanges is difficult, and the duct is large enough to permit internal access, internal angle flanges shall be used. They shall be as specified in Clause 6.2 herein and as illustrated on drawing PM4902.

(b) Cross Joints - Shop Assembled Only:

Cross joints, shop assembled only, shall be as specified in Clause 6.3 herein and as illustrated on drawing PM4904.

(c) Longitudinal Joints:

Longitudinal joints shall be as specified in Clause 6.4 herein and as illustrated on drawing PM4905.

(d) Sealing of Joints

Liquid sealants or mastics are not acceptable for sealing joints airtight, unless the sealant or mastic is held in the joint by lapping metal surfaces or by surfaces in compression. Liquid sealants are "Minnesota Mining Company 3M-EC800" or "Norton BM669". Mastics are "Bostic - Prestic", or "Nonporite - Elastite", or equal.

Where joints intersect, the sheets shall be carefully developed and notched before edges are formed and the finished joint shall have neat fitting edges on corners without gaps or holes. Fitting and sealing of intersection joints shall be as specified in Clause 7.0 herein and as illustrated on drawings PM4906 thru PM4909 and shall apply to all ductwork joints, except those where soldering method shall apply, including all unavoidable holes in the ductwork.

All joints in ductwork shall be airtight. Leaking ductwork shall be replaced at the Contractor's expense.

(e) Soldering of Joints:

All ductwork external to the building and located in close proximity to external walls open to natural elements shall have all jointing fully riveted and soldered. If ductwork is externally insulated, metal sheathing protection shall be provided and the joints of such sheathing shall be riveted and soldered. If ductwork is internally insulated, the duct joints shall be riveted and soldered. Where ductwork is installed to serve research areas where the escape of bacteriological media is to be suppressed for contamination risk purposes, the duct joints shall be riveted and soldered.

Where ductwork has U. V. lamps installed therein all joints shall be riveted and soldered. Access openings shall be provided for maintenance of U. V. lamps, as illustrated on drawing PM4935.

(f) Welding on Galvabond sheets:

Welding by carbon arc or coated metal electric arc processes are permitted where specified in this Specification. After welding, loose or flaking galvanising zinc oxide and slag, shall be removed by wire brushing and the prepared surface painted with one coat of cold galvanising paint.

6.0 ILLUSTRATIONS OF RECTANGULAR DUCT CONSTRUCTION

6.1 ANGLE STIFFENERS:

Angle stiffeners shall be cut from rolled steel angles, drilled for rivets, and shall be in accordance with the illustration on drawing PM4901.

For sizes of angles for various sizes of ducts refer to Clause 8.0 herein and drawings PM4910 thru PM4914.

6.2 CROSS JOINTS SHOP OR FIELD ASSEMBLED:

(a) General

The drawings PM4902 and PM4903 illustrate details of acceptable types of cross joints. The particular cross joints to be used are specified in the Works Specification, and as described hereunder.

(b) Angle Flange Joints (Type A):

Angle flanges shall be fabricated from rolled steel angles drilled for bolts and rivets and welded into a frame, all in accordance with the illustration on drawing PM4901. For sizes of angles for various sizes of ducts refer to Clause 8.0 herein and drawings PM4910 thru PM4914. Rivets shall be 5 mm diameter at 100 mm centres.

The ends of ducts shall be knocked down 6 mm across the flange faces and the double thicknesses of longitudinal joints shall be cut away either before rolling the joints or after the flanges are assembled to the duct, but before knocking down.

Holes in flange angles shall be drilled or punched in a jig or to a template.

Bolt hole clearances shall be 2 mm in diameter and may be slotted. Bolts shall be spaced at 150 mm centres and of sizes specified in Clause 8.0 herein.

Flanges may be outside or inside of ducts. Refer to illustrations on drawing PM4902. When inside the duct and where specified in the Work Specification the flange angles shall be covered with a sheet metal fairing riveted to the duct.

Angles shall be coated for corrosion protection as specified in Clause 15.0 herein. Duct sections shall be bolted together with sufficient mastic between flanges to give an air tight joint. When bolting up, the distance between flange faces shall not exceed 2 mm.

(c) Sheet Metal Joints:

Sheet metal joints shall be rolled formed in a correctly set and adjusted machine to make a tight fitting joint.

When sheet metal joints are allowed in the Work Specification, the successful Contractor shall submit samples of these sheet metal joints to the Inspecting Officer for permission to use prior to fabrication of any ductwork. Refer to Clause 5.0 of Standard Specification SM1. The sample of joints of the types C, D and E illustrated on drawing PM4903, shall each include a cornered ductwork.

Type B-Drive Slip for ducts up to 600 mm longest side.

The ends of duct sections shall be rolled back. At erection, a bar rolled from Galvabond sheet shall be driven across the ends of the duct sections to clasp them together.

Type C-Plain Slip for duct up to 600 mm longest side.

One end of a duct section shall be joggled and inserted into an "S" formed in the end of the adjacent section, or in a separate piece slipped over the end of the adjacent section. The slip shall be fastened with 3 mm diameter rivets at 100 mm centres.

Type D-Reinforced Slip for ducts above 600 mm and up to 2100 mm longest side.

Make the joint as described above for Plain Slip, then reinforce the joint by riveting 38 mm x 38 mm x 3 mm angle to outside of joint with 5 mm rivets at 100 mm centres.

Angles shall be coated for corrosion protection as specified in Clause 15.0 herein. Plain slip joints may be used on adjacent duct sides up to 600 mm wide.

Type E-Bar Slip above 600 mm up to 2100 mm longest side.

A separate "S" shaped bar with a doubled over standing edge for reinforcement shall be formed from Galvabond sheet. The standing edges shall be overlapped at the duct corners and fixed together with not less than two (2) rivets. The ends of the duct sections shall be inserted into the "S" and fastened with 3 mm diameter rivets at 100 mm centres.

6.3 CROSS JOINTS SHOP ASSEMBLED ONLY:

Only shop assembled cross joints may be used to join sheets or two sections of duct to form a longer section for field erection.

Type F-Lapped Riveted and Soldered used on any size duct. Ends of sheets on duct sections shall be lapped 25 mm riveted at 100 mm centres and the outside edges soldered airtight. The ends of longitudinal joints shall be accurately notched before forming the seam. A stiffening angle shall be riveted adjacent to, or within 220 mm of the joint in any duct side greater than 300 mm wide. Stiffening angles shall be coated for corrosion protection as specified in Clause 15.0 herein.

Type G-Acme Lock or Grooved Seam used on any size duct. Edges of sheets shall be rolled formed in a correctly set and adjusted machine. After assembly, the joints shall be hammered tight. Ends of sheets shall be accurately notched before forming the seam. For sealing joints at corner of duct or at intersection of side seam, refer to Clause 7.0 herein and drawings PM4906 thru PM4909.

6.4 LONGITUDINAL JOINTS - SHOP OR FIELD ASSEMBLED

(a) In Corners:

Type H-Pittsburg Seam Edges of adjacent sheets shall be rolled formed in a correctly set and adjusted machine, to make a tight fitting joint. After assembly, the outside edge of one sheet shall be snugly knocked down around the corner.

Type J-Snap Lock Seam Snap lock seams may only be used when permission to use has been obtained from the Inspecting Officer. Refer to Clause 5.0 of Standard Specification SM1. The granting of permission to use will be subject to an inspection of ductwork with snap lock seam currently passing through the factory of the successful Contractor.

Edges of adjacent sheets shall be rolled formed in a correctly set and adjusted machine, to make a tight fitting joint.

For assembly, the edge of one sheet shall be hammered into the seam of the adjacent sheet until it locks tight.

(b) In Flat Sides of Duct:

Acme Lock or Groove Seam (Type G)

Edges of sheets shall be rolled formed in a correctly set and adjusted machine. After assembly, the joint shall be hammered tight.

7.0 DETAILS AT JOINT INTERSECTIONS

7.1 TYPICAL DUCT AND JOINTS:

The drawing PM4906 illustrates a typical duct with the possible combination of joint intersections. Further, drawings PM4906 thru PM4909 illustrate details of each particular joint intersection.

7.2 EXTERNAL FLANGES:

(Joint Types A, to H, or J and A to G)

Turn down duct 6 mm over angle flange. Double thickness of Pittsburgh, Snap Lock and Acme Joints shall be cut away before rolling seam or after assembly of flange to duct. Apply mastic to flange face before bolting up flanges. Refer to drawing PM4906 (Fig. 2) and Clause 6.0 herein for Joint Types.

7.3 INTERNAL FLANGES

(Joint Types A to H or J and A to G)

Turn down duct 6 mm over angle flange. Double thickness of Pittsburgh, Snap Lock and Acme Joints shall be cut away before rolling seam, or after assembly of flange to duct. Apply mastic to flange face before bolting up flanges. Refer to drawing PM4907 (Fig. 1) and Clause 6.0 herein for Joint Types.

7.4 (Joint Types B to H or J and B to G):

Joints Type G, shall be staggered in adjacent duct sections. Apply mastic along corners of duct. Knock 20 mm of bar of joint Type B around corners. Alternatively, insert tongues of 0.600 mm Galvabond into bar at corners. Solder or seal with Prestic or similar. Cut away double thickness of Pittsburgh, Snap-Lock or Acme Joints, before rolling seams. Refer to drawing PM4907 (Fig. 2) and Clause 6.0 herein for Joint types.

7.5 (Joint Types G to C or D and H or J to C or D):

Joint Type G, shall be staggered in adjacent duct sections. Double thickness of Pittsburgh, Snap-Lock and Acme Joints shall be cut away before rolling seam. Refer to drawing PM4908 (Fig. 1) and Clause 6.0 herein for Joint Types.

7.6 (Joint Types E to G and E to H or J):

Joints Types G shall be staggered in adjacent duct sections. Double thickness of Pittsburgh, Snap-Lock and Acme Joints shall be cut away before rolling seam. Refer to drawing PM4908 (Fig. 2) and Clause 6.0 herein for Joint Types.

7.7 (Joint Types G to H or J and G to G):

Cross joints Type G in adjacent duct sides shall be staggered at not less than 600 mm apart on ducts up to 300 mm wide on the longest side and not less than 300 mm apart on ducts over 300 mm wide on longest side.

Double thickness of joints at intersections shall be cut away before rolling seams. Seal intersections of joints by soldering.

Refer to drawing PM4909 (Fig. 1) and Clause 6.0 herein for Joint Types.

7.8 (Joint Types F to G and F to H or J) Shop Assembled Only:

Joints Type G shall be staggered in adjacent duct sections. Double thickness Pittsburgh Snap-Lock, Acme Joints shall be cut away before rolling seam.

Seal ends of joints Type G and duct corners by soldering. Refer to drawing PM4909 (Fig. 2) and Clause 6.0 herein for joint Types.

8.0 DUCT CONSTRUCTION DETAILS

8.1 DUCTS UP TO 600 mm WIDE ON LONGEST SIDE. Refer to drawing PM4910

(a) Longitudinal Joints shall be:-

At corners - Pittsburgh (H) or when permission to use Snap-Lock (J)

On sides - Acme Lock or Grooved Seam (G).

(b) Field assembled cross joints shall be Types (A), (B), (C), (D) or (E) as specified in the Work Specification. Where angle flanges (A) are specified, angles shall be 32 mm x 32 mm x 3 mm with M6 bolts.

(c) Field assembled cross joints may be up to 4800 mm centres, depending on the available fabricating facilities, and on access for erection on site. Shop assembled cross joints Type (F) or (G) may be used to join sheets for the length of duct section required.

(d) Stiffeners (R) shall be 25 mm x 25 mm x 3 mm angles welded into a frame and fixed to all 4 sides of the duct at 2400 mm maximum centres.
Stiffeners (R) shall be omitted if field cross joints are spaced at not greater than 2400 mm centres.

(e) Ducts which are uninsulated shall have all sides over 300 mm wide, cross broken. Cross breaking shall be in panels not greater than 1200 mm long. Panels of cross breaking shall be located between stiffeners and angle flanges.

(f) Ducts shall not be cross broken when insulated internally. Refer to Clause 5.2 herein
When an air grille is to be fitted to a duct side with the flanges in contact with the duct, the duct side shall not be cross broken.

8.2 DUCTS ABOVE 600 mm to 1000 mm WIDE ON LONGEST SIDE Refer to drawing PM4911

(a) Longitudinal Joints shall be:-

At corners - Pittsburg (H) or when permission to use, Snap-Lock (J)

On Sides - Acme Lock or Grooved Seam (G)

(b) Field assembled cross joints shall be Types (A), (D), (E) as specified in the Work Specification and depending on the width of the duct. Where angle flanges (A) are specified, angles shall be 38 mm x 38 mm x 3 mm with M6 bolts.

(c) Field assembled cross joints may be up to 4800 mm centres depending on the available fabricating facilities, and on access for erection on site. Shop assembled cross joints Type (F) or (G) may be used to joint sheets for the length of duct section required.

(d) Stiffeners (R) shall be 25 mm x 25 mm x 3 mm angles welded into a frame and fixed to all 4 sides of the duct at 2400 mm maximum centres. Stiffeners (R) shall be omitted if field cross joints are spaced at not greater than 2400 mm centres.
Stiffeners (R) shall be 25 mm x 25 mm x 3 mm angles, fixed to any duct side over 600 mm wide, at 1200 mm maximum centres.

(e) Ducts which are uninsulated shall have all sides over 300 mm wide, cross broken. Cross breaking shall be in panels not greater than 1200 mm long. Panels of cross breaking shall be located between stiffeners and angle flanges.

(f) Ducts shall not be cross broken when insulated internally. Refer to Clause 5.2 herein.
Where an air grille is to be fitted to a duct side with the flanges in contact with the duct, the duct side shall not be cross broken.

8.3 DUCTS ABOVE 1000 mm to 1500 mm WIDE ON LONGEST SIDE. Refer to drawing PM4912

(a) Longitudinal Joints shall be:-

At corners - Pittsburg (H) or when permission to use Snap Lock (J)

On Sides - Acme Lock or Grooved Seam (G)

(b) Field assembled cross joint shall be types (A), (D), (E) as specified in the Work Specification, and depending on the width of the duct. Where angle flanges (A) are specified, angles shall be 38 mm x 38 mm x 3 mm with M8 bolts.

(c) Field assembled cross joints may be at up to 4800 mm centres depending on the available fabricating facilities, and on access for erection on site. Shop assembled cross joints Types (F) or (G) may be used to join sheets for the length of duct sections required.

(d) Stiffeners (R) shall be 38 mm x 38 mm x 3 mm angles welded into a frame and fixed to all 4 sides of the duct at 2400 mm maximum centres.
Stiffeners (R) shall be omitted if field cross joints are spaced at not greater than 2400 mm.
Stiffeners (P) shall be 38 mm x 38 mm x 3 mm angles fixed to any duct side over 600 mm wide, at 1200 mm maximum centres.

(e) Ducts which are uninsulated shall have all sides over 300 mm wide, cross broken. Cross breaking shall be in panels not greater than 1200 mm long. Panels of cross breaking shall be located between stiffeners and angle flanges.

(f) Ducts shall not be cross broken when insulated internally. Refer to Clause 5.2 herein. Where an air grille is to be fitted to a duct side with the flanges in contact with the duct, the duct side shall not be cross broken.

8.4 DUCTS ABOVE 1500 TO 2250 mm WIDE ON LONGEST SIDE. Refer to drawing PM4913

(a) Longitudinal joints shall be:-

At Corners - Pittsburgh (H) or when permission to use Snap Lock (J)
On Sides - Acme Lock or Grooved Seam (G)

(b) Field assembled cross joints shall be types (A), (D) or (E) on ducts up to 2100 mm wide and as specified in the Work Specification, or angle flanges (A) for ducts over 2100 mm wide longest side. Where angle flanges (A) are specified, angles shall be 38 mm x 38 mm x 3 mm with M10 bolts.

(c) Field assembled joints may be at up to 2400 mm centres, depending on the available fabricating facilities, and on access for erection on site. Shop assembled cross joints Types (F) or (G) may be used to join sheets for the length of duct section required.

(d) Stiffeners (R) shall be 38 mm x 38 mm x 3 mm angles welded into a frame and fixed to all 4 sides of the duct at 1200 mm maximum centres. Stiffeners (R) shall be omitted if field cross joints are spaced at not greater than 1200 mm centres. Stiffeners (P) shall be 38 mm x 38 mm x 3 mm angles fixed to any duct side over 1500 mm wide at 600 mm maximum centres. Sides up to 1500 mm wide require no stiffening angles between the field assembled cross joint and stiffener (R), or between field assembled cross joints, where these are not greater than 1200 mm centres.

(e) Ducts shall not be cross broken.

8.5 DUCTS OVER 2250 mm WIDE ON LONGEST SIDE. Refer to drawing PM4914

(a) Longitudinal joints shall be:-

At Corners - Pittsburgh (H) or when permission to use Snap Lock (J)
On Sides - Acme Lock or Grooved seam (G).

(b) Field assembled cross joints shall be angle flanges (A) using 51 mm x 51 mm x 5 mm angles with M10 bolts.

(c) Field assembled cross joints may be at up to 2400 mm centres, depending on the available fabricating facilities, and on access for erection on site. Shop assembled cross joints Types (F) or (G) may be used to join sheets for the length of duct section required.

(d) Stiffeners (R) shall be 51 mm x 51 mm x 5 mm angles welded into a frame and fixed to all 4 sides of the duct at 1200 mm maximum centres. Stiffeners (R) shall be omitted if field cross joints are spaced at not greater than 1200 mm centres. Stiffeners (P) shall be 38 mm x 38 mm x 5 mm angles fixed to any duct side over 1500 mm wide at 600 mm maximum centres. Sides up to 1600 mm wide require no stiffening angles between flange angle (A) and stiffener (R), or between field assembled cross joints where these are spaced at not greater than 1200 mm centres.

(e) Ducts shall not be cross broken.

9.0 TAPERS AND OFFSETS

9.1 TAPERS:

The construction of a typical taper section is illustrated on drawing PM 4915 (Fig. 1)

The taper section shall be constructed of Galvabond sheet, of gauge specified depending on greatest duct dimension, refer to Clause 4.0 herein.

Longitudinal joints shall be Pittsburgh (H) or where permission to use Snap Lock (J). Seams on all four corners with the lock placed on the sides and the top and bottom flanged to fit the lock. Acme Lock (G) may be used in the flat sides.

Shop assembled cross joints Types (F) or (G) may be used to join sheets for large taper sections.

Stiffener angles shall be sized and spaced as for duct sections.

Field cross joints shall be as specified in the Work Specification for straight duct sections. For joint Types refer to Clause 6.0 herein, and drawings PM 4910 thru PM4914.

9.2 DIVERGING SECTIONS:

When a taper is used in a diverging air flow and the duct size increased, the slope of any side shall not exceed 1 in 7 to prevent turbulence and undue friction, as illustrated on drawing PM 4915 (Fig. 2) except where otherwise shown on the Work Specification Drawing/s.

9.3 CONVERGING SECTIONS:

When a taper is used in a converging air flow and the duct size decreased, the slope of any side shall not exceed 1 in 4 to prevent turbulence and undue friction as illustrated on drawing PM 4915 (Fig. 3) except where otherwise shown on the Work Specification Drawing/s.

9.4 OFFSET TYPE 1:

This type of offset may be used to avoid any obstruction where space limitation will not allow bends Type 1 or Type 2, and, shall be used where shown on the Work Specification Drawing/s. Bends Type 3 shall be used in this offset, as illustrated on drawing PM 4915 (Fig. 4)

9.5 OFFSET TYPE 2:

This type of offset is preferred in all cases and shall be used, where shown on the Work Specification Drawing/s, to change direction of the duct either horizontally or vertically. The bends shall preferably be Type 1. Refer to drawing PM 4915 (Fig. 5)

10.0 STREAMLINERS, OBSTRUCTION TO DUCTS AND RESTRICTIONS

10.1 STREAMLINERS:

Where it is impossible to offset a duct around an obstruction such as a pipe or small beam or around a small building column the obstruction may be encompassed with a two piece streamliner as illustrated on drawing PM 4916 (Fig. 1)

The area of duct at the obstruction shall be not less than 80% of the area of the duct before the obstruction.

The taper on the converging and diverging sections shall comply with Clause 9.0 herein.

The streamliner around the obstruction shall be rounded on the air entering side and be tapered to a 60° point on the leaving side. Cross joints shall be as specified in the Work Specification for straight duct sections except those adjacent to the obstruction where Slip Joints (E) or Angle Flanges (A), if the duct depth allows for access to the bolts. Refer to Clause 6.0 herein for Joint Types.

10.2 OBSTRUCTION IN CONTACT WITH AIR SYSTEM:

An obstruction may pass through a duct provided it does not decrease the duct area by more than 20% except that, where the obstruction is of circular cross section up to and including 76 mm outside diameter, the decrease of duct area due to the obstruction may exceed 20%.

A slotted hole may be cut in one section of ductwork to permit installation of duct work around the obstruction. The slotted hole shall be patched, as illustrated on drawing PM 4916 (Fig. 2) before the flange is riveted into place. The obstruction shall be sealed to ductwork with rubber grommets.

10.3 RESTRICTIONS:

Where one side of a duct or a corner of a duct is obstructed by part of a structure or building and space is restricted, the duct may be locally reduced to clear the obstruction, provided that the reduction of duct area does not exceed 20% of the initial area of duct. The tapers of the duct diverging and converging sections shall comply with Clause 9.0 herein. Refer to drawing PM 4917.

11.0 BENDS

11.1 CONSTRUCTION:

For the method of construction of a bend refer to drawing PM 4918. Bends shall be constructed of Galvabond sheet. The sheet gauge shall be selected from the table in Clause 4.0 herein depending on duct width. Bends shall be constructed with Pittsburgh (H) or Snap Lock (J) seams on all corners with the lock placed on the sides and on the top and bottom flanged to fit the lock.

On large ducts shop assembled cross joints Types (F) or (G) shall be used to join sheets.

Stiffening angles shall be sized and spaced as for duct sections illustrated on drawings PM 4910 thru PM 4914.

Field cross joints shall be as specified in the Work Specification for duct straight sections.

11.2 SELECTION OF BENDS:

Bends in duct and at branch connections shall comply with one of the types described below and illustrated on drawing PM 4919.

(a) Bend Type 1:

This type of bend, in which the inside or throat radius of the bend is equal to or greater than three quarters (3/4) of the duct dimension in the direction of the turn, is preferred for all situations.

(b) Bend Type 2 (with throat radius greater than 76 mm):

This type of bend may be used where it is not possible to use bends Type 1 and shall be used where shown on the Work Specification Drawing/s. The throat radius of these bends shall preferably be not less than one quarter (1/4) of the duct dimension in the direction of the turn but, in no case, shall be less than 76 mm.

Bends Type 2 shall be fitted with flat plate stream splitters, the number and spacing of which shall be determined from the chart and instruction on drawing PM 4921.

Each splitter shall be continuous through the full angle of the bend and for a distance of one third (1/3) of the duct width on the trailing end of the bend.

Splitters shall be made from not thinner than 1.200 mm Galvabond sheet. Ends of splitters shall be folded at right angles to the splitter and riveted to the sides of the bend. Where a bend is internally insulated and lined with perforated metal the splitter shall be riveted to the perforated metal lining. Edges of splitters shall be hemmed for stiffening and noise reduction. Hems shall be on the outside of splitters and 38 mm long.

(c) Bend Type 3 (with throat radius less than 76 mm):

Bends Type 3 shall only be installed where shown on the Work Specification Drawing/s.

The throat radius of these bends may be from zero to 76 mm. Bends Type 3 shall be fitted with single thickness, single radius turning vanes. Ends of the vanes shall be folded at right angles to the vane and riveted to the sides of the bend. Where a bend is internally insulated and lined with perforated metal the splitter shall be riveted to the perforated metal lining. Length of vanes between supports shall not exceed 900 mm. Refer to drawing PM 4920.

12.0 ARRANGEMENT OF BRANCH TAKE-OFFS

Acceptable arrangements for branch take-offs are illustrated on drawing PM 4922 and unless specified otherwise in the Work Specification, the bends at branch take-offs shall be made to the proportion as shown on these arrangements.

The type of branch take-off to be used depends on the duct location, duct static pressures, and the ratio of branch air quantity handled by the main duct preceding the branch. The particular type of take-off which shall be used in each location is shown on the Work Specification Drawing/s.

The entry area of branches shall be proportioned for the same velocity as in the main duct. The velocity shall be reduced in the downstream duct only in a straight length - not in a bend.

13.0 ARRANGEMENT OF TEES

Tees shall comply with one of the types described below and illustrated on drawing PM 4923.

13.1 TEE TYPE 1:

This is the preferred method of taking a tee connection from a duct, and shall be used whenever space will allow it, and where shown on the Work Specification Drawing/s. Refer to the illustration on drawing PM 4923.

13.2 TEE TYPE 2:

This is an alternative method of taking a tee connection from a duct, and shall be used when space does not permit the use of Tee Type 1, and where shown on the Work Specification Drawing/s. Refer to the illustration on drawing PM 4923.

13.3 TEE TYPE 3:

This is an alternative method of taking a tee connection from a duct, and shall be used only where shown on the Work Specification Drawing/s. Refer to the illustration on drawing PM 4923.

14.0 CONSTRUCTION OF BRANCH CONNECTIONS AND END CLOSURES

14.1 BRANCH CONSTRUCTION:

Branch ducts may be connected to a main duct by one of the types of joints illustrated on drawing PM 4924.

14.2 DUCT END CLOSURES:

Ends of ducts shall be sealed with removable cover plates constructed as illustrated on drawing PM 4924.

The joints of the end closure shall be sealed with liquid sealant.

15.0 CORROSION PROTECTION OF ANGLE FLANGES, STIFFENERS AND HANGERS

15.1 GENERAL:

The following coatings for protection against corrosion shall be applied to all rolled steel angles used for flanges, hangers, or stiffeners or ductwork, after fabrication and before the angles are assembled to the duct.

15.2 DUCTS NOT EXPOSED TO WEATHER AND NOT IN VIEW:

Angles shall be cleaned and painted as specified in Clause 9.03 of Standard Specification SM6.

15.3 DUCTS NOT EXPOSED TO WEATHER AND IN VIEW:

Treatment as specified in Clause 9.04 of Standard Specification SM6.

15.4 DUCTS EXPOSED TO WEATHER:

Angles shall be treated as specified in Clause 9.05 of Standard Specification SM6.

16.0 ERECTION OF EXPOSED DUCTWORK

Where two or more ducts are installed adjacent to each other and are in view, angle flanges and stiffeners shall be in line to present a neat appearance. Where space limitations prevent the lining up of angle flanges and stiffeners, they shall be nested together.

17.0 SUPPLY AIR OUTLETS, EXHAUST INTAKES AND GRILLES

17.1 GENERAL:

Number, sizes and final positions of air outlets, intakes and grilles shall be selected by the Contractor and shall be set by him to provide satisfactory distribution of the air quantities to obtain the conditions and noise levels specified in the Work Specification.

The number and position of all outlets shown on the Work Specification Drawing/s is for the guidance of the Contractor only.

All outlets, intakes and grilles shall be of the types indicated on the Work Specification Drawing/s, and shall be machine made of established designs. The Contractor shall submit an itemised list of the number of outlets, grilles and intakes, make, size and type of fittings, air quantities settings and air face velocity per room. Before ordering any type of air outlet, intake or grille, the Contractor shall establish that all details of the wall or ceiling to which the outlets (orientates) are to be fitted have been finally decided; and shall submit for permission to use samples of the outlets proposed, with drawing/s showing edge details and fixing methods. Refer to Clause 5.0 of Standard Specification SM1.

All outlets shall be of proprietary manufacture fabricated from extruded aluminium cross sections. Each shall be complete with accessories ensuring even distribution of air over the face and a means of adjusting the air volume rate delivered. The heads of fasteners shall not be visible from the conditioned space and no air shall by-pass the discharge orifice of the fitting.

All registers shall be of uniform size with the surround formed to fit the ceiling tile system.

Outlets generally shall be selected on the basis of air distribution and the combined effect of sound levels of all supply and return air fittings in the individual areas served.

Unless otherwise specified, all outlets, intakes, and grilles, shall have an anodised finish of selected (not necessarily standard) colours. Where it is selected that outlets, intakes, and grilles have a colour matching that of adjoining surfaces, the Contractor shall arrange to obtain a paint sample, in order to achieve as close a colour match as possible.

Where the outlet centre is clipped in position (and thus can readily be removed) the volume regulator shall have the feature that it can be easily adjusted without having to remove any part of the outlet.

Each exhaust or return air intake shall be complete with an opposed blade volume regulator. Except where the intake centre is clipped in position (and thus can be easily removed) the volume regulator shall have the feature that it can be easily adjusted without having to remove any part of the intake.

Outlets shall be installed as illustrated on drawings PM 4925 thru PM4930 and as described hereunder.

17.2 SUPPLY AIR/OUTLETS - CEILING TYPES:

(a) Square Outlet Taken Direct From Duct:

Where the Work Specification Drawing/s show square or rectangular outlets connected rigidly to a duct directly above the outlet, the installation shall be as illustrated on drawing PM 4925.

(b) Round Outlet Taken Direct From Duct:

Where the Work Specification Drawing/s show round ceiling outlets connected rigidly to a duct directly above the outlet, the installation shall be as illustrated on drawing PM 4926 (Fig. 1)

(c) Outlet at End of Duct:

All outlets connected to the end of a duct run shall be provided with a cushion head as illustrated on drawing PM 4926 (Fig. 2)

(d) Outlets in Rigid Branch:

Where the Work Specification Drawing/s show outlets to be branched off a duct, the installation shall be as illustrated on drawing PM 4927.

(e) Outlets on Flexible Branch - Volume Control at Main Duct:

Where shown on the Work Specification Drawing/s, ceiling outlets connected to the main duct by flexible ducts, shall be installed in accordance with method 'A' or 'B' illustrated on drawing PM 4928. With these methods, the outlet volume control shall be located at the connection to the main duct and the take-off shall be either Type 1 or Type 2 as shown on the Work Specification Drawing/s.

(f) Outlets on Flexible Branch - Volume Control at Outlet:

Where shown on the Work Specification Drawing/s, ceiling outlets of round, square or rectangular type, connected to the main duct by flexible ducts, shall be installed in accordance with method 'C' illustrated on drawing PM 4929. The damper box shall be as specified in the Work Specification.

17.3 SUPPLY AIR OUTLETS - WALL TYPE:

Wall outlet registers shall be of the double deflection type provided with horizontal and vertical vanes, each set being individually adjustable. Vanes shall be a tight fit on spindles so that they will not vibrate loose and generate noise.

Wall outlets shall be installed as illustrated on drawing PM 4930. Where the length of neck from the duct to the outlet grille is equal to or exceeds two and a half (2-1/2) times the neck width, the outlet may be connected with either a Branch Type 1 or Type 3. Where the length of neck from the duct to the outlet grille is less than two and a half (2-1/2) times the neck width, the outlet shall be connected with a Branch Type 2. Ductwork shall be painted matt black internally local to outlet.

17.4 RETURN AIR INTAKES - CEILING AND WALL TYPES:

(a) Ceiling Types:

Return air grilles in the ceiling shall be of similar appearance and construction to the ceiling mounted supply air diffuser and be complete with volume control dampers.

(b) Wall Mounted Type:

Return air grilles in the wall shall be of similar appearance and construction to the wall mounted supply air diffuser but shall have fixed horizontal louvres mounted in a heavy frame and shall be complete with volume control damper.

Ductwork shall be painted matt black internally, local to intake.

17.5 AIR TRANSFER GRILLES:

Air transfer grilles shall be of aluminium construction comprising a double frame for mounting in the lower panel of the doors or wall, as indicated on the Work Specification Drawing/s. The external frame shall have fixed V-louvres to give a flush finish on the corridor side of the door.

17.6 EXTERNAL FRESH AIR OR EXHAUST AIR GRILLES:

External Fresh Air or Exhaust Air Grilles shall be of weather-proof construction and shall be constructed with special care to appearance to suit the architectural treatment of the building local to the grilles.

18.0 VOLUME CONTROL DAMPERS

18.1 MULTIVANE DAMPERS:

Construction of this type of damper is illustrated on drawing PM 4931 (Fig. 1). Blades shall be constructed from 0.800 mm Galvabond sheet, pivotted at each end on steel rods and supported by steel sheet side plates and tie bars.

A means shall be provided for adjusting the setting of the blades, and access for this adjustment shall be provided either through an air outlet, when this is close enough to the damper, or through a handhole located in the duct for this purpose. The frame of the damper shall be fixed into the duct by rivetting.

18.2 SPLITTER DAMPER:

The illustration on drawing PM 4921 (Fig. 2) shows a splitter damper installed at a branch connection to a main duct.

The length of a damper blade shall be not less than the width of the branch duct and not less than 300 mm.

Splitter dampers shall not be used where their length would exceed 600 mm.

(a) Damper blades up to 450 mm wide shall be constructed of 1.600 mm Galvabond sheet turned down 25 mm at the sides and turned back 12 mm at the leading edge. The damper blade shall be pivotted on not less than two 50 mm cadmium or zinc plated steel butt hinges. The hinges shall be attached to the damper blade and duct with three 3 mm diameter rivets per hinge leaf.

(b) Damper blades exceeding 450 mm wide shall be constructed of 0.800 mm Galvabond sheet in a double streamline section and pivoted on a hinge rod of not less than 16 mm diameter. The hinge rod shall be cadmium plated steel and shall be supported at each end by bearings as shown. The double streamline blade shall be securely fixed to the hinge rod by spot welding, riveting or screwing.

The damper blade shall be controlled by a rod/s firmly fastened with a hinged fastener near the leading edge of the blade and through a guiding boss/es riveted to the duct. Rod/s shall be cadmium plated steel of the size and numbers illustrated on drawing PM 4931. A 3 mm felt gasket shall be located between the guiding boss and duct side to provide an air seal. The rod/s shall be securely clamped to the bosses with set screws.

The damper blades, hinges and adjusting rod/s and their fixing clips, shall not have any slack or excessive clearance which will allow the blade to vibrate. Fixing clips shall be rigidly constructed and fixed to the duct and damper blade.

19.0 MULTI-BLADE DAMPERS OF MOTOR OPERATED AND MANUAL TYPES

19.1 GENERAL:

Multi-blade dampers shall be of either the parallel blade or opposed blade type as illustrated on drawing PM 4932 (Figs. 1 and 2) and as specified on the Work Specification Drawing/s.

Motor operated dampers shall be full duct size unless otherwise specified in the Work Specification or shown on the Work Specification Drawing/s. Where dampers are smaller than duct size, blanking plates shall be provided unless convergent and divergent duct sections are shown on the Work Specification Drawing/s.

Manually operated dampers shall be full duct size unless otherwise specified in the Work Specification or shown on the Work Specification Drawing/s.

Angle flanged cross joints (A) in accordance with Clause 6.0 herein shall be provided on the duct for connection of the dampers. Damper frames shall be drilled to suit bolt holes in the angle flanges.

19.2 DAMPER FRAMES:

Frames shall be constructed of 3 mm Galvabond steel sheet folded to channel sections not less than 152 mm wide. Frames shall be welded at the corners and painted to comply with Clause 5.3 herein and as illustrated on drawing PM 4932 (Fig. 3)

Mullions shall be constructed of 1.600 mm Galvabond steel sheet folded to channel sections and riveted into a box section as illustrated on drawing PM 4933 (Fig. 2)

19.3 DAMPER BLADES:

Blades shall be fabricated from 1.600 mm Galvabond sheet and shall interlock with adjacent blades as illustrated on drawing PM 4933 (Fig. 1). Blades shall not be more than 250 mm wide and shall not exceed 750 mm between supports. Neoprene rubber or felt sealing strips shall be bonded to the tips of the blades to prevent air leakage.

Damper leakage shall not exceed 5% of the maximum design air quantity for the particular damper.

19.4 BEARINGS AND SPINDLES:

Bearings shall be of ball bearing type similar to "Fafnir Flangette" or of self oiling sintered bronze. The housings of bearings shall be riveted or, where permission to use, spot welded to the damper side frames. Spindles shall be of 16 mm diameter and shall be securely fixed to the centre fold of the blades. Spindles may be of the stub type or may be run the full length of the blades.

Spindles shall be cadmium plated.

19.5 LINKAGES:

Dampers shall be linked with tie bars and links arranged to give parallel or contra-rotating action as specified in the Work Specification. Tie bars and links shall be fabricated from bright steel flat bar cadmium plated and shall be jig drilled. Drilling shall be carried out before plating. Link pins shall be of brass and shall be held in position with circlips.

Where two sets of dampers are operated from one motor, the linkage shall be such as to allow either damper to be adjusted as to position and/or amount of movement without affecting the adjustment of the other.

The linkages used with manually operated dampers shall incorporate a means for positioning, locking and indicating the position of the damper.

19.6 MOUNTING OF DAMPER MOTORS:

Generally damper motors shall be mounted on two stiffening bands which shall be bolted to the duct adjacent to the damper assembly. The stiffening bands shall be continuous around the full duct perimeter and shall be fabricated from rolled steel angles of the same size as flanged joint angle, refer to Clause 6.0 herein.

Where dampers in ductwork exceed 1500 mm in width, damper motors shall be located and mounted as specified in the Work Specification.

20.0 FIRE PROTECTION

20.1 FIRE DAMPERS:

Fire dampers shall be constructed and installed to the requirements of AS. 1668 - Part 1, Specification 7 of the Building Act and the Fire and Accident Underwriters Association of Queensland.

20.2 HEATERS IN DUCTWORK

The section of ductwork housing heaters and for a clear distance of 450 mm minimum on each side of the housing shall be insulated internally with a non-combustible material of Thermal Conductance not greater than $30 \text{ W/m}^2\text{K}$ at 98.3°C . The insulation shall be secured to the casing so that it remains in position under all operating conditions.

21.0 MANHOLES AND HANDHOLES

21.1 MANHOLES:

Where required by the Work Specification, ducts with a minimum side of 600 mm or greater shall be fitted with manholes, located where shown on the Work Specification Drawing/s.

Manholes shall be 600 mm x 450 mm.

The ducts shall be reinforced around the hole with a frame pressed from 1.600 mm Galvabond steel sheet and riveted to the duct.

Doors shall be made of 2.000 mm Galvabond steel sheet, stiffened around the edges by either folding or by a frame folded from 2.000 mm Galvabond steel sheet.

Doors shall preferably be hinged with galvanised steel butt hinges and locked with edge-type window sash catches 'Huckson' No.122 or equal. However, wedge type window catches may be used instead of hinges where this facilitates sealing of the door on its gasket. A typical manhole is illustrated on drawing PM 4934.

21.2 HANDHOLES:

Where required by the Work Specification, ducts with a minimum side of less than 600 mm shall be provided with 300 mm x 300 mm handholes or where this size is not possible with square handholes the side length of which shall be 50 mm narrower than the side of the duct in which the handhole is located.

The edges of the hole shall be turned back to made a rounded edge or else a piece of pressed Galvabond steel sheet shall be fitted to obtain a similar result.

Handhole coverplates shall be made from 1.600 mm Galvabond steel sheet. Doors shall be attached to the duct with M6 x 16 mm studs or where the sealing of the door is designed to avoid "Cold Bridging". wedge type window sash catches "Huckson" No. 122 or equal may be used.

A typical handhole is illustrated on drawing PM 4934.

21.3 INSULATING AND SEALING MANHOLE AND HANDHOLE DOORS:

Where the duct is insulated, the door shall be insulated to the same thickness and to the same requirements as the duct. Where insulation is inside the duct the surface of the door insulation shall be flush with that of the duct.

Doors shall be sealed airtight to the duct with suitable gaskets, which shall be securely fixed to either the door or the duct. On the ducts carrying cooled air, the door and door seal shall be particularly designed and constructed to avoid "Cold Bridging" which will result in sweating on the outside of the duct. In these cases the particular design shall be submitted for permission to use. This shall be done without prejudice to the Contract Completion Time, refer to Clause 5.0 of Standard Specification SM1.

22.0 HANGERS FOR DUCTS

22.1 GENERAL:

Unless otherwise specified in the Work Specification hangers for vertical horizontal ducts shall comply with the details, materials, sizes and spacing illustrated on drawings PM 4936 thru PM 4939.

Hangers shall be fabricated from strips of Galvabond steel sheet, rolled steel angles and rolled steel flat and round bars as shown in this Specification.

Where possible, duct hangers shall not be used to hang piping, ceilings or other loads. Where it is necessary to hang items other than ductwork from duct hangers, the maximum stress in hanger rods, straps and bolts shall not exceed 38.0 MPa.

All rolled steel angles and rolled steel flat used for hangers shall be coated for protection against corrosion in accordance with Clause 15.0 herein.

22.2 FIXING OF HANGERS:

Permission to use will not be given for explosive powered fastenings.

The following fixing methods are for attaching hangers to structures except where otherwise specified in the Work Specification.

(a) To Steel or Timber Structures - mild steel bolts of the sizes listed on drawings PM 4936 thru PM 4939.

(b) To Masonry Structures - expanding type plugs used with steel bolts, of sizes listed on drawings PM 4936 thru PM 4939. Plugs shall be equivalent to "Loxins", "Drivets" or "Wej-its". Bolts or nuts cast into concrete structures are acceptable provided that they are fitted with steel washers to adequately distribute the load into the concrete.

23.0 FLEXIBLE CONNECTIONS

Unless otherwise specified in the Work Specification, airtight flexible connection, constructed of PVC (vinyl) coated fabric which has a glass fibre or nylon backing, and a total weight of not less than 580 g/m², shall be fitted to isolate fans and/or conditioner casings from ductwork. These connections shall be arranged to permit the renewal of fabric without disturbing ductwork or plant.

The metal parts of connected equipment shall be separated by not less than 50 mm.

Where flexible connections are exposed to weather, they shall be protected as illustrated on drawing PM 4941.

Items of equipment that shall be connected by a flexible connection shall be aligned within a tolerance of 6 mm for connections up to 38 mm diameter or square, and 12 mm for connections above 38 mm diameter or square.

24.0 FLEXIBLE DUCTING

Flexible ducting shall be constructed of a continuous spring steel wire helix which is clad inside and out with neoprene impregnated calico or fibre glass. The cladding shall be two ply.

The flexible ducting shall be non-combustible when tested for early fire hazard properties in accordance with AS A30 - Part III. Test certificates shall be supplied.

When shown on the Work Specification Drawing/s flexible ducting shall be sized and finally located by the Contractor.

Connection of flexible ducting to spigots of metal ductwork shall be by means of "Jubilee" work-drive type hose clips.

Equivalent, alternative flexible ducting may be submitted by the Contractor for permission to use. Square flexible ducting droppers, where used, shall be constructed of P. V. C. (vinyl) coated fabric which has a nylon backing, and a total weight of not less than 510 grams per square metre. Each corner shall have a 6 mm seam for rigidity along full length of droppers.

25.0 FLASHING

Unless otherwise specified in the Work Specification, flashing of ducts where they pass through roofs or outside walls shall be carried out by the Contractor.

26.0 CLEANING OF DUCTWORK AND PROTECTION DURING CONSTRUCTION

All ducts shall be thoroughly cleaned inside before starting fans.

Covers shall be provided during installation to prevent building materials or rubbish entering the ducts and fans.

27.0 DUCTS THROUGH WALLS

Where ducts pass through walls and are in view, escutcheons shall be provided as specified in the Work Specification.

28.0 BALANCING POINTS

Balancing points shall be provided in the ducts for testing purposes.

They shall be located in main branches adjacent to the connection to the main duct, inlet and outlet of fans, and, in addition, where specified in the Work Specification, balancing points shall be located in the main duct downstream of the branch connection.

Other balancing points shall be located where shown on the Work Specification Drawing/s.

All points shall be in readily accessible positions.

Points shall be provided to the following scale:-

Longest side of duct up to 225 mm - 2 openings.

Longest side of duct above 225 mm to 375 mm - 3 openings.

Longest side of duct above 375 mm to 600 mm - 4 openings.

Longest side of duct above 600 mm to 1200 mm - 5 openings.

Longest side of duct above 1200 mm - 6 openings.

Balancing points shall comprise 38 mm diameter holes drilled in the duct and plugged with rubber grommets all as illustrated on drawing PM 4940.

29.0 PAINTING AND SURFACE PREPARATION

All painting and surface preparation shall be in accordance with Standard Specification SM6, and as indicated hereunder:-

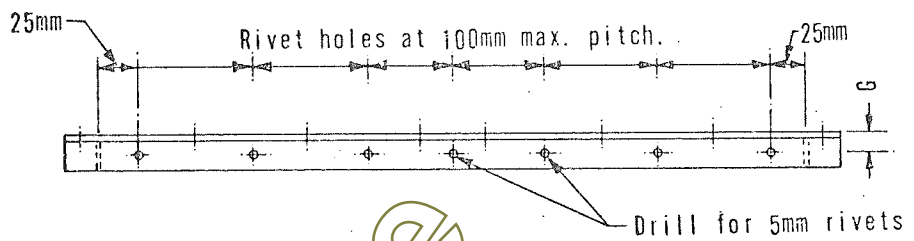
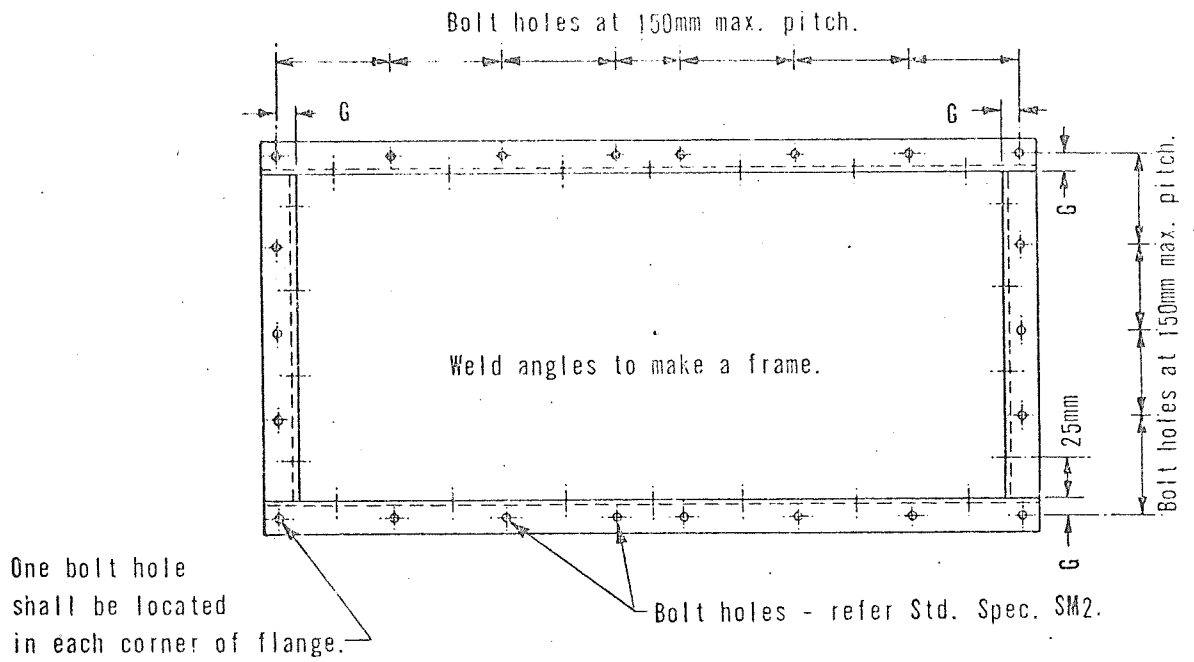
(a) All galvabond or equal ducting concealed from view, but not exposed to the weather, in roof space etc., shall not be painted.

(b) All ductwork and equipment exposed to view but not exposed to the weather, in roof space etc., shall be painted by the contractor.

(c) All ductwork, equipment, hangers and brackets exposed to the weather shall be painted by the contractor.

30.0 SEALING DUCTWORK EXPOSED TO WEATHER

All longitudinal joints and intermediate cross joints shall be sealed by soldering. Angle flanges and angle stiffeners on the duct shall be sealed with a "Butyl" rubber based plastic sealant, "Norton BM669" or equal. The top side of the duct shall be crowned, and the duct side shall be cross broken between the corners and the crown. Stiffening angles on the top side of the duct shall be bent to follow the set of the crown. On ducts above 1500 mm wide, a separate roof over the duct shall be provided so as to properly shed water.



For size of angle - Refer to Std. Spec. SM2.

G = 20mm on 32mm angles

G = 23mm on 38mm angles

G = 29mm on 51mm angles

FIG. 1 ANGLE FLANGE

Drill for 5mm rivets.

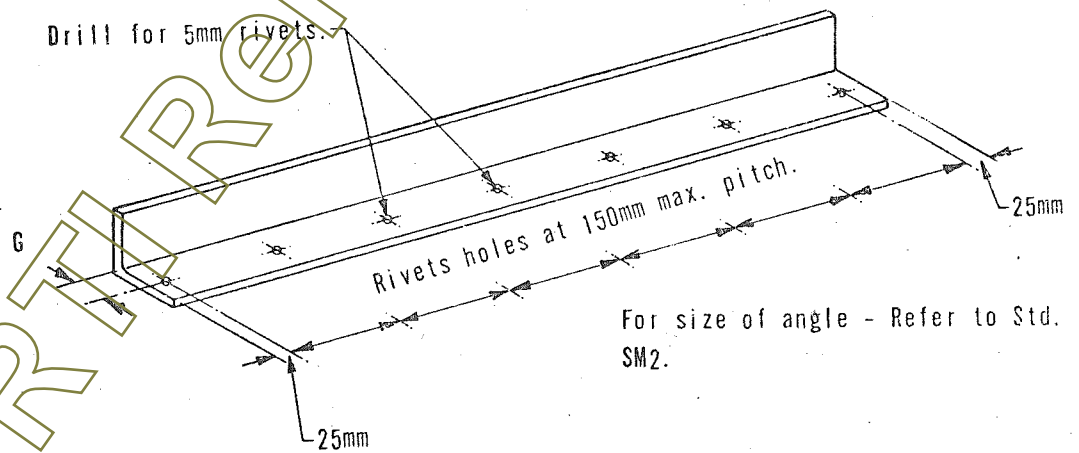


FIG. 2 ANGLE STIFFENER

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ENGINEERING BRANCH

STANDARD DETAIL
LOW PRESSURE DUCTWORK
DUCT ANGLES

SCALE	N. T. S.
DESIGN	REB.
DRAWN	R.J.Y.
CHECKED	<i>[Signature]</i>
DATE	1/1/77

AUTHORISED FOR ISSUE

[Signature]
EXECUTIVE ENGINEER

P/M 4901

SHOP OR FIELD ASSEMBLED

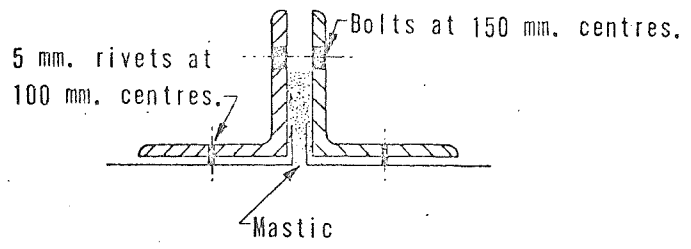


FIG. 1 FLANGES OUTSIDE DUCT

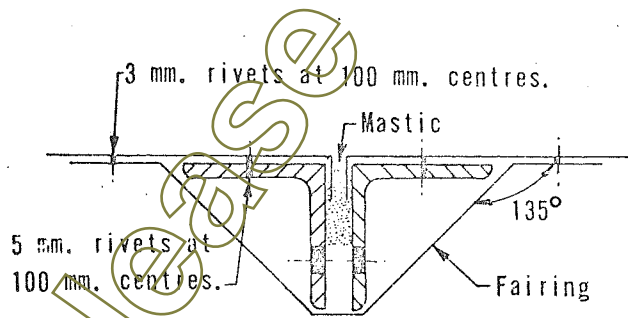


FIG. 2 FLANGES INSIDE DUCT

(A) ANGLE FLANGES - USE ON ALL DUCT WIDTHS

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STANDARD DETAIL LOW PRESSURE DUCTWORK CROSS JOINTS - ANGLE FLANGES	DRAWN	GR.	P M4902
	CHECKED	1/1/77	
	DATE	11/7/77	

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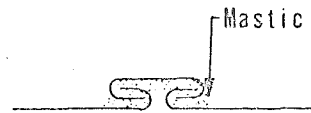


FIG. 1 (B) DRIVE SLIP - USE UP TO 600mm LONGEST DUCT SIDE

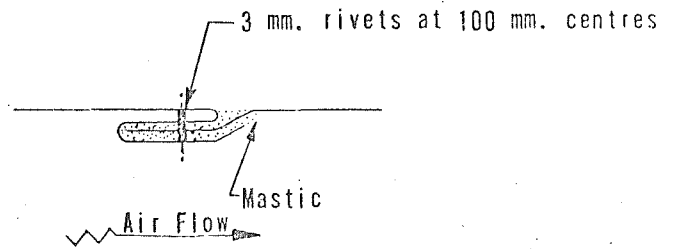


FIG. 2 (C) PLAIN SLIP - USE UP TO 600mm LONGEST DUCT SIDE

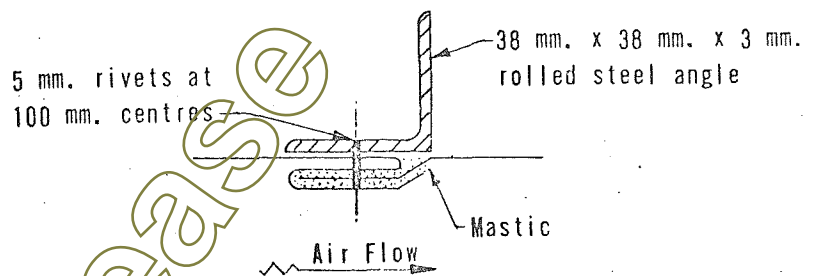


FIG. 3 (D) REINFORCED SLIP - USE UP TO 2100mm LONGEST DUCT SIDE

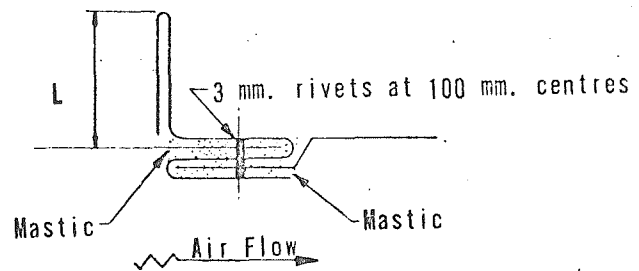


FIG 4 (E) BAR SLIP - USE 'L' = 38mm ON DUCTS ABOVE 600mm TO 1500mm WIDE.

USE 'L' = 50mm ON DUCTS ABOVE 1500mm TO 2100mm WIDE.

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STANDARD DETAIL LOW PRESSURE DUCTWORK CROSS JOINTS - SHEET METAL JOINTS	DRAWN	J.R.	P M4903
	CHECKED	<i>[Signature]</i>	
	DATE	14/7/72	

SHOP ASSEMBLED ONLY

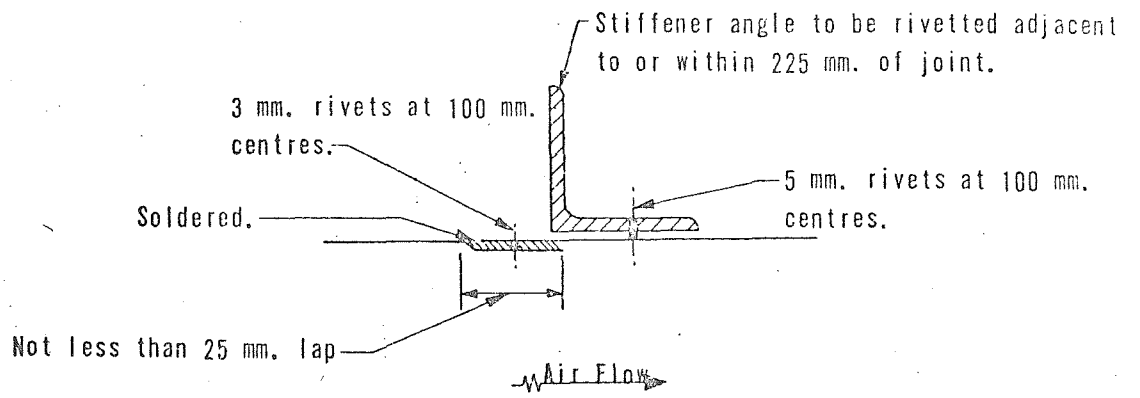


FIG. 1 (F) LAPPED, RIVETTED, AND SOLDERED

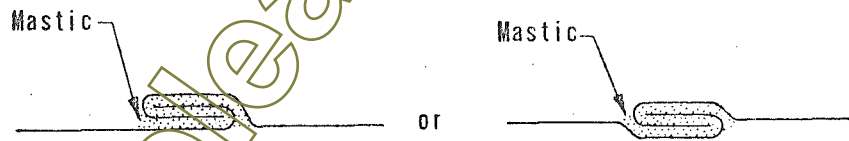


FIG 2 (G) ACME LOCK OR GROOVED SEAM

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STANDARD DETAIL LOW PRESSURE DUCTWORK CROSS JOINTS - SHEET METAL JOINTS	DRAWN	R.J.Y.	
	CHECKED	<i>M.S.</i>	P M4904
	DATE	11/7/77	

SHOP OR FIELD ASSEMBLED

IN CORNERS

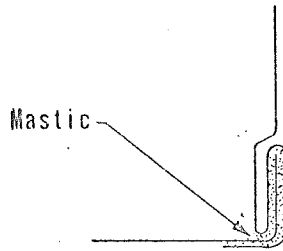


FIG. 1 (H) PITTSBURG SEAM

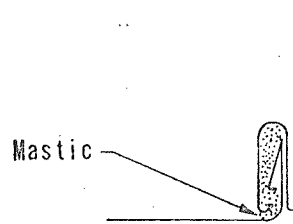


FIG. 2 (I) SNAP LOCK SEAM

IN FLAT SIDE

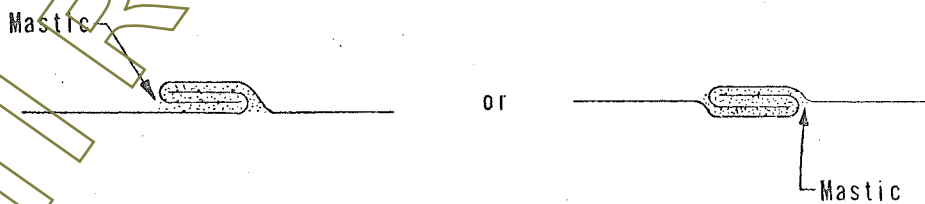
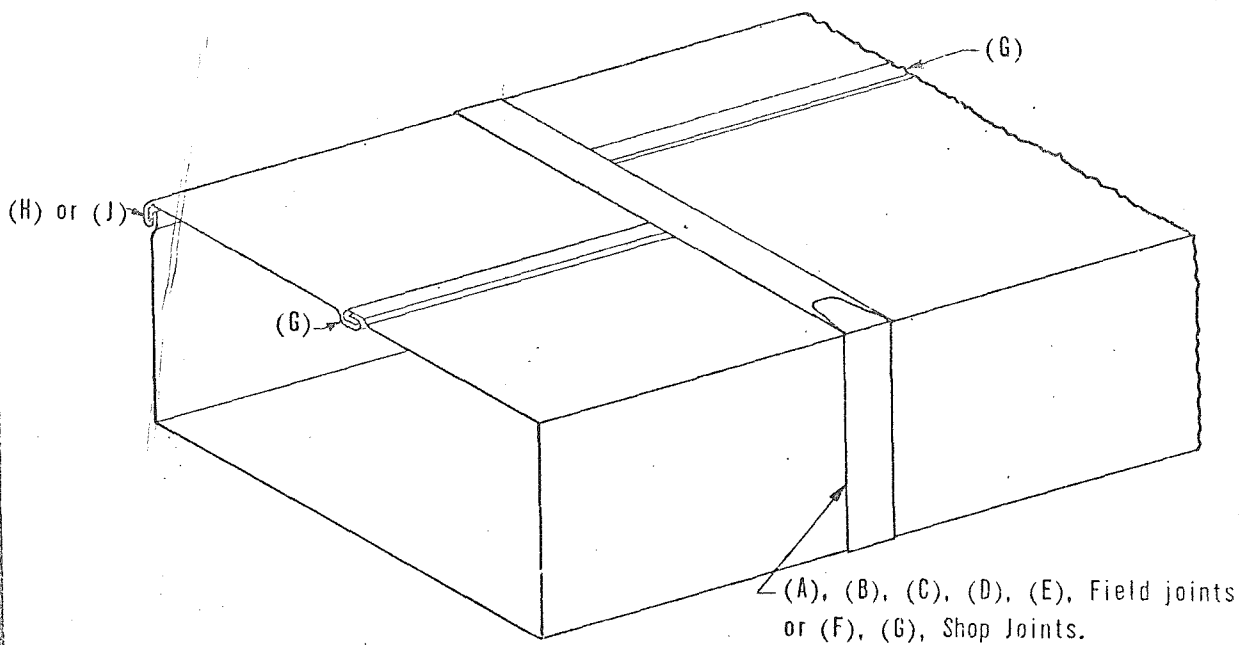


FIG. 3 (G) ACME LOCK OR GROOVED SEAM

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	DESIGN	R.E.B.	
STANDARD DETAIL LOW PRESSURE DUCTWORK LONGITUDINAL JOINTS	DRAWN	J.R.	P M4905
	CHECKED	[Signature]	
	DATE	12/7/76	



(A), (B), (C), (D), (E), Field joints
or (F), (G), Shop Joints.

FIG. 1 TYPICAL DUCT AND JOINTS

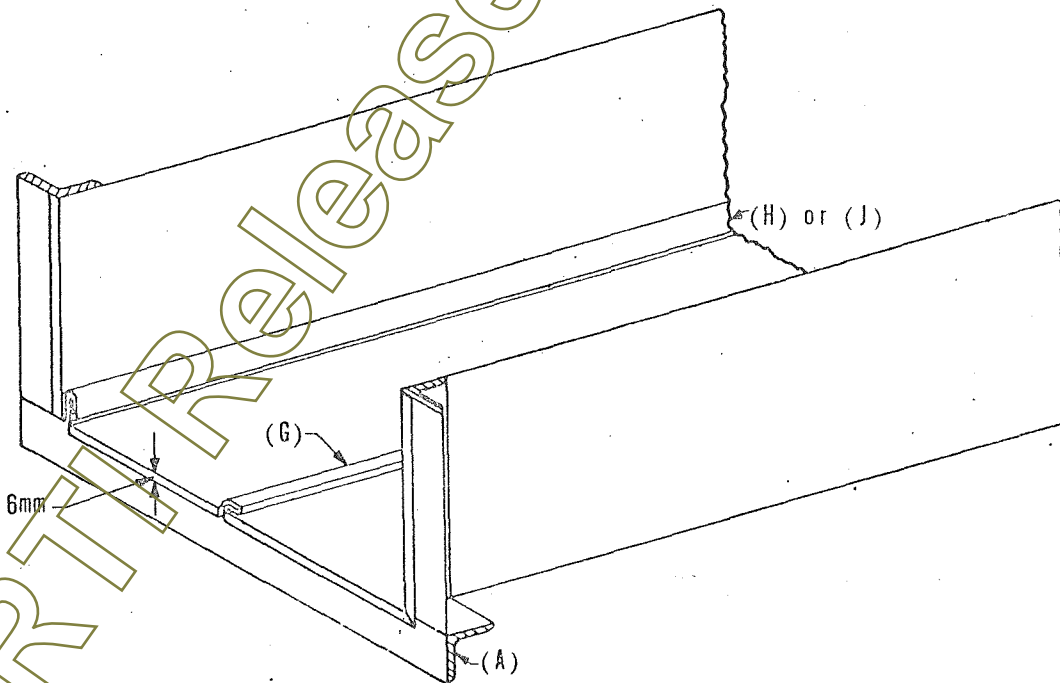




FIG. 2-(A) to (H) or (J) and (A) to (G) EXTERNAL FLANGES.

DEPARTMENT OF WORKS ENGINEERING BRANCH STANDARD DETAIL LOW PRESSURE DUCTWORK DETAILS OF JOINT INTERSECTIONS	SCALE	N.T.S.	AUTHORIZED FOR ISSUE  EXECUTIVE ENGINEER
	DESIGN	REB.	
	DRAWN	R.J.Y.	P M4906
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	DATE	11/7/73	

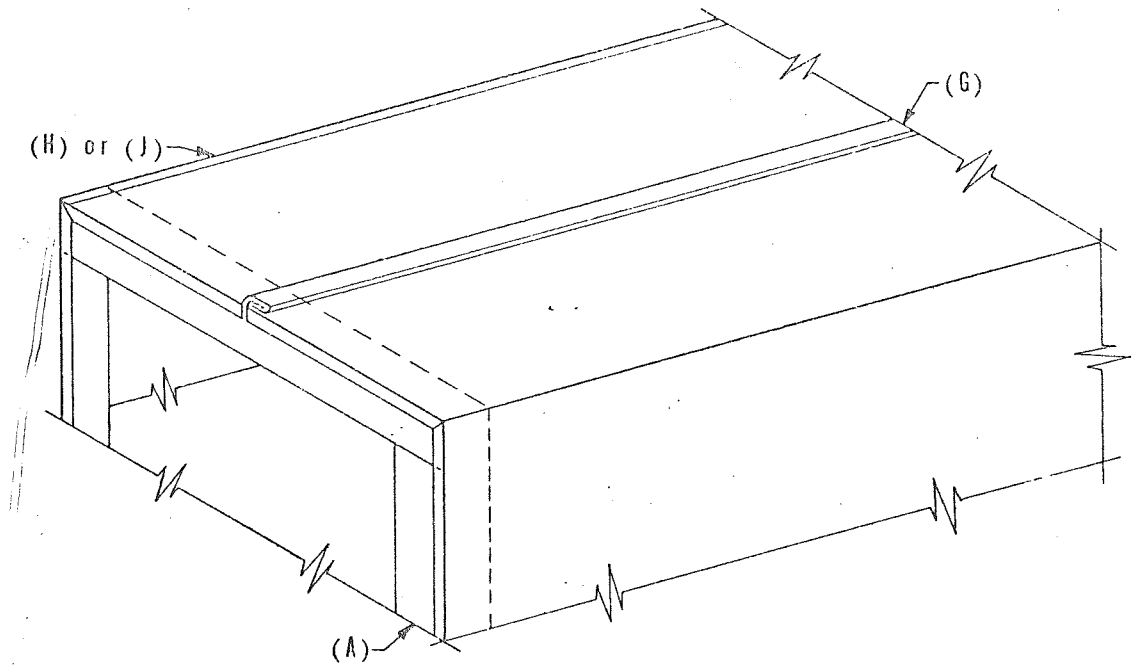


FIG. 1 - (A) to (H) or (J) and (A) to (G) INTERNAL FLANGES

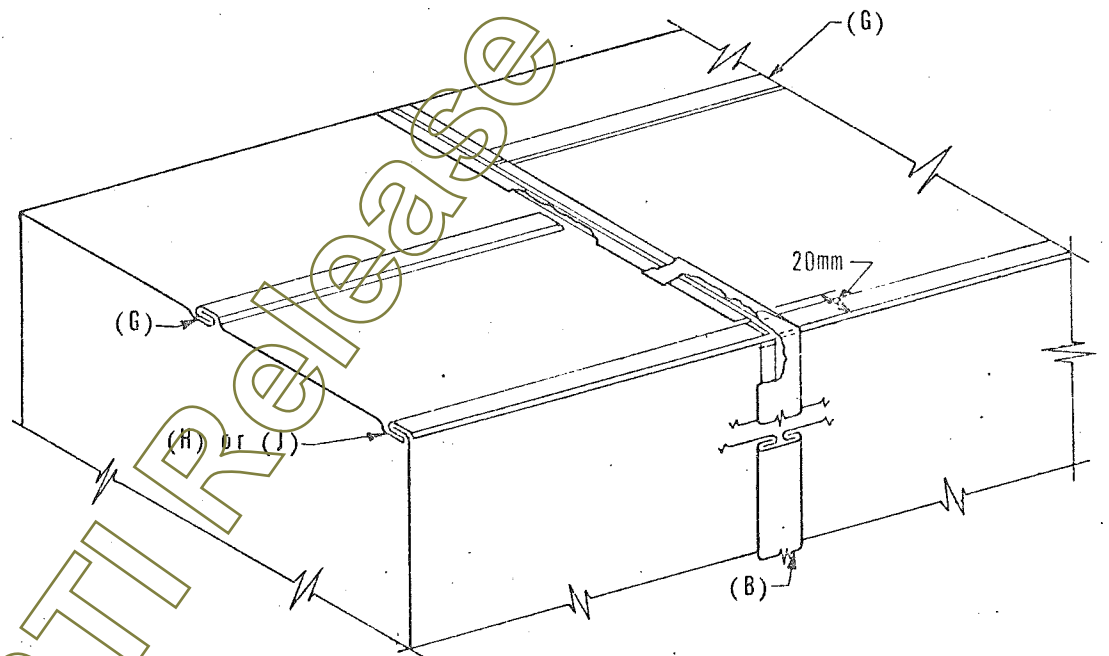


FIG. 2 - (B) to (H) or (J) and (B) to (G).

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	CHECKED	<i>R.E.B.</i>	P M4907
	DATE	14/7/77	
STANDARD DETAIL LOW PRESSURE DUCTWORK DETAILS OF JOINT INTERSECTIONS.			

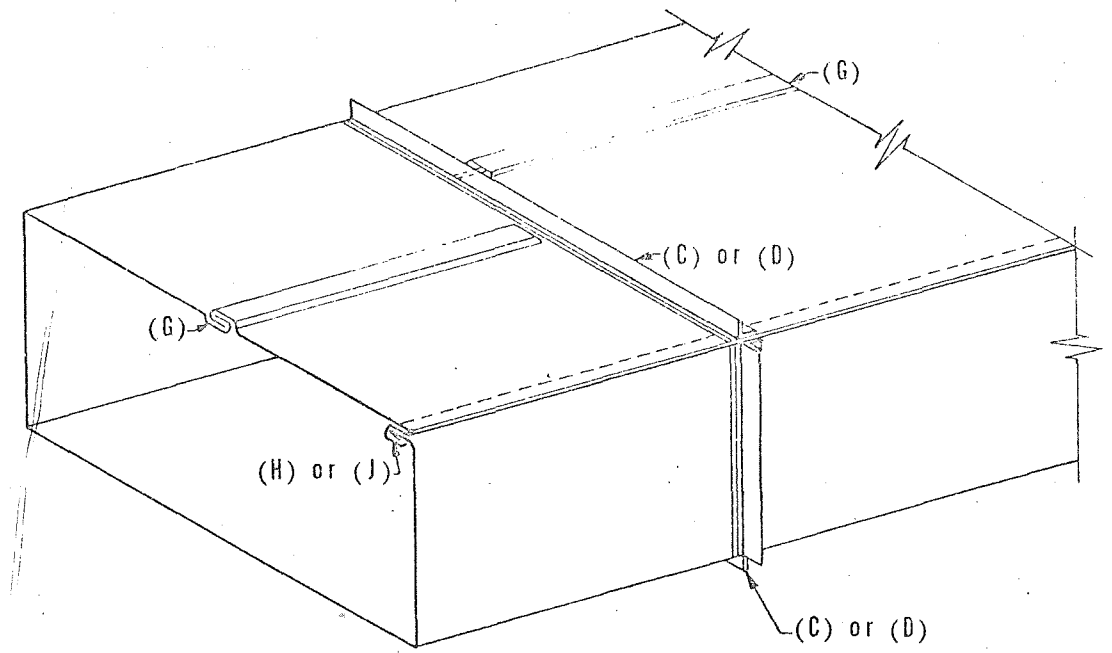


FIG. 1 - (G) to (C) or (D) and (H) or (J) to (C) or (D)

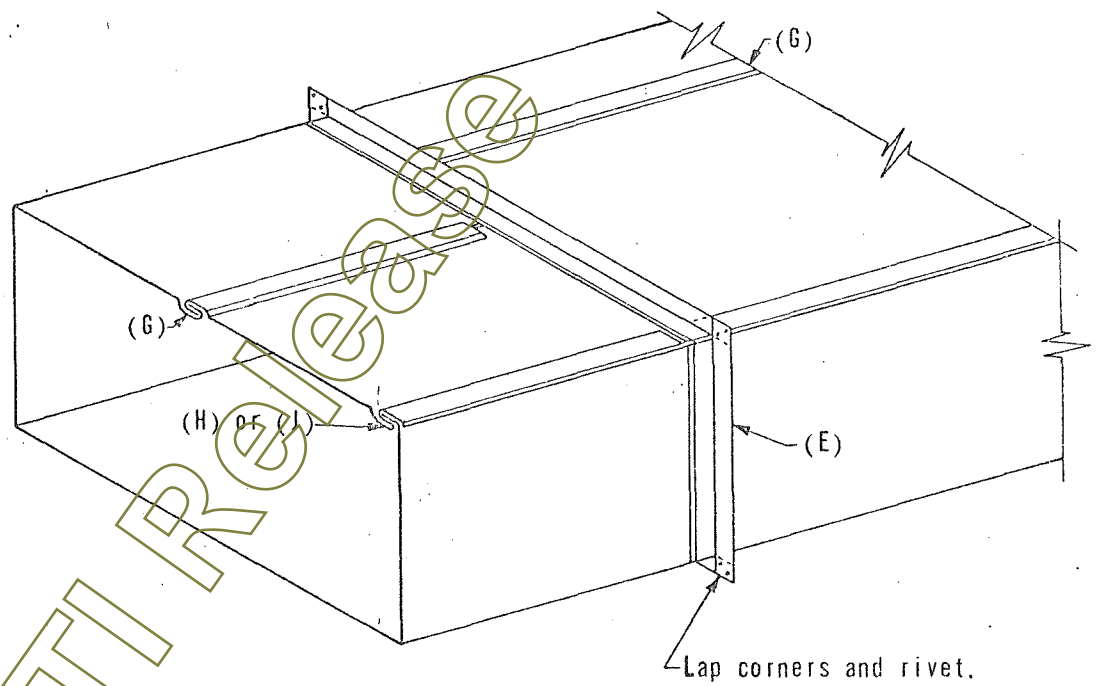


FIG. 2 - (E) to (G) and (E) to (H) or (J).

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DEPARTMENT OF WORKS ENGINEERING BRANCH	SCALE	N.T.S.	AUTHORISED FOR ISSUE
	DESIGN	A.E.B.	<i>R. J. Y.</i> EXECUTIVE ENGINEER
STANDARD DETAIL LOW PRESSURE DUCTWORK DETAILS OF JOINT INTERSECTIONS	DRAWN	R.J.Y.	
	CHECKED	<i>[Signature]</i>	P M4908
	DATE	12/1/73	

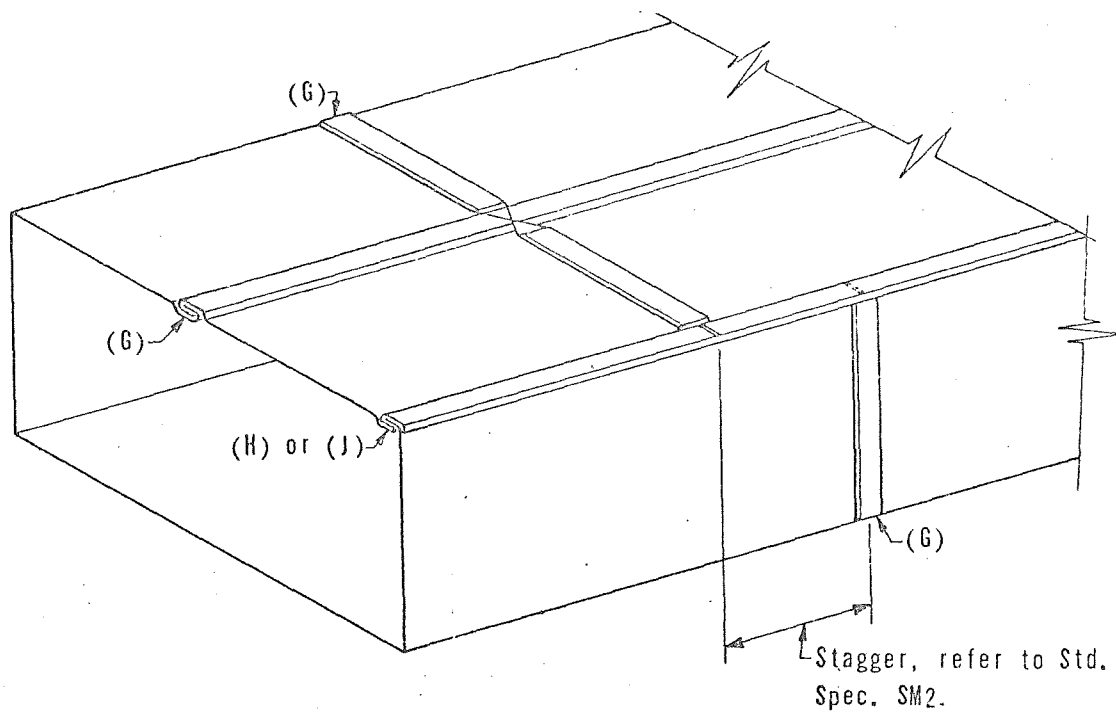


FIG. 1. - (G) to (H) or (J) and (G) to (G).

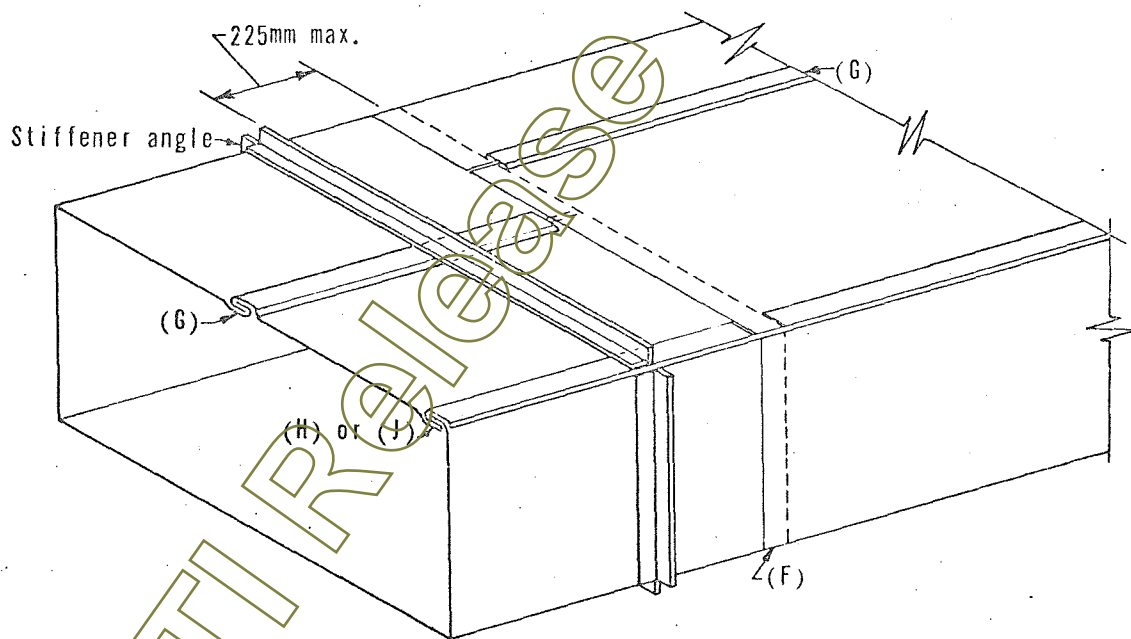


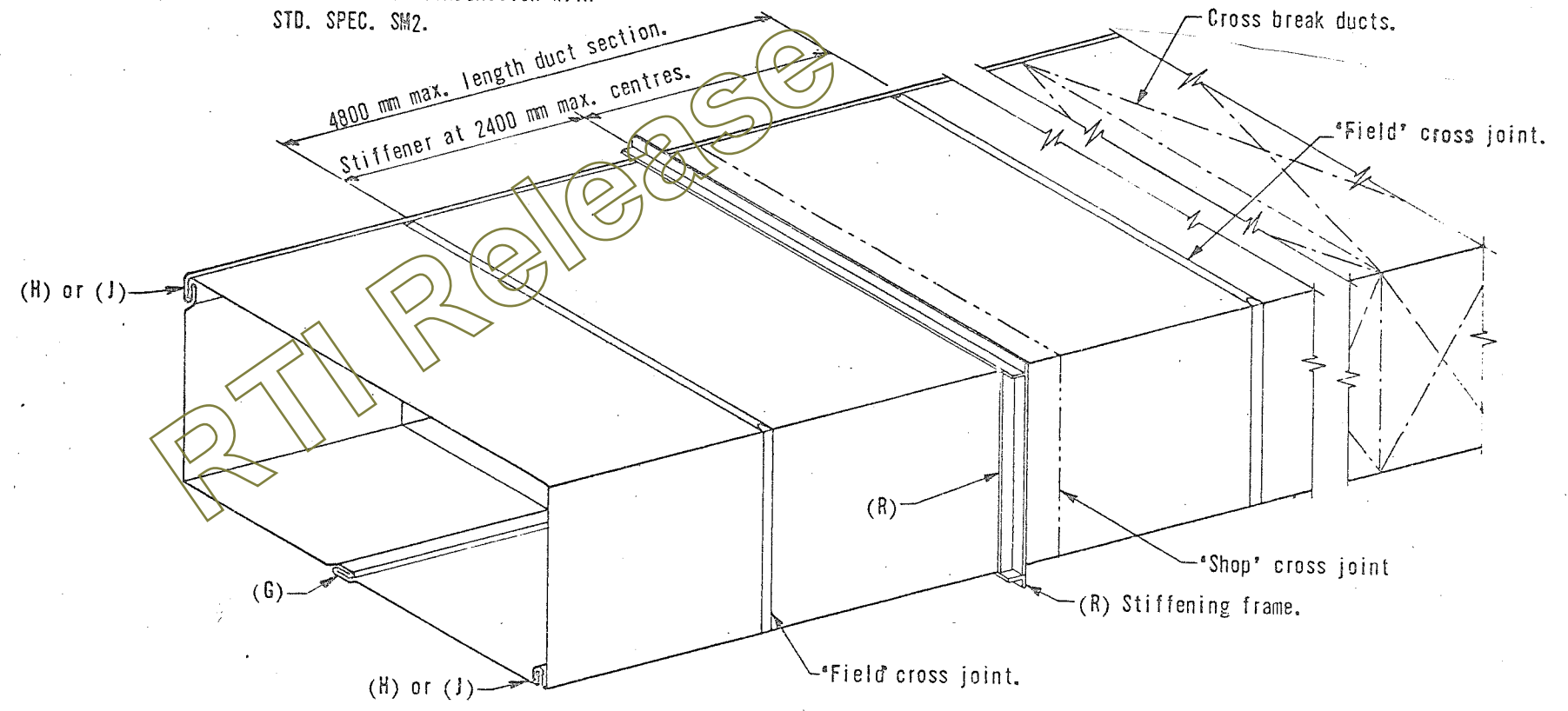
FIG. 2 - (F) to (G) and (F) to (H) or (J) - SHOP ASSEMBLED ONLY.

DEPARTMENT OF WORKS ENGINEERING BRANCH STANDARD DETAIL LOW PRESSURE DUCTWORK DETAILS OF JOINT INTERSECTIONS	SCALE	N.T.S.	AUTHORISED FOR ISSUE <i>R. J. Y.</i> EXECUTIVE ENGINEER
	DESIGN	R.E.B.	
	DRAWN	R.J.Y.	P M4909
	CHECKED	<i>M.A.</i>	
	DATE	11/7/70	

DEPARTMENT OF WORKS
 ENGINEERING BRANCH
 STANDARD DETAIL
 LOW PRESSURE DUCTWORK
 CONSTRUCTION DETAILS - DUCTS UP TO 600mm WIDE ON
 LONGEST SIDE

SCALE	N.T.S.	AUTHORISED FOR ISSUE
DESIGN	A.E.B.	
DRAWN	J.A.H.	
CHECKED		
DATE	11/9/73	
		EXECUTIVE ENGINEER
		P M4910

TO BE READ IN CONJUNCTION WITH
STD. SPEC. SM2.



DUCTS - 0.600 mm thick.

STANDARD DETAIL
 LOW PRESSURE DUCTWORK
 CONSTRUCTION DETAILS - DUCTS ABOVE 600mm TO 1000mm
 WIDE ON LONGEST SIDE

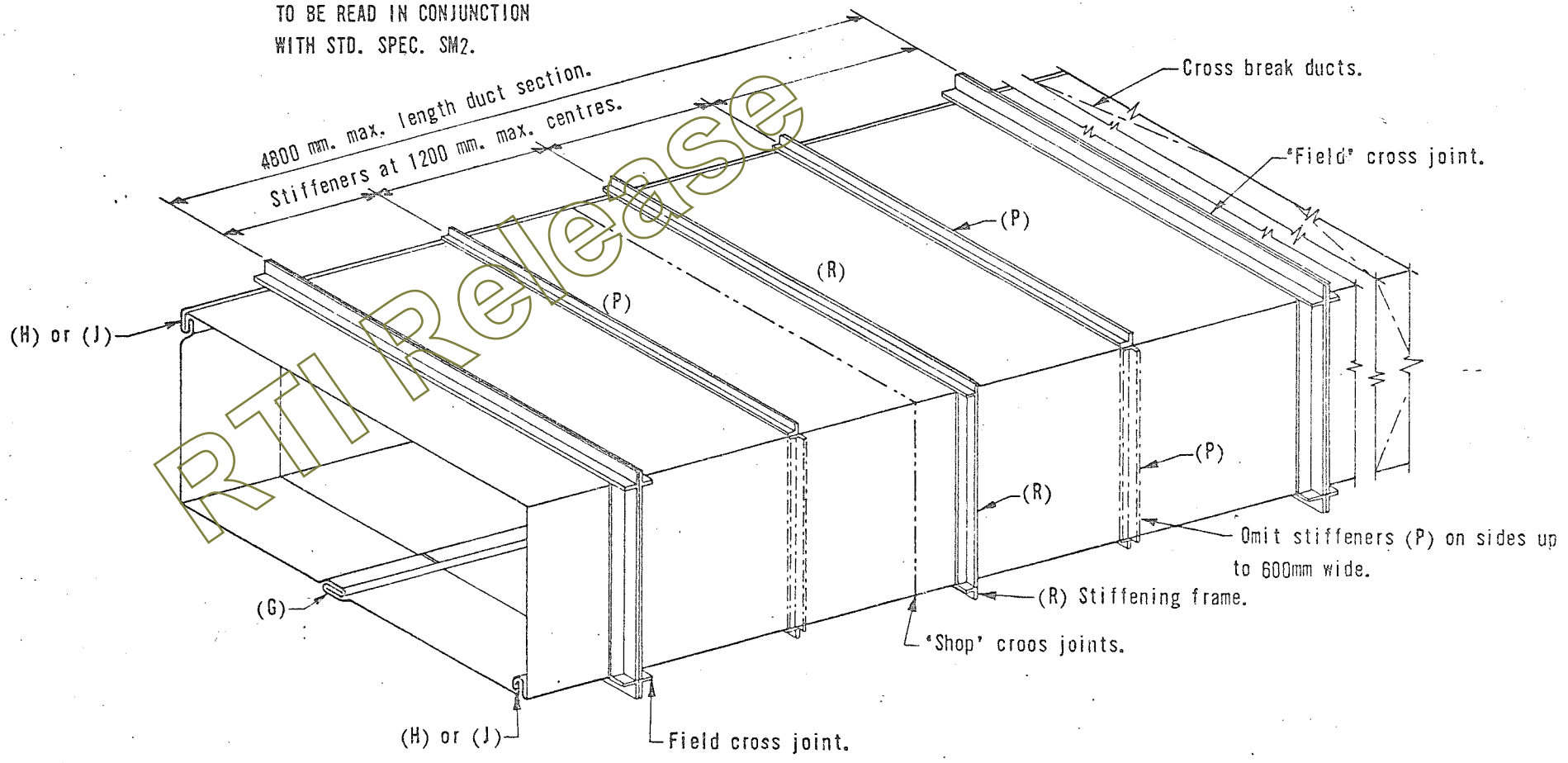
DEPARTMENT OF WORKS
 ENGINEERING BRANCH

SCALE	N.T.S.
DESIGN	REB.
DRAWN	R.J.Y.
CHECKED	
DATE	14/9/55

AUTHORISED FOR ISSUE
K. J. A. G. E. Y.
 EXECUTIVE ENGINEER

P M 4911

TO BE READ IN CONJUNCTION
 WITH STD. SPEC. SM2.



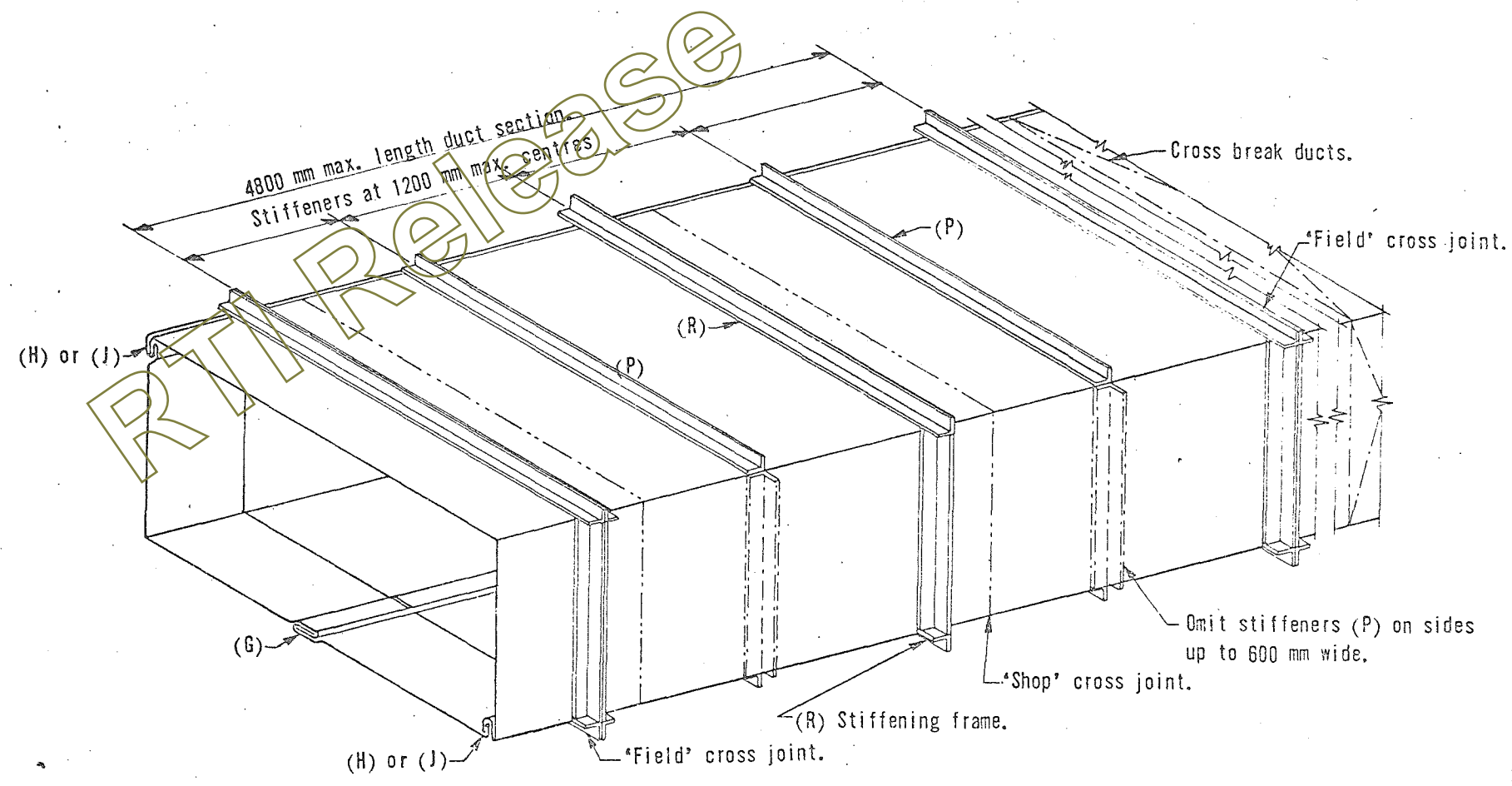
DUCTS - 0.800 mm thick.

DEPARTMENT OF WORKS
ENGINEERING BRANCH

STANDARD DETAIL
LOW PRESSURE DUCTWORK
CONSTRUCTION DETAILS - DUCTS ABOVE 1000mm TO 1500mm
WIDE ON LONGEST SIDE

SCALE	N.T.S.	AUTHORISED FOR ISSUE
DESIGN	R.E.B.	
DRAWN	J.A.H.	
CHECKED		
DATE	14/5/74	
	P.M.4912	
		EXECUTIVE ENGINEER

TO BE READ IN CONJUNCTION
WITH STD. SPEC. SM2.



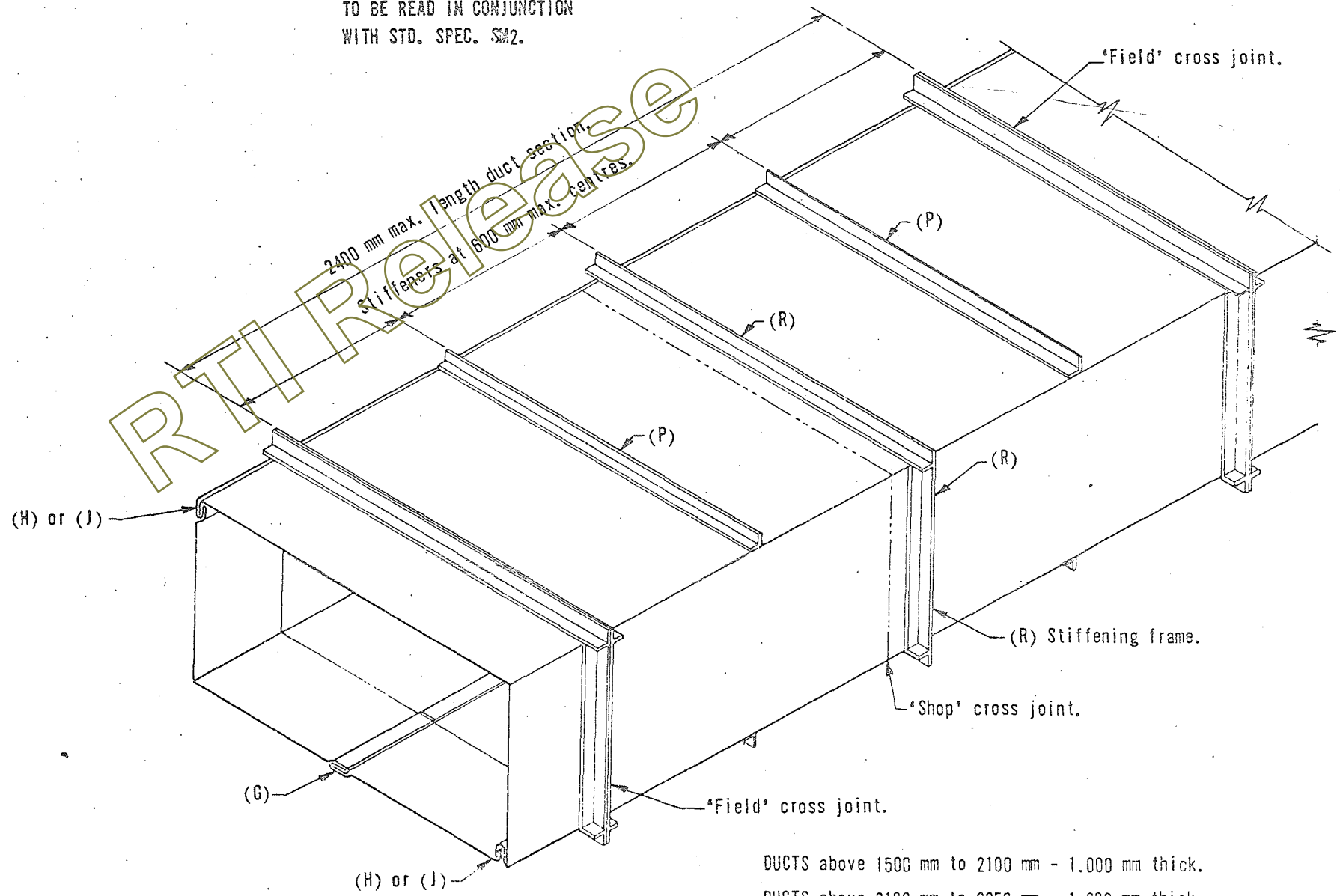
DUCTS ABOVE 1000 mm to 1200 mm - 0.900 mm THICK.
DUCTS ABOVE 1200 mm to 1500 mm - 1.000 mm THICK.

DEPARTMENT OF WORKS
 ENGINEERING BRANCH

STANDARD DETAIL
 LOW PRESSURE DUCTWORK
 CONSTRUCTION DETAILS - DUCTS ABOVE 1500 mm TO 2250mm
 WIDE ON LONGEST SIDE

SCALE	N.T.S.	AUTHORISED FOR ISSUE
DESIGN	R.R.R.	
DRAWN	J.A.H.	
CHECKED	M.S.	
DATE	02/11/75	
		P.M. 913
		EXECUTIVE ENGINEER

TO BE READ IN CONJUNCTION
 WITH STD. SPEC. SM2.



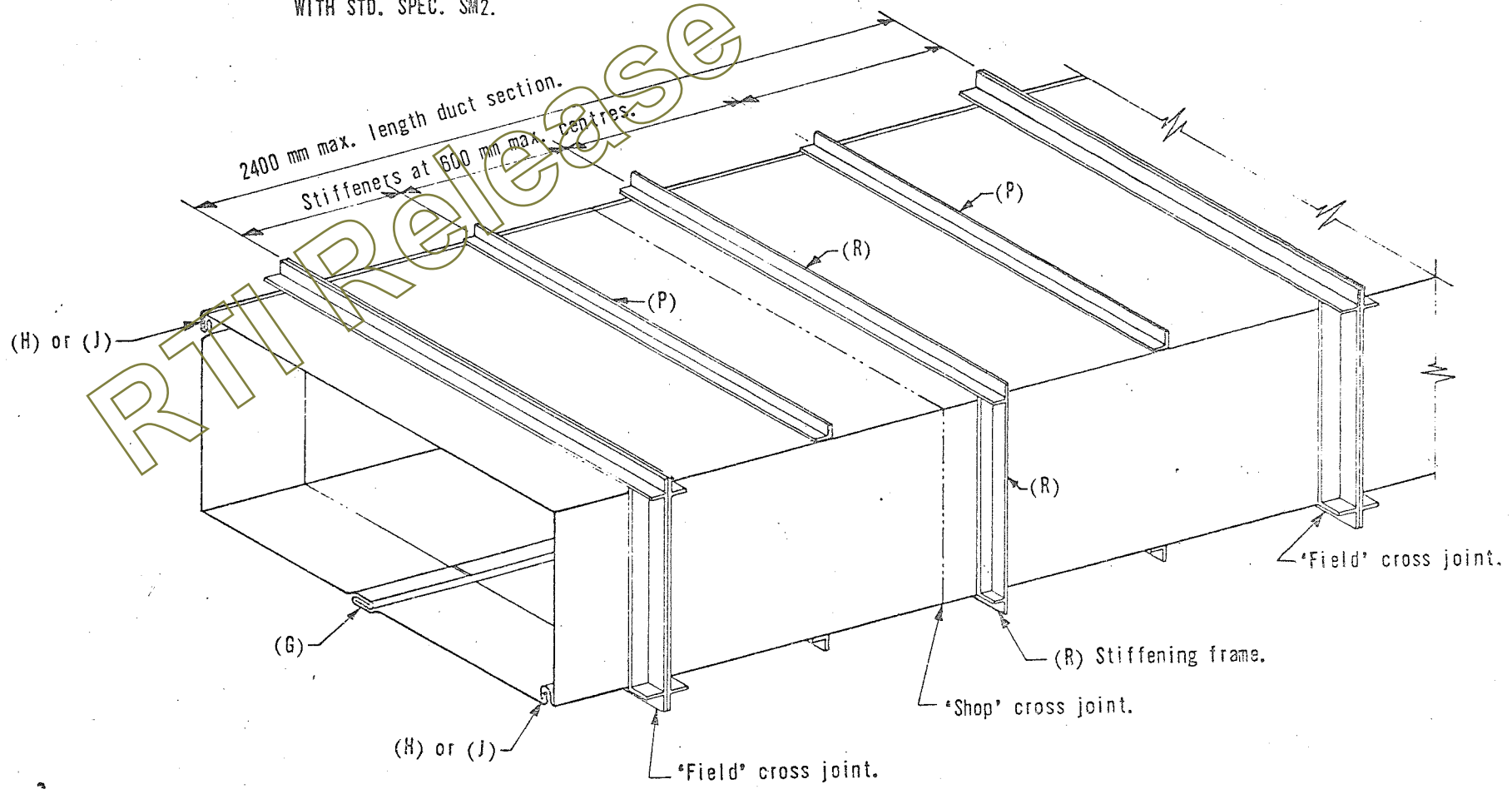
DUCTS above 1500 mm to 2100 mm - 1.000 mm thick.
 DUCTS above 2100 mm to 2250 mm - 1.200 mm thick.

DEPARTMENT OF WORKS
 ENGINEERING BRANCH
 STANDARD DETAIL
 LOW PRESSURE DUCTWORK
 CONSTRUCTION DETAILS - DUCTS ABOVE 2250mm WIDE ON
 LONGEST SIDE

SCALE	N.T.S.
DESIGN	R.G.B.
DRAWN	J.A.H.
CHECKED	M.G.
DATE	1/7/74

AUTHORISED FOR ISSUE
[Signature]
 EXECUTIVE ENGINEER
 P/M 4914

TO BE READ IN CONJUNCTION
 WITH STD. SPEC. SM2.



DUCT - 1.200 mm thick.

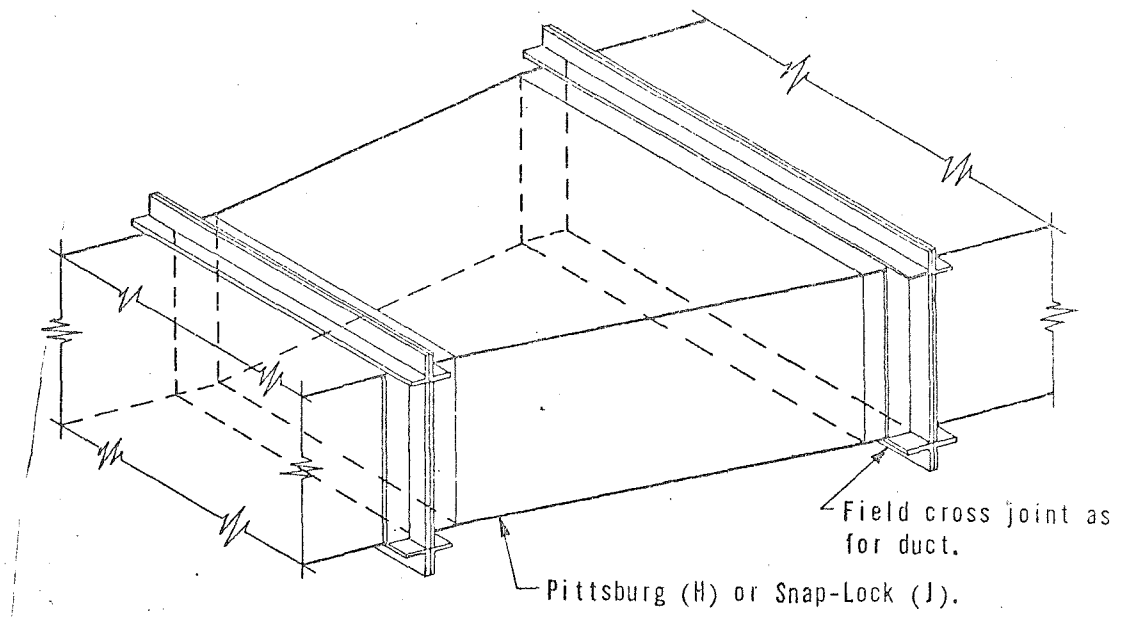


FIG. 1. TAPER CONSTRUCTION

Slope of any side shall not exceed 1 in 7.

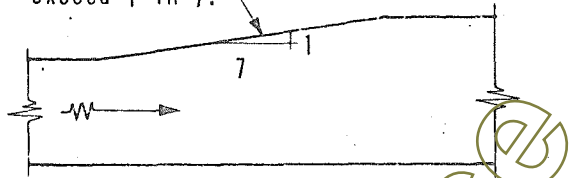


FIG. 2. DIVERGING SECTION

Slope of any side shall not exceed 1 in 4.

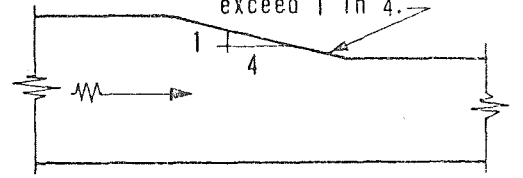
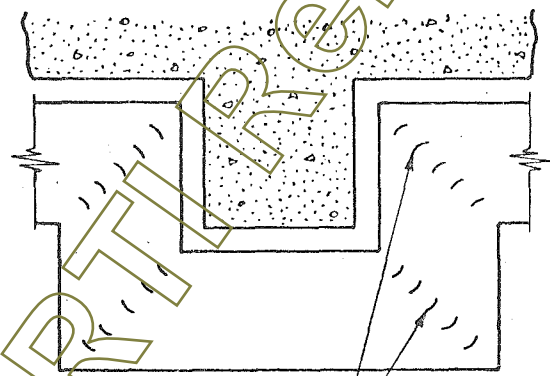


FIG. 3. CONVERGING SECTION



Bends Type 3 - refer to Std. Spec. SM2.

FIG. 4. OFFSET TYPE 1.

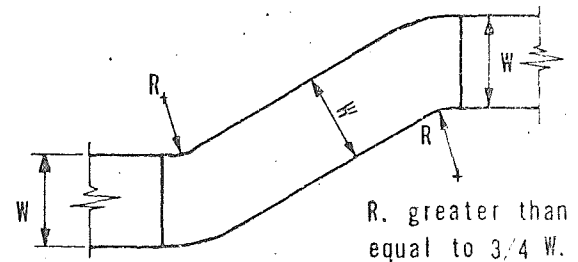


FIG. 5. OFFSET TYPE 2.

DEPARTMENT OF WORKS
ENGINEERING BRANCH

STANDARD DETAIL
LOW PRESSURE DUCTWORK
TAPERS AND OFFSETS

SCALE	NTS.	AUTHORISED FOR ISSUE
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DRAWN	J.A.H.	
CHECKED	<i>[Signature]</i>	P M4915
DATE	14/7/71	

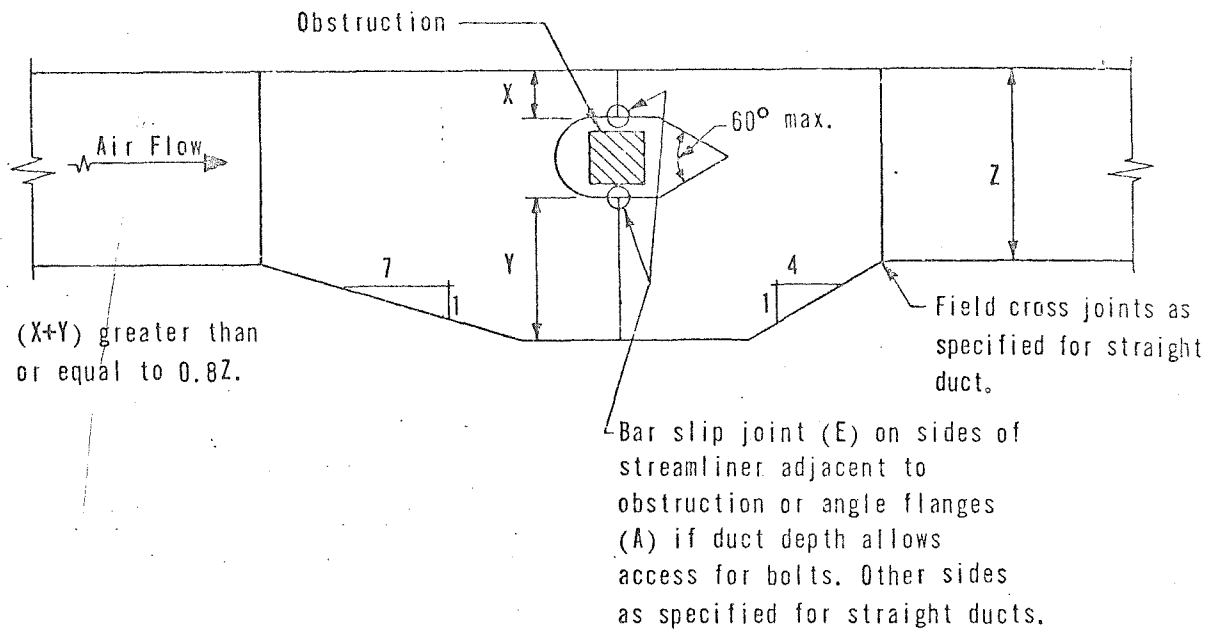


FIG. 1. STREAMLINER

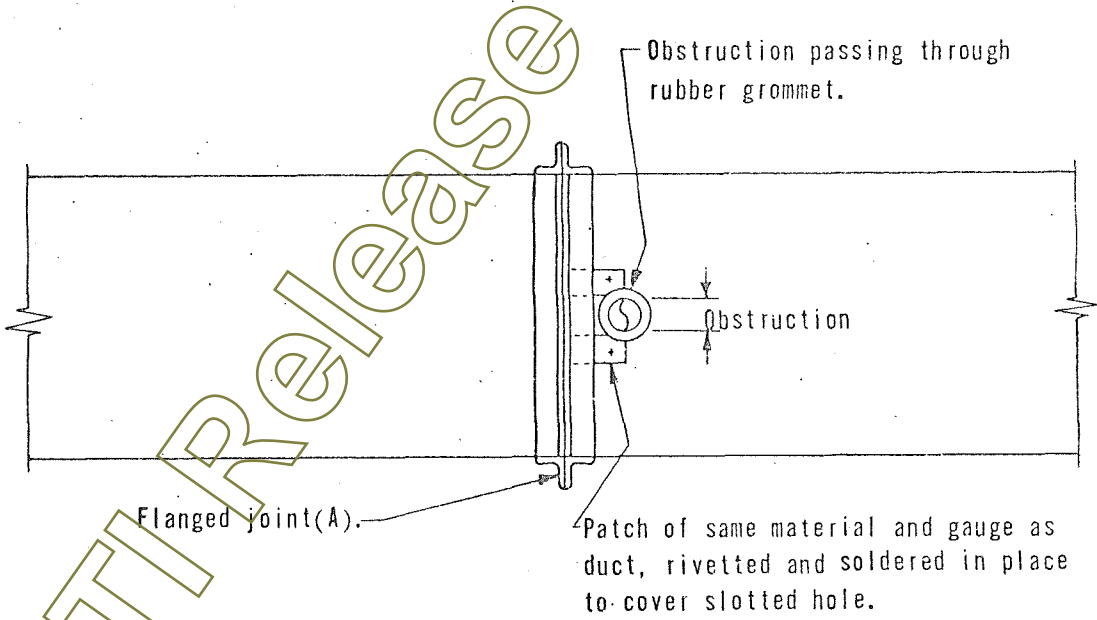


FIG. 2 OBSTRUCTION IN CONTACT WITH AIR SYSTEM

DEPARTMENT OF WORKS ENGINEERING BRANCH	SCALE	N.T.S.	AUTHORISED FOR ISSUE
	DESIGN	R.E.B.	<i>R. E. B.</i>
STANDARD DETAIL LOW PRESSURE DUCTWORK OBSTRUCTIONS TO DUCTS - INTERNALLY.	DRAWN	R.J.Y.	EXECUTIVE ENGINEER
	CHECKED	<i>M/S</i>	P M4916
	DATE	12/7/75	

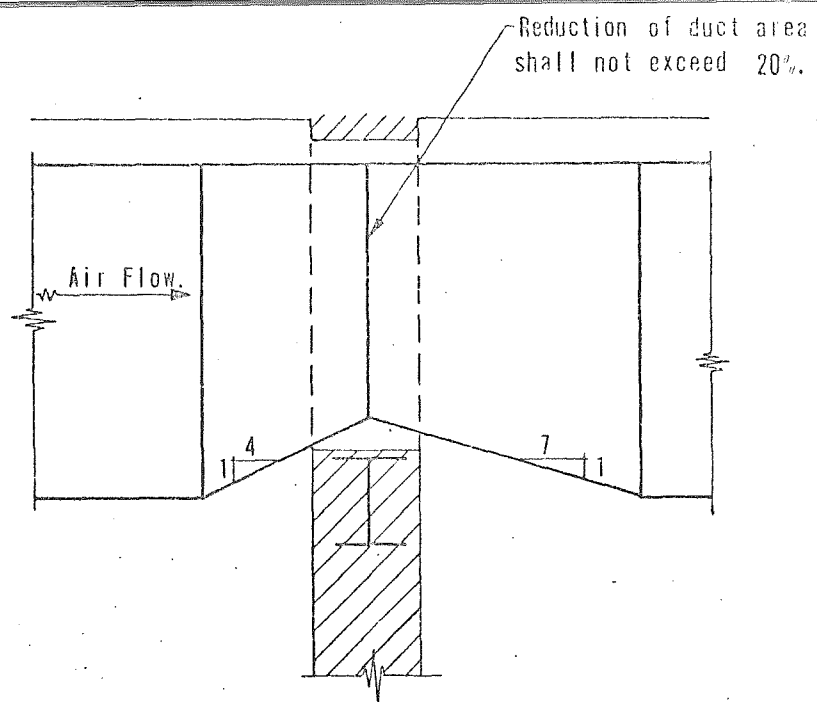


FIG. 1. RESTRICTION

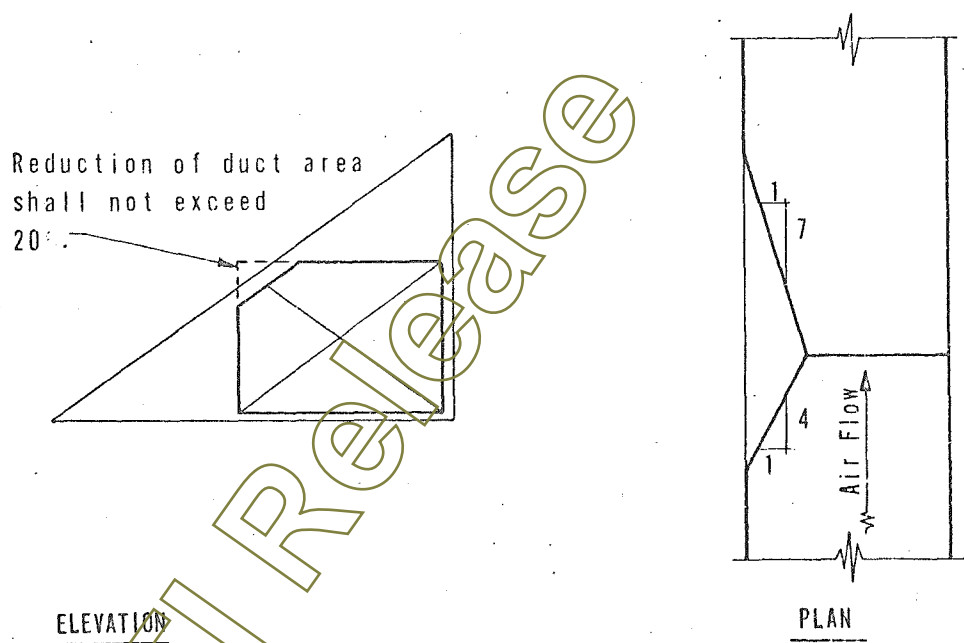


FIG. 2 RESTRICTION

DEPARTMENT OF WORKS ENGINEERING BRANCH	SCALE	N.T.S.	AUTHORISED FOR ISSUE <i>R. J. H.</i> EXECUTIVE ENGINEER
	DESIGN.	R.E.B.	
STANDARD DETAIL LOW PRESSURE DUCTWORK OBSTRUCTIONS TO DUCTS - EXTERNALLY	DRAWN	J.A.H.	P M4917
	CHECKED	<i>M.S.</i>	
	DATE	11/7/32	

Shop cross joints (F) or (G) as required.

Pittsburg, or where approved, snaplock on all corners. Refer to (H) or (J).

Sheet gauge as for duct.

Stiffening angle as for duct angles.

Field cross joints as for adjusted duct.

RTI Release

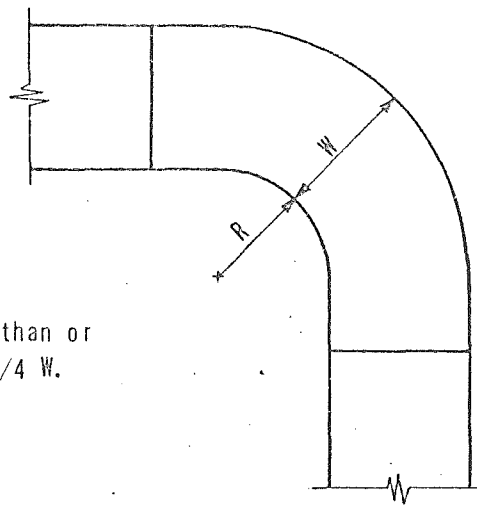
DEPARTMENT OF WORKS
ENGINEERING BRANCH

SCALE	N.T.S.
DESIGN	REB.
DRAWN	J.A.H.
CHECKED	<i>[Signature]</i>
DATE	11/17/55

AUTHORISED FOR ISSUE
[Signature]
EXECUTIVE ENGINEER

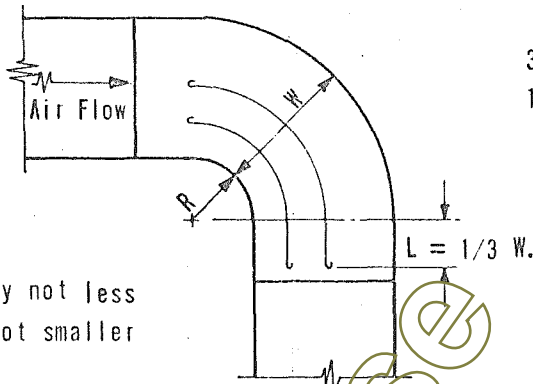
STANDARD DETAIL
LOW PRESSURE DUCTWORK
BEND CONSTRUCTION

P M4918



R greater than or equal to $\frac{3}{4} W$.

FIG. 1 BEND TYPE 1.



R = preferably not less than $\frac{W}{4}$ but not smaller than 80mm.

FIG. 2 BEND TYPE 2.

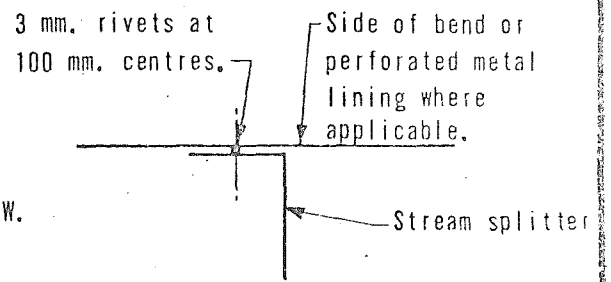


FIG. 3 FIXING OF STREAM SPLITTERS

Turning vanes, refer to drawing No. PM 4920.

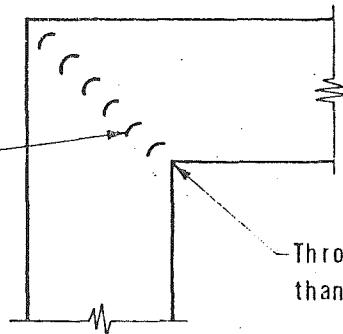


FIG. 4 BEND TYPE 3.

DEPARTMENT OF WORKS ENGINEERING BRANCH	SCALE	N.T.S.	AUTHORISED FOR ISSUE
	DESIGN	R.E.B.	<i>R.E.B.</i>
STANDARD DETAIL LOW PRESSURE DUCTWORK BENDS WITH STREAM SPLITTERS AND TURNING VANES	DRAWN	J.A.H.	EXECUTIVE ENGINEER
	CHECKED	<i>[Signature]</i>	
	DATE	14/7/70	P M4919

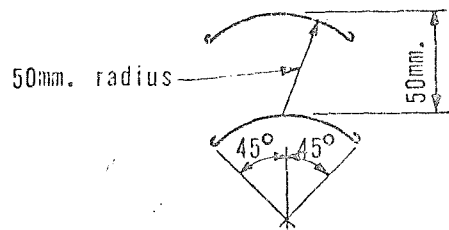


FIG. 1 VANES FOR DUCTS UP TO 450mm. WIDE

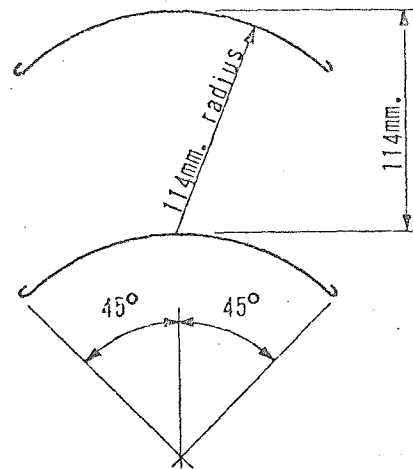


FIG. 2 VANES FOR DUCTS ABOVE 450mm. WIDE.

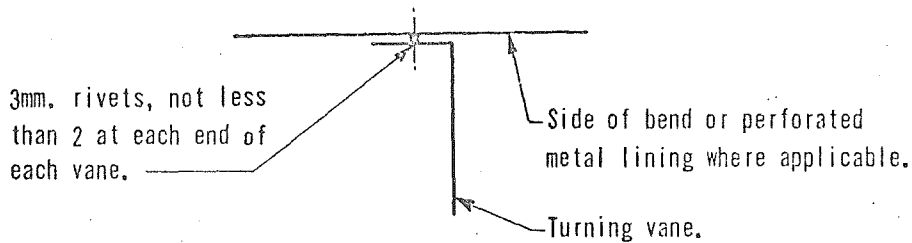


FIG. 3 FIXING OF TURNING VANE.

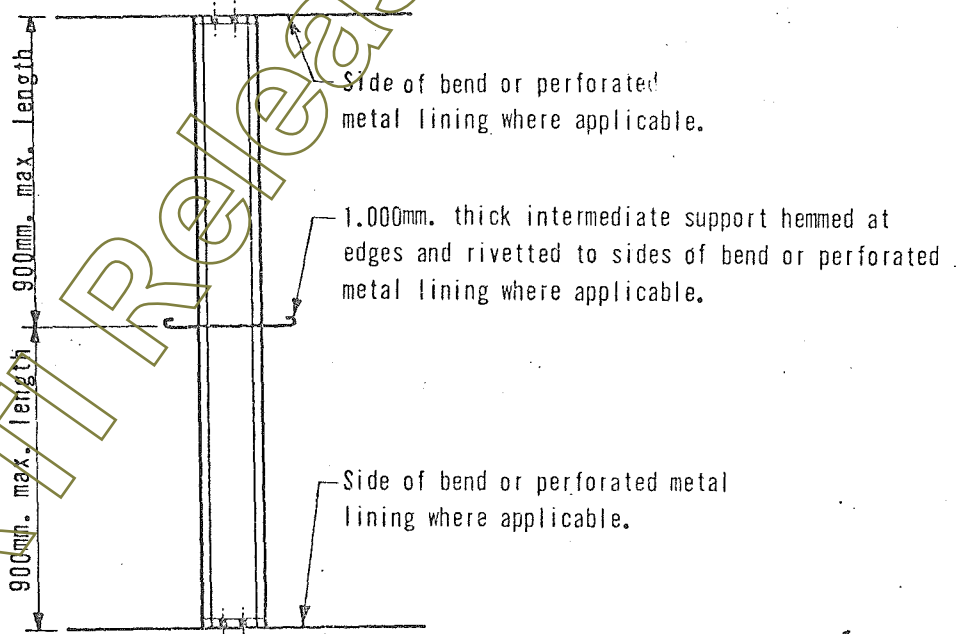


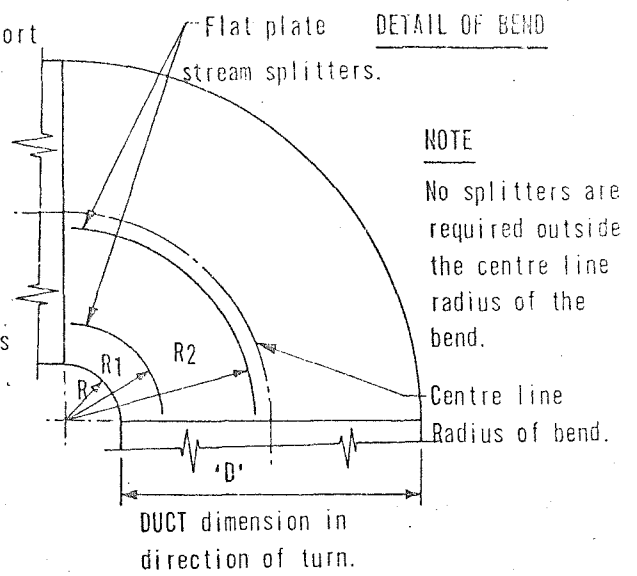
FIG. 4 INTERMEDIATE SUPPORT FOR VANES ABOVE 900 mm. LONG.

DEPARTMENT OF WORKS ENGINEERING BRANCH	SCALE	N.T.S.	AUTHORISED FOR ISSUE
	DESIGN	R.E.B.	<i>[Signature]</i>
STANDARD DETAIL LOW PRESSURE DUCTWORK DETAILS OF TURNING VANES FOR BENDS	DRAWN	J.A.H.	EXECUTIVE ENGINEER
	CHECKED	<i>[Signature]</i>	P M 4920
	DATE	1/1/76	

EXAMPLE: To determine the spacing of splitters in short radius bends. Chart shall be used as described below:

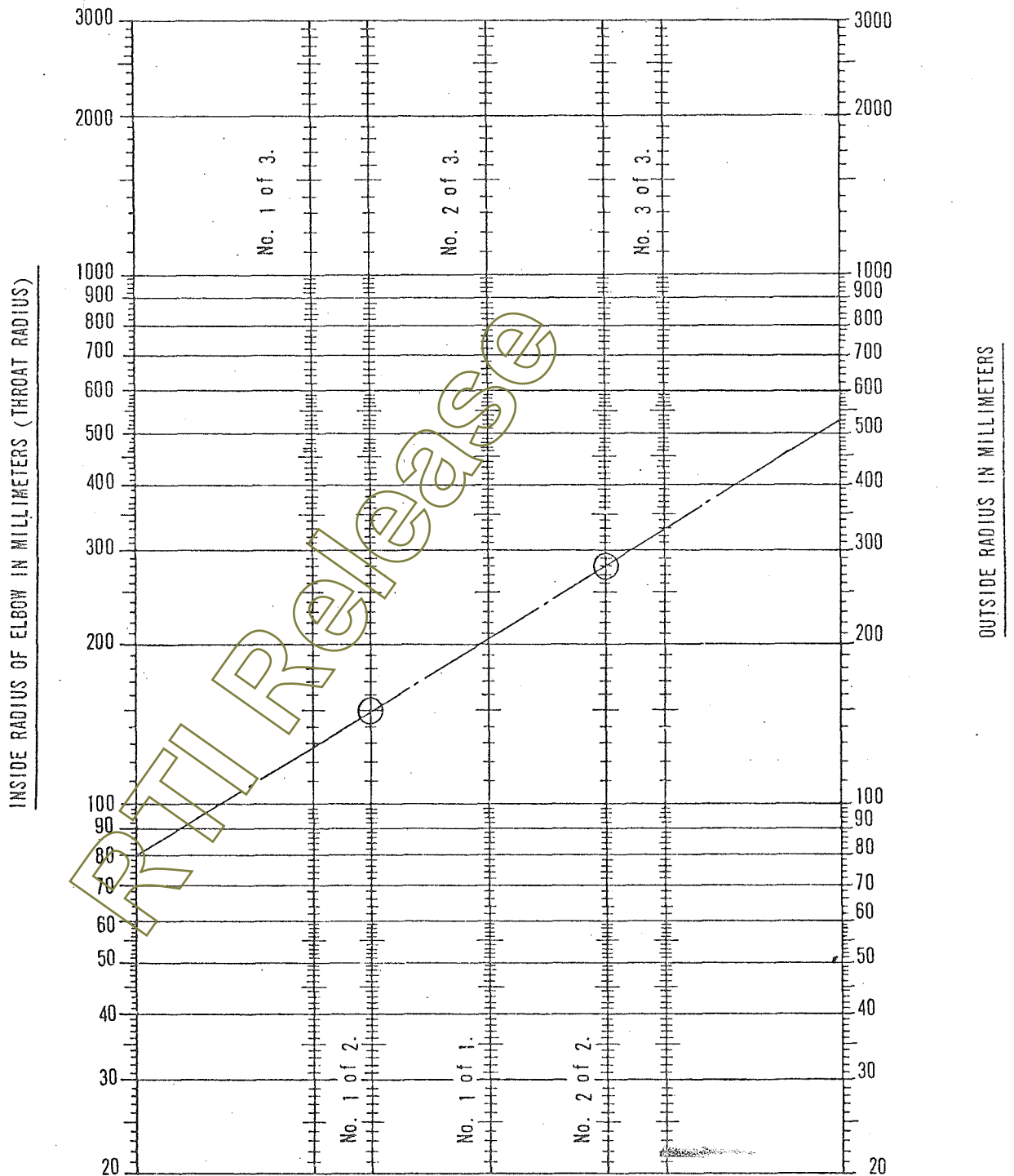
GIVEN: An elbow (see diagram below) with a 80mm throat radius and duct width 'D' of 450mm. Centre line radius is 305mm.

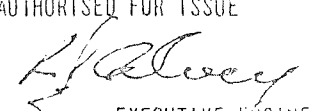
SOLUTION: On chart 1 draw line for 80mm throat radius and 530mm outside radius and select number of splitters so that no splitter is located outside the centre line radius of the bend. Then from chart two splitters are required and $R_1 = 150\text{mm}$, $R_2 = 280\text{mm}$.



NOTE
No splitters are required outside the centre line radius of the bend.

NOTE: R = Throat Radius.



DEPARTMENT OF WORKS ENGINEERING BRANCH STANDARD DETAIL LOW PRESSURE DUCTWORK STREAM SPLITTER SPACING FOR BENDS	SCALE	N.T.S.	AUTHORIZED FOR ISSUE  EXECUTIVE ENGINEER
	DESIGN	R.B.B.	
	DRAWN	R.J.Y.	P M4921
	CHECKED	Ms	
	DATE	14/7/76	

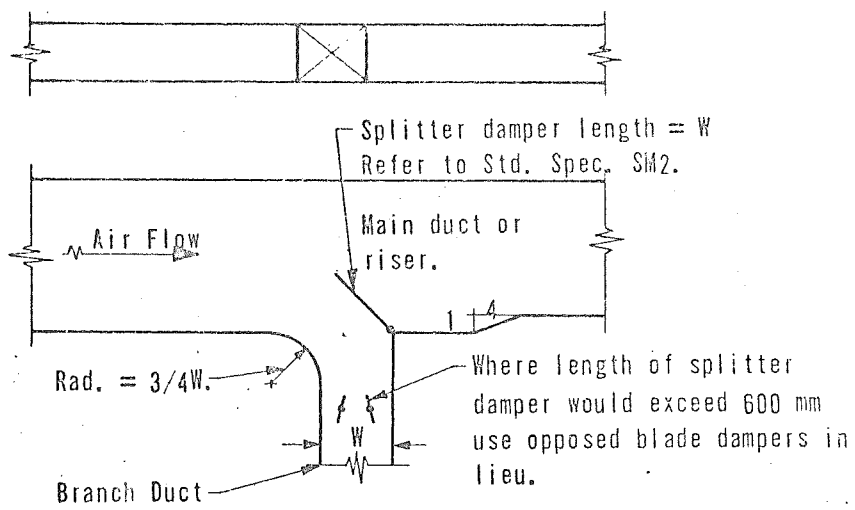


FIG. 1 BRANCH TYPE 1.

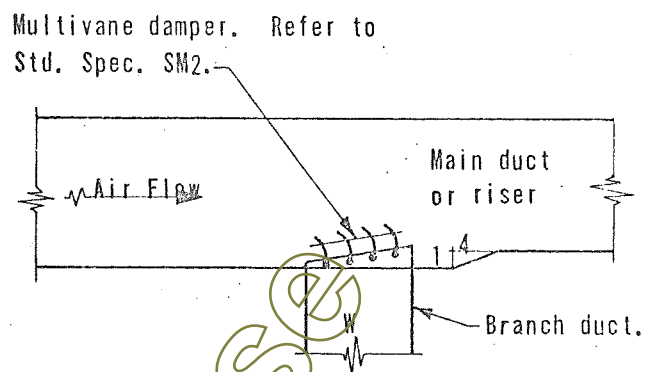


FIG. 2 BRANCH TYPE 2.

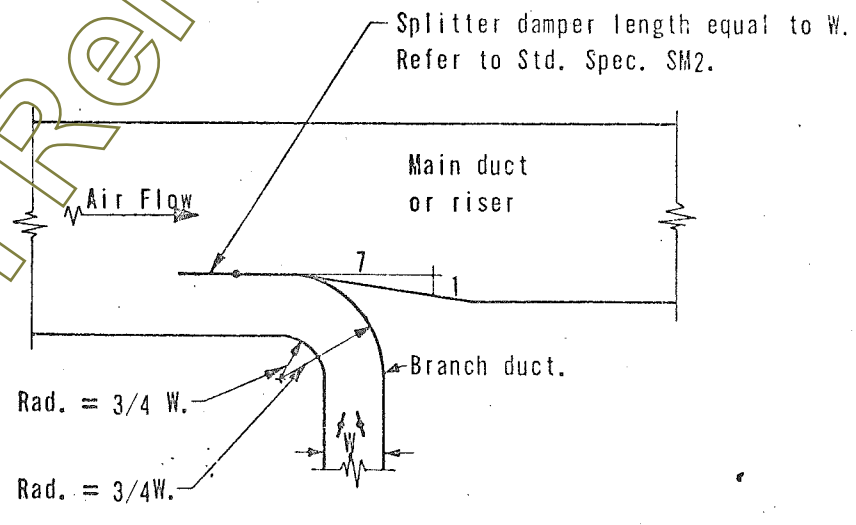


FIG. 3 BRANCH TYPE 3.

DEPARTMENT OF WORKS ENGINEERING BRANCH	SCALE	N.T.S.	AUTHORISED FOR ISSUE <i>R. J. Alway</i> EXECUTIVE ENGINEER
	DESIGN	REB.	
STANDARD DETAIL LOW PRESSURE DUCTWORK ARRANGEMENT OF BRANCH TAKE OFFS	DRAWN	J.A.H.	P M4922
	CHECKED	<i>REB.</i>	
	DATE	12/7/77	

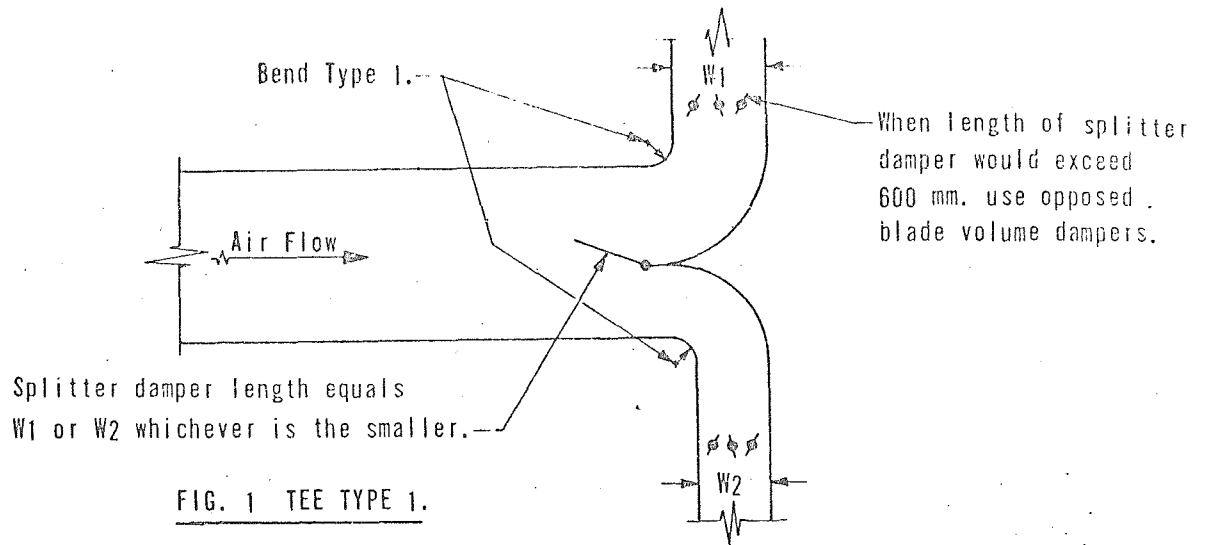


FIG. 1 TEE TYPE 1.

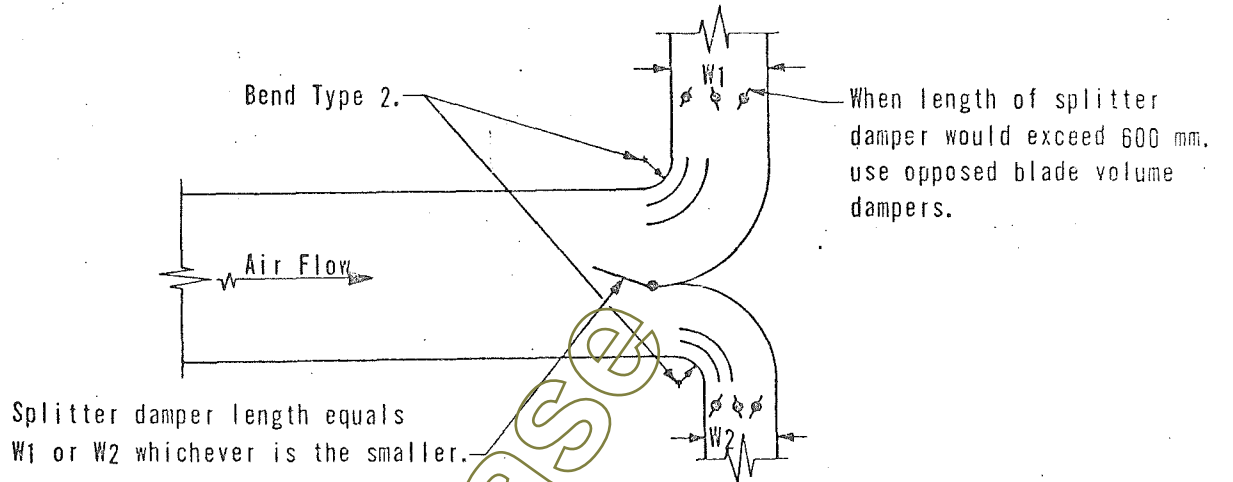


FIG. 2. TEE TYPE 2.

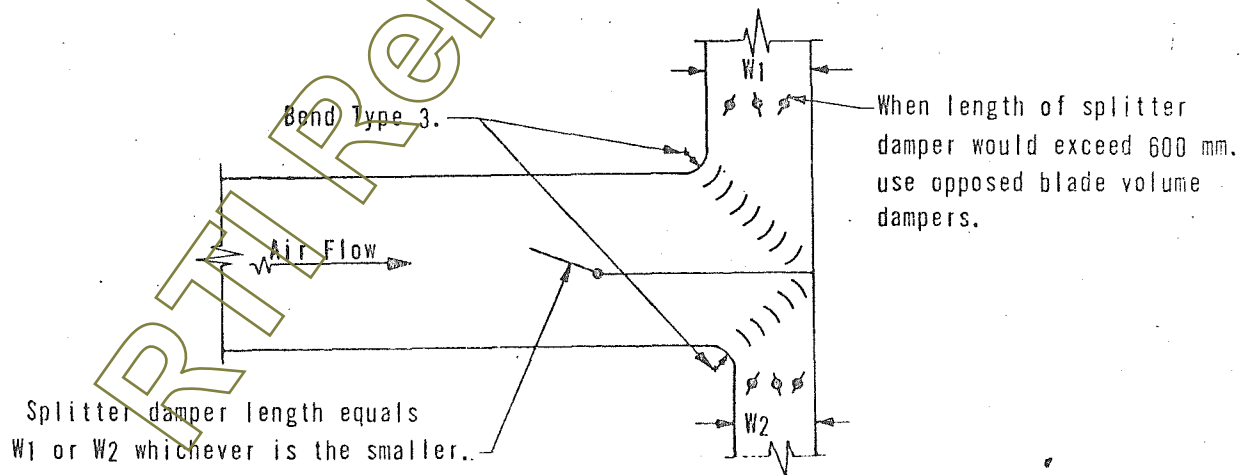


FIG. 3. TEE TYPE 3.

DEPARTMENT OF WORKS ENGINEERING BRANCH	SCALE	N.T.S.	AUTHORISED FOR ISSUE <i>R. E. B.</i> EXECUTIVE ENGINEER
	DESIGN	R.E.B.	
STANDARD DETAIL LOW PRESSURE DUCTWORK ARRANGEMENT OF TEES	DRAWN	R.J.Y.	P M4923
	CHECKED	<i>[Signature]</i>	
	DATE	14/7/70	

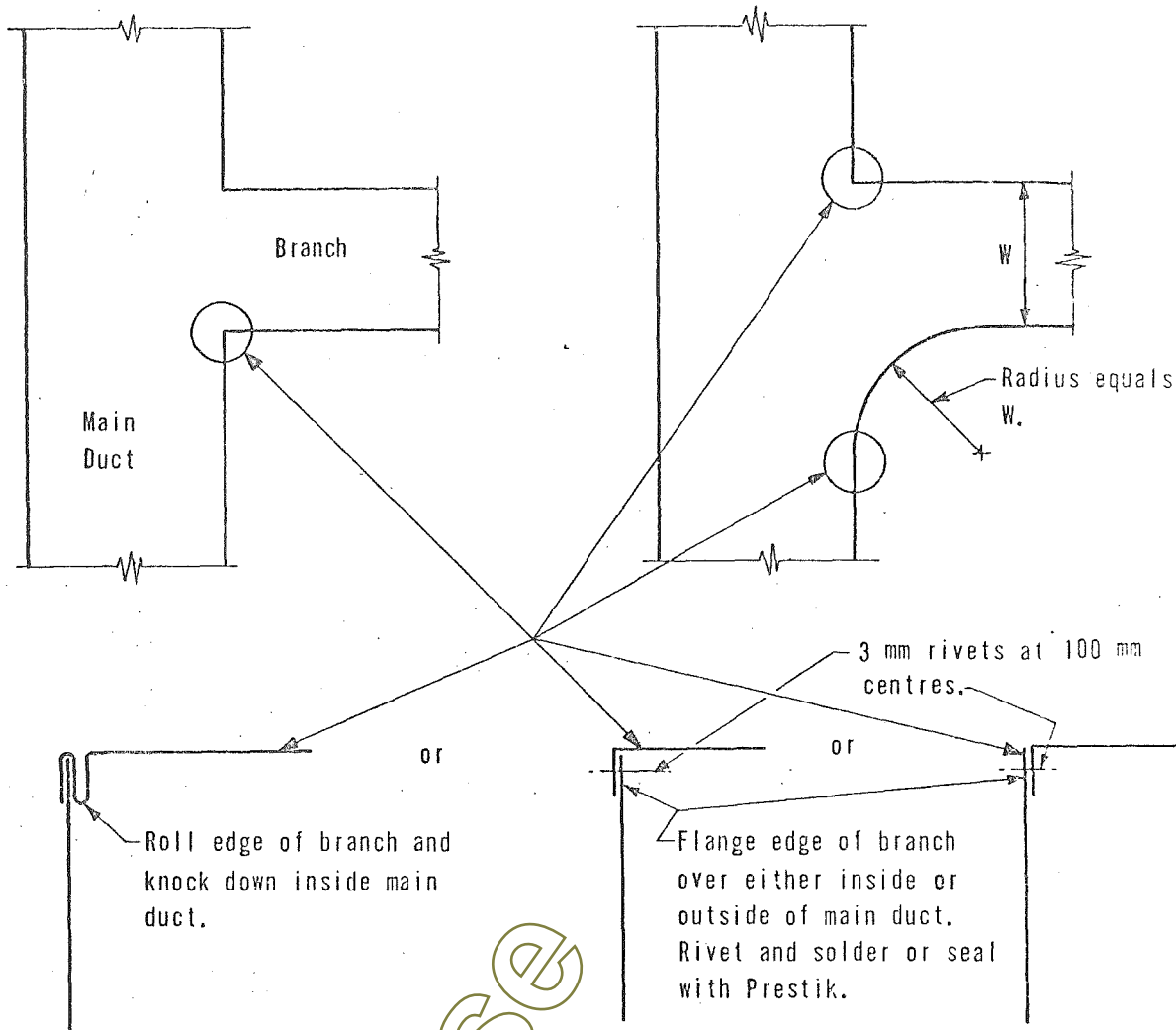


FIG. 1 BRANCH CONSTRUCTION

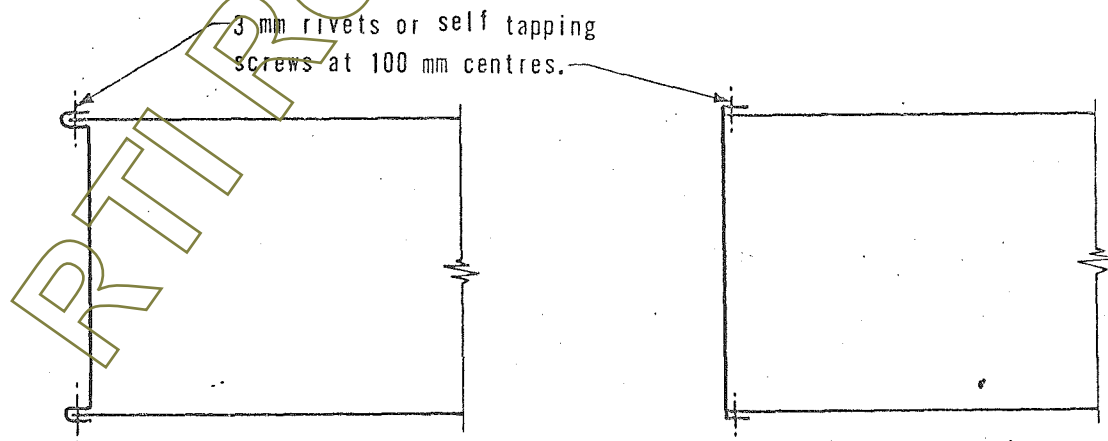


FIG. 2 DUCT END CLOSURES

DEPARTMENT OF WORKS ENGINEERING BRANCH STANDARD DETAIL LOW PRESSURE DUCTWORK BRANCH CONNECTIONS AND END CLOSURES	SCALE	N. T. S.	AUTHORISED FOR ISSUE
	DESIGN	REB.	<i>R. J. Alvey</i>
	DRAWN	J. A. H.	EXECUTIVE ENGINEER
	CHECKED	<i>[Signature]</i>	P M4924
	DATE	14/7/72	

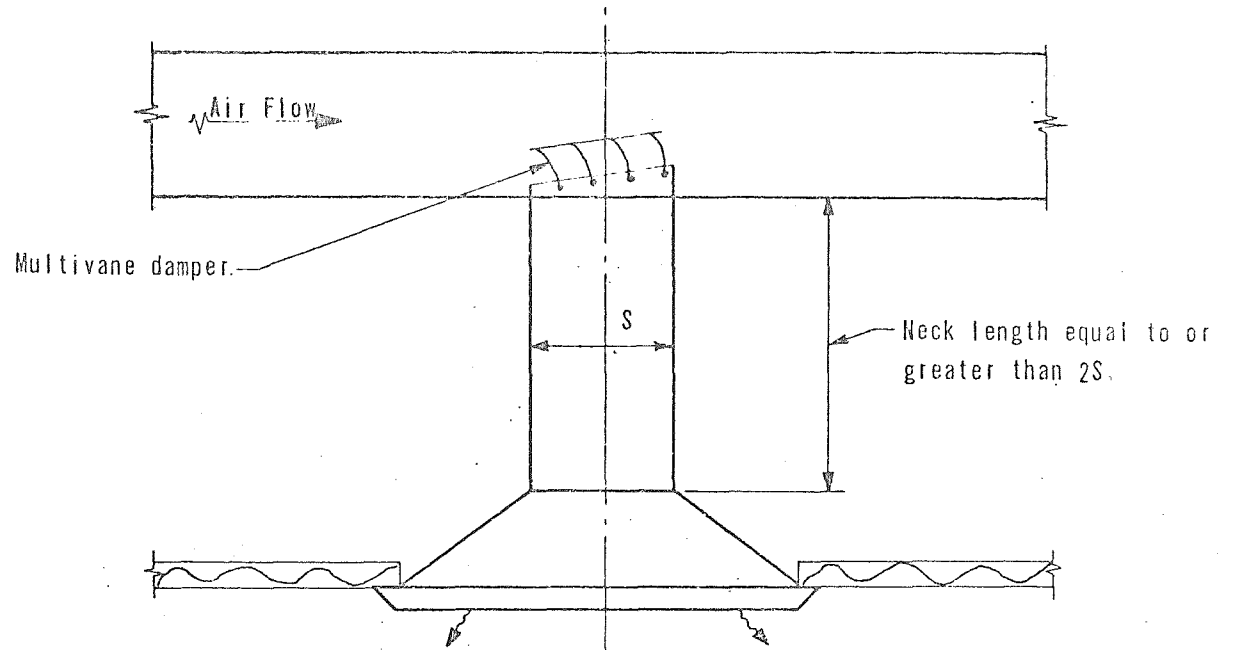
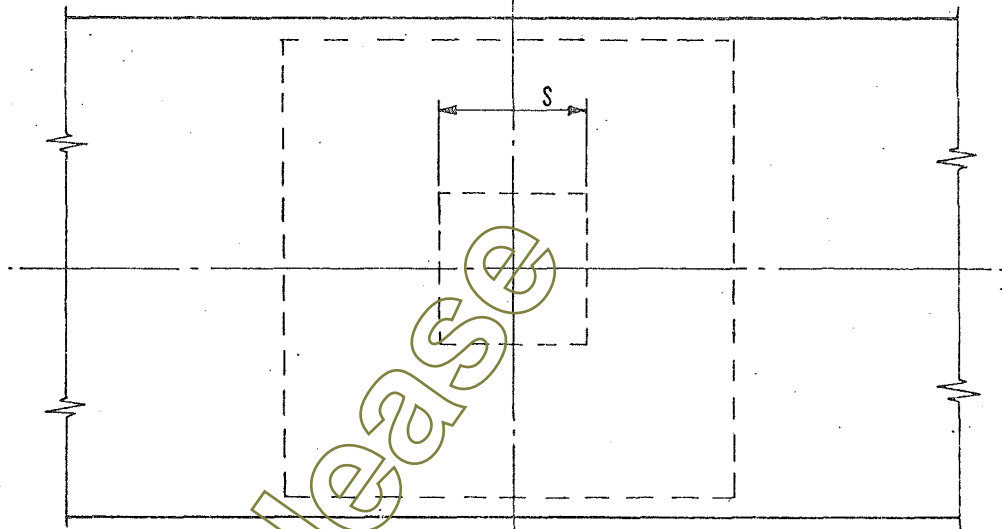


FIG. 1 ELEVATION



PLAN

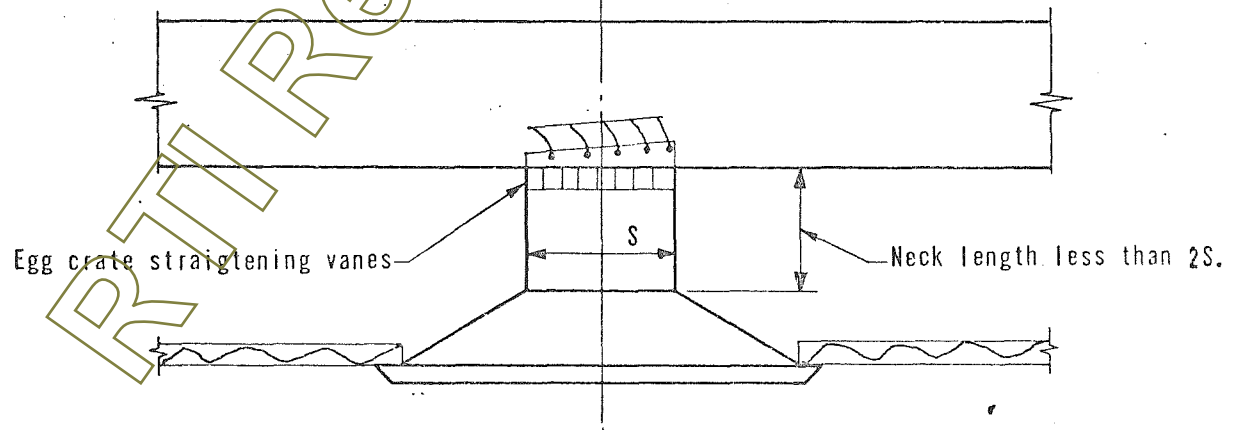


FIG. 2 ELEVATION

SQUARE OUTLET TAKEN DIRECT FROM DUCT.

DEPARTMENT OF WORKS ENGINEERING BRANCH	SCALE	N.T.S.	AUTHORISED FOR ISSUE <i>R. E. B.</i> EXECUTIVE ENGINEER
	DESIGN	R.E.B.	
STANDARD DETAIL LOW PRESSURE DUCTWORK SUPPLY AIR OUTLETS - CEILING TYPES	DRAWN	J.A.H.	P/M4925
	CHECKED	<i>[Signature]</i>	
	DATE	12/7/70	

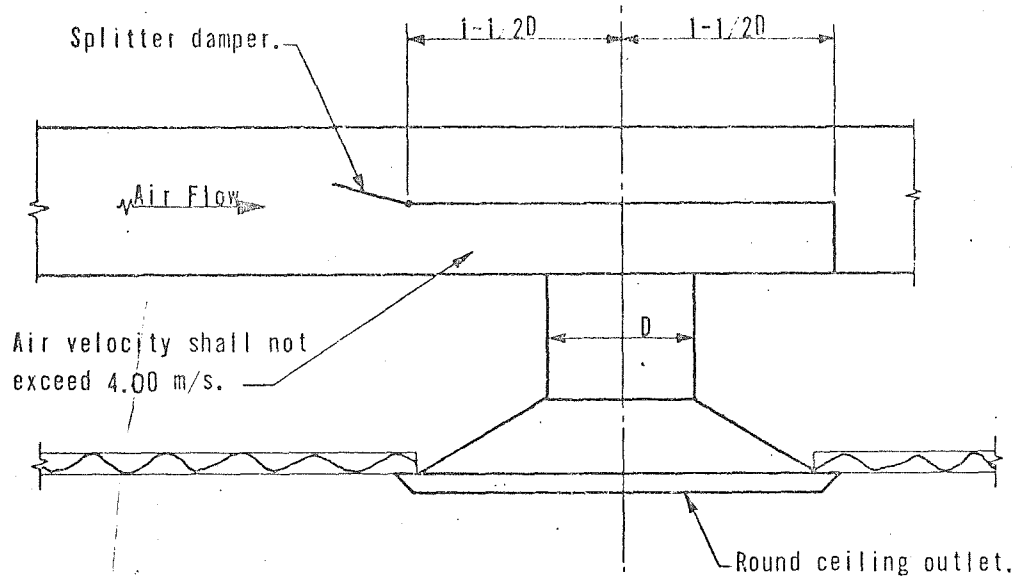


FIG. 1. ROUND OUTLET TAKEN DIRECT FROM DUCT.

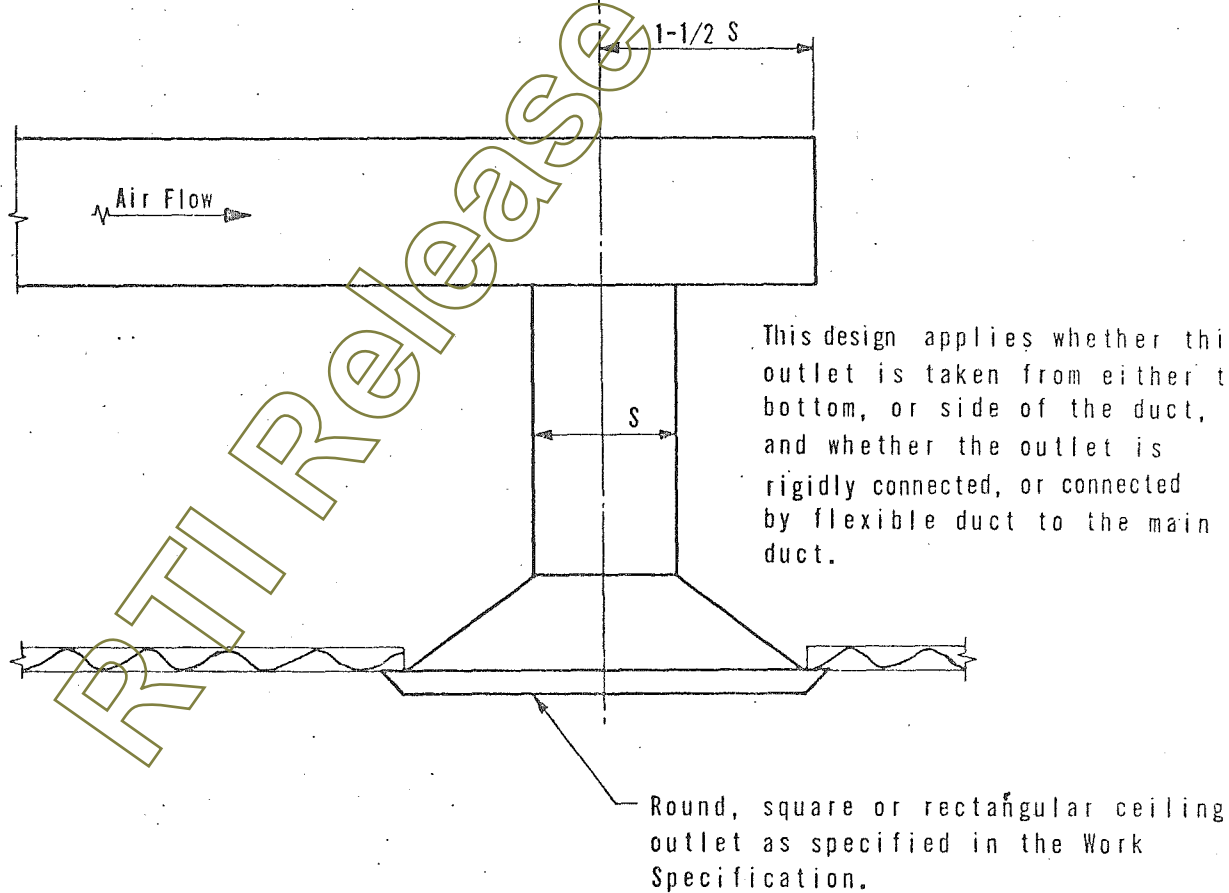


FIG. 2. OUTLET AT END OF DUCT.

DEPARTMENT OF WORKS ENGINEERING BRANCH STANDARD DETAIL LOW PRESSURE DUCTWORK SUPPLY AIR OUTLETS - CEILING TYPES	SCALE	N.T.S.	AUTHORISED FOR ISSUE
	DESIGN	REB.	 EXECUTIVE ENGINEER
	DRAWN	J.A.H.	
	CHECKED	MS	P M4926
	DATE	11/7/71	

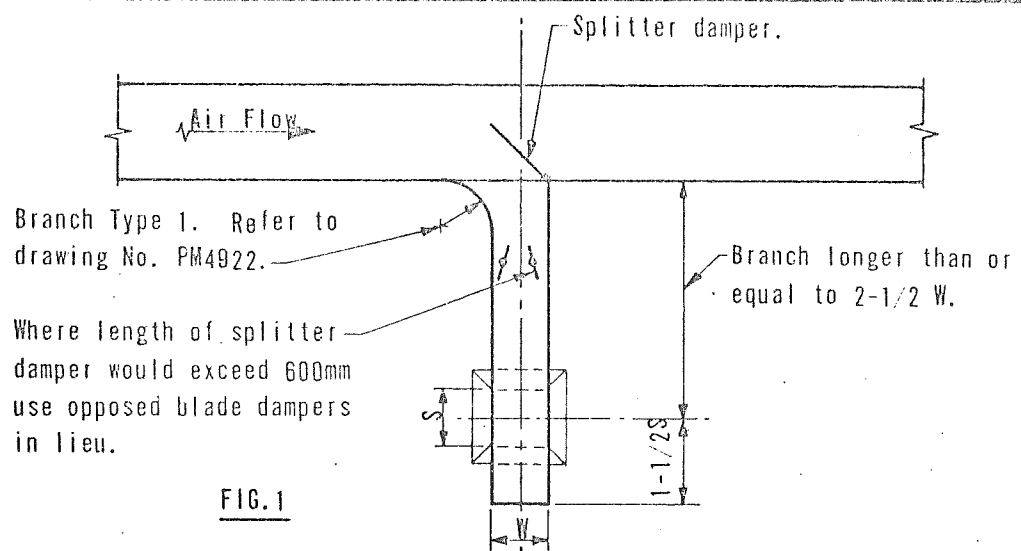


FIG. 1

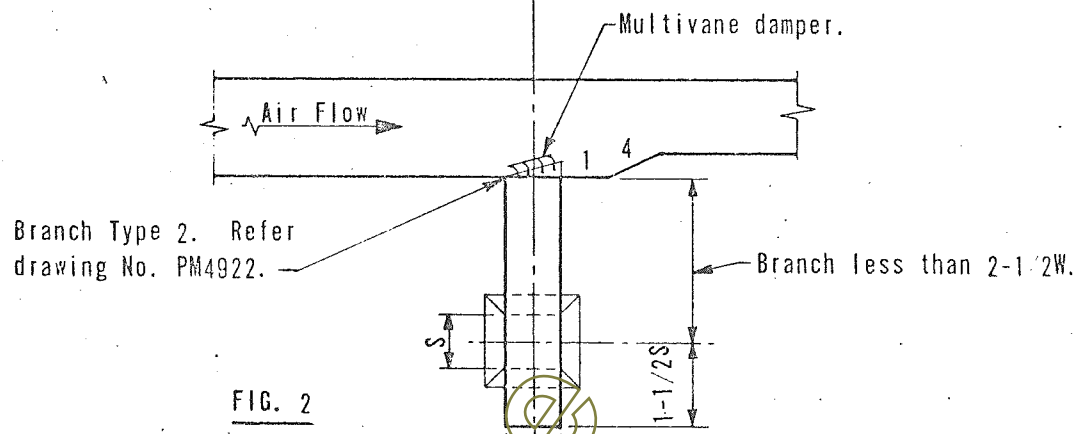


FIG. 2

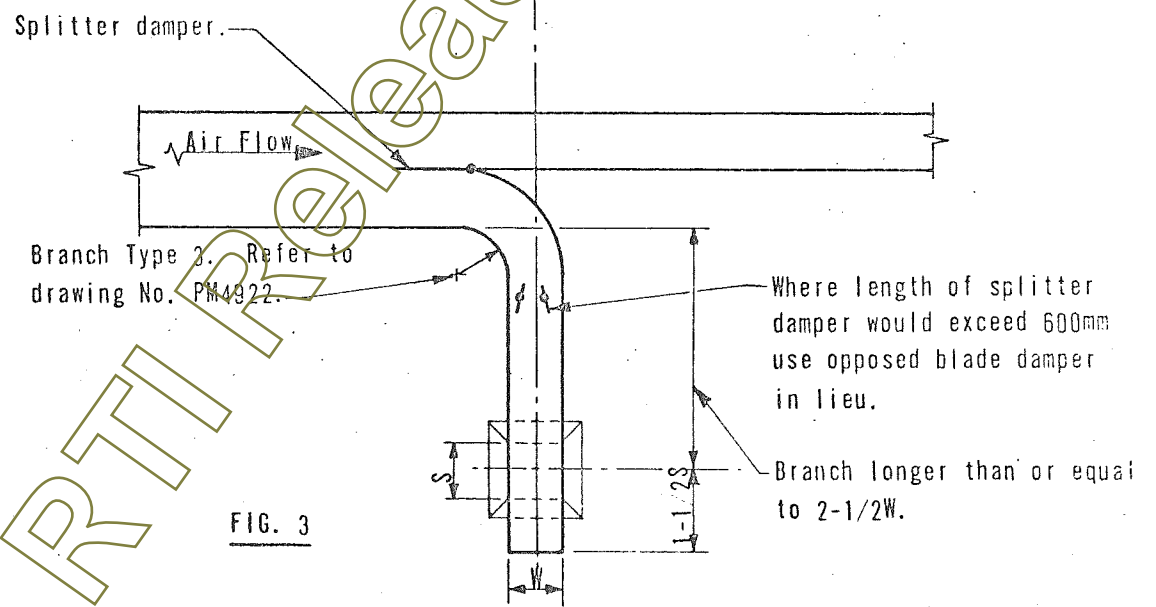


FIG. 3

OUTLETS IN RIGID BRANCH.

DEPARTMENT OF WORKS
ENGINEERING BRANCH

STANDARD DETAIL
LOW PRESSURE DUCTWORK
SUPPLY AIR OUTLETS - CEILING TYPES

SCALE	N. T. S.	AUTHORISED FOR ISSUE
DESIGN	R.E.B.	<i>R. J. Alvey</i> EXECUTIVE ENGINEER
DRAWN	J.A.H.	
CHECKED	<i>[Signature]</i>	P M4927
DATE	15/7/73	

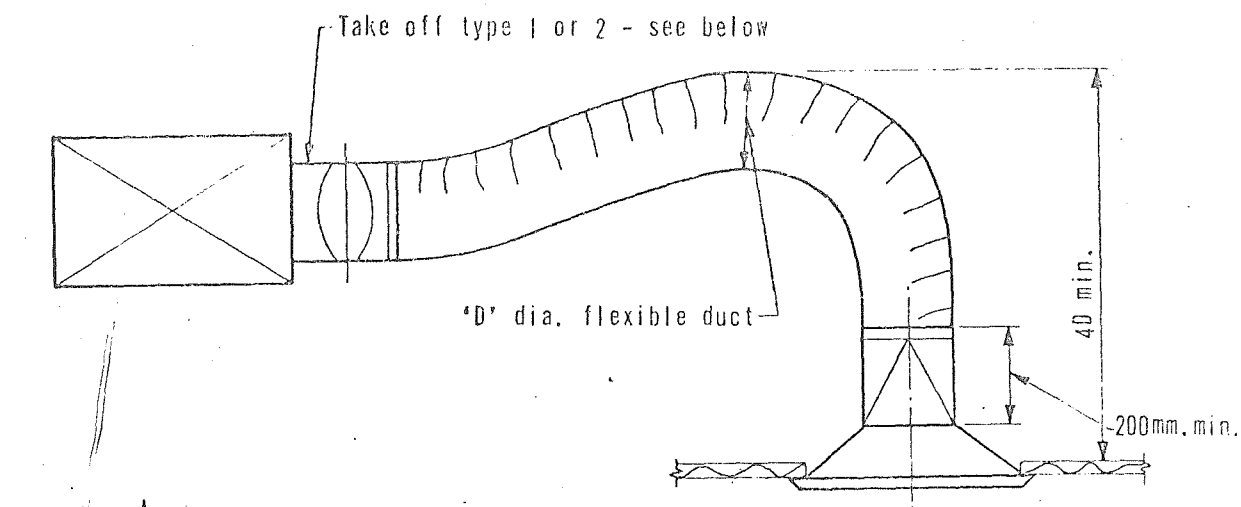


FIG. 1 METHOD 'A'

ELEVATION OF OUTLET

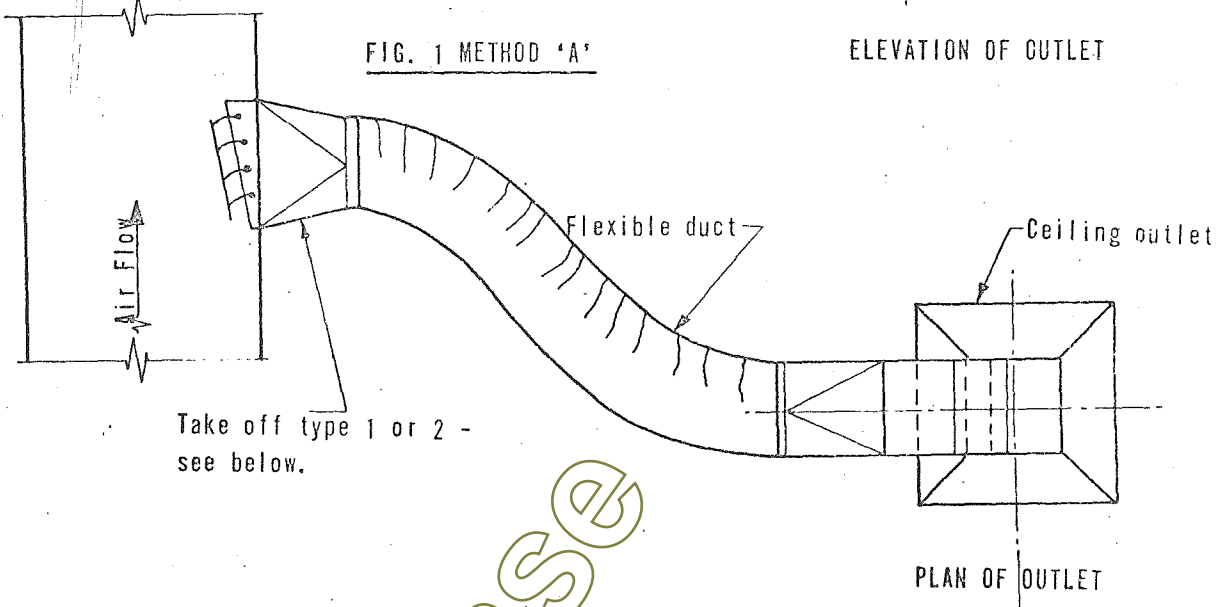
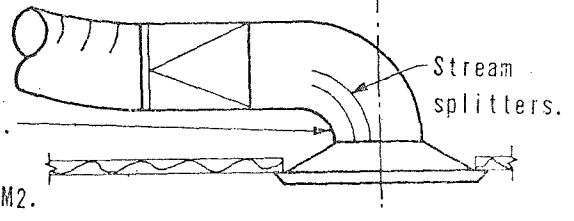
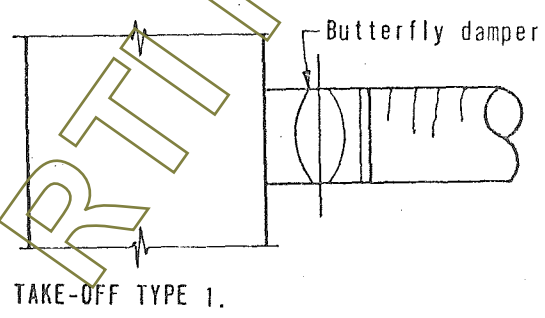


FIG. 2 METHOD 'B'

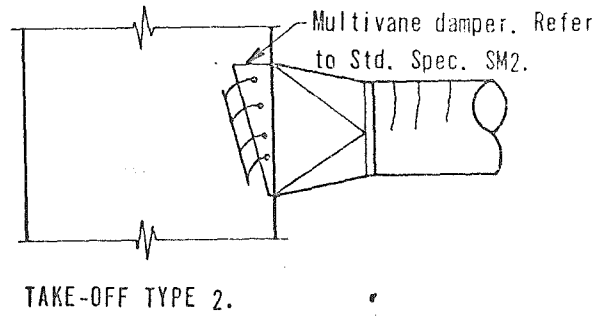
PLAN OF OUTLET



ELEVATION OF OUTLET



TAKE-OFF TYPE 1.

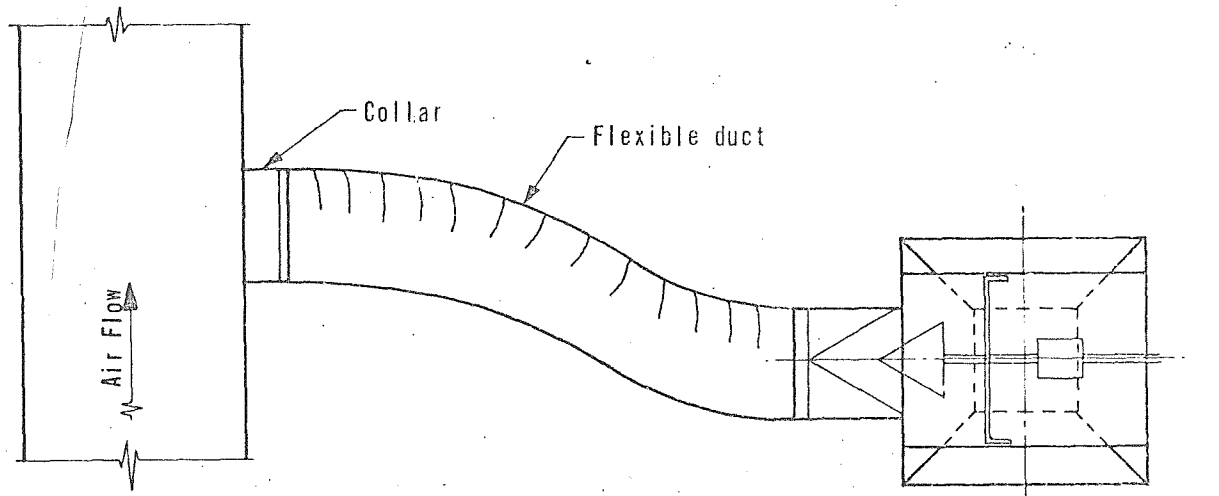


TAKE-OFF TYPE 2.

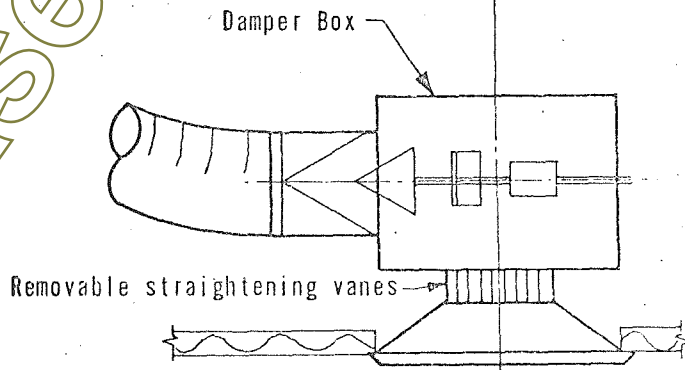
FIG. 3 ALTERNATIVE DUCT TAKE-OFFS.

OUTLETS ON FLEXIBLE BRANCH - VOLUME CONTROL AT MAIN DUCT.

DEPARTMENT OF WORKS ENGINEERING BRANCH STANDARD DETAIL LOW PRESSURE DUCT SUPPLY AIR OUTLETS - CEILING TYPES (ON FLEXIBLE BRANCHES)	SCALE	N.T.S.	AUTHORISED FOR ISSUE
	DESIGN	A.E.B.	 EXECUTIVE ENGINEER
	DRAWN	J.A.H.	
	CHECKED		P M4928
	DATE	18/7/77	



PLAN



ELEVATION OF OUTLETS

METHOD 'C'

RTI Release

OUTLETS ON FLEXIBLE BRANCH - VOLUME CONTROL AT OUTLET.

DEPARTMENT OF WORKS ENGINEERING BRANCH	SCALE	N.T.S.	AUTHORISED FOR ISSUE <i>[Signature]</i> EXECUTIVE ENGINEER
	DESIGN	REB.	
STANDARD DETAIL LOW PRESSURE DUCTWORK SUPPLY AIR OUTLETS - CEILING TYPES ON(FLEXIBLE BRANCHES)	DRAWN	J.A.H.	P M4929
	CHECKED	<i>[Signature]</i>	
	DATE	12/7/70	

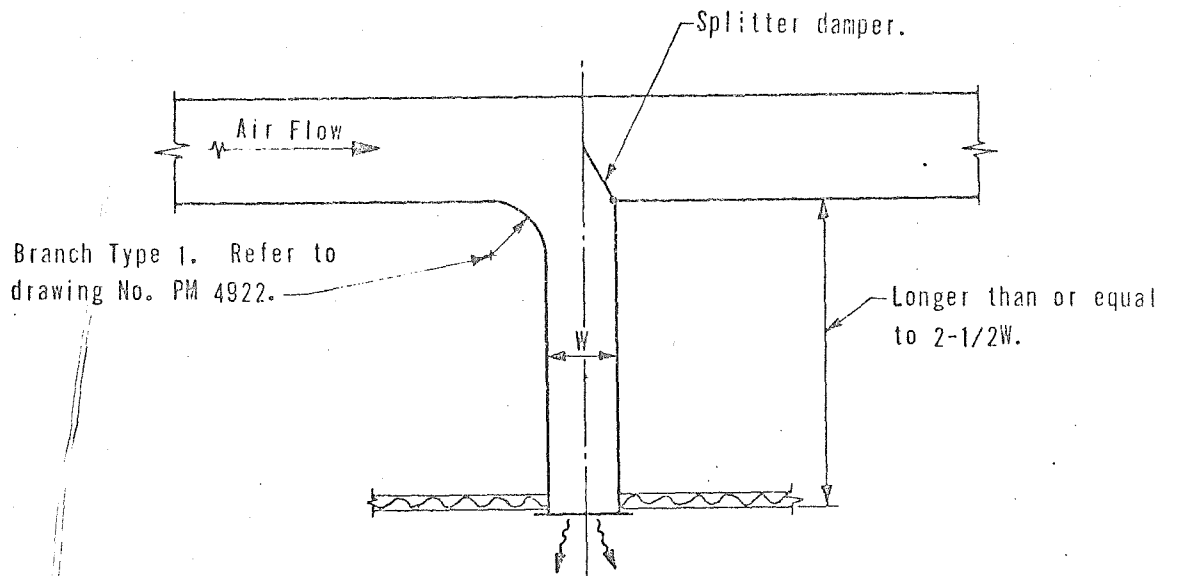


Fig. 1

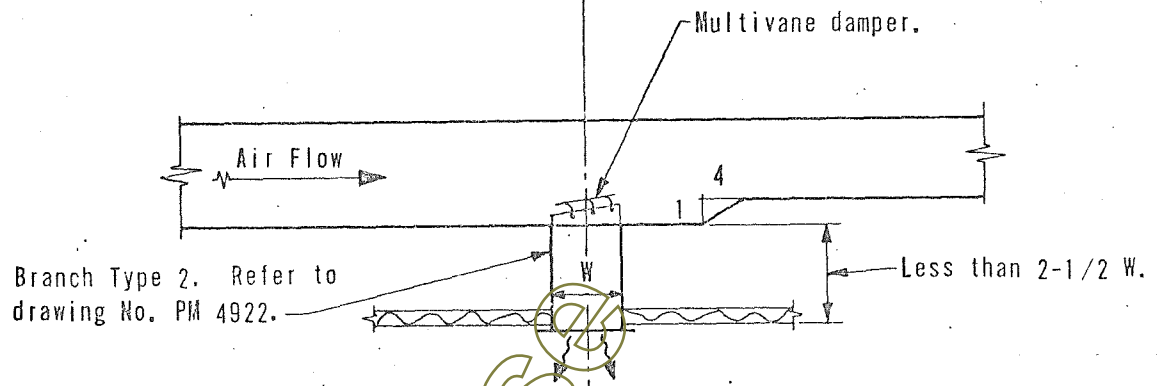


Fig. 2

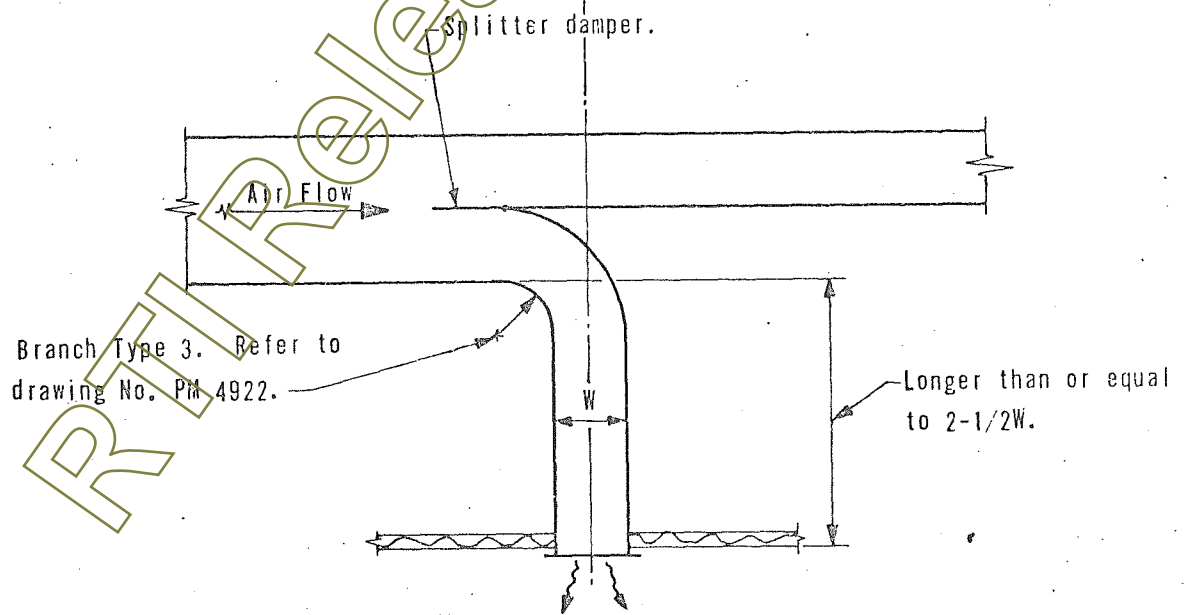


Fig. 3

DEPARTMENT OF WORKS ENGINEERING BRANCH STANDARD DETAIL LOW PRESSURE DUCTWORK SUPPLY AIR OUTLETS - WALL TYPE	SCALE	N.T.S.	AUTHORISED FOR ISSUE
	DESIGN	REB.	<i>R. J. Sheehey</i>
	DRAWN	J.A.H.	EXECUTIVE ENGINEER
	CHECKED	<i>[Signature]</i>	
	DATE	1/5/72	PM 4930

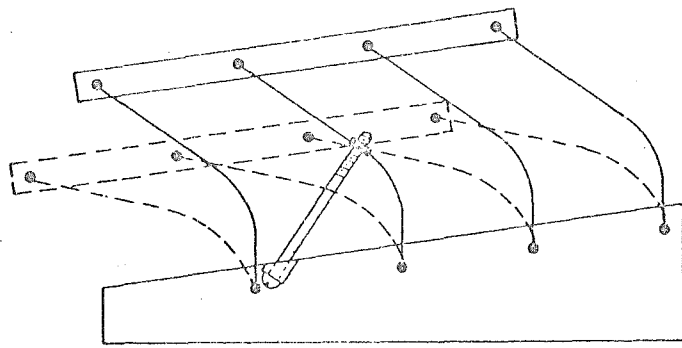


FIG. 1. MULTIVANE DAMPER

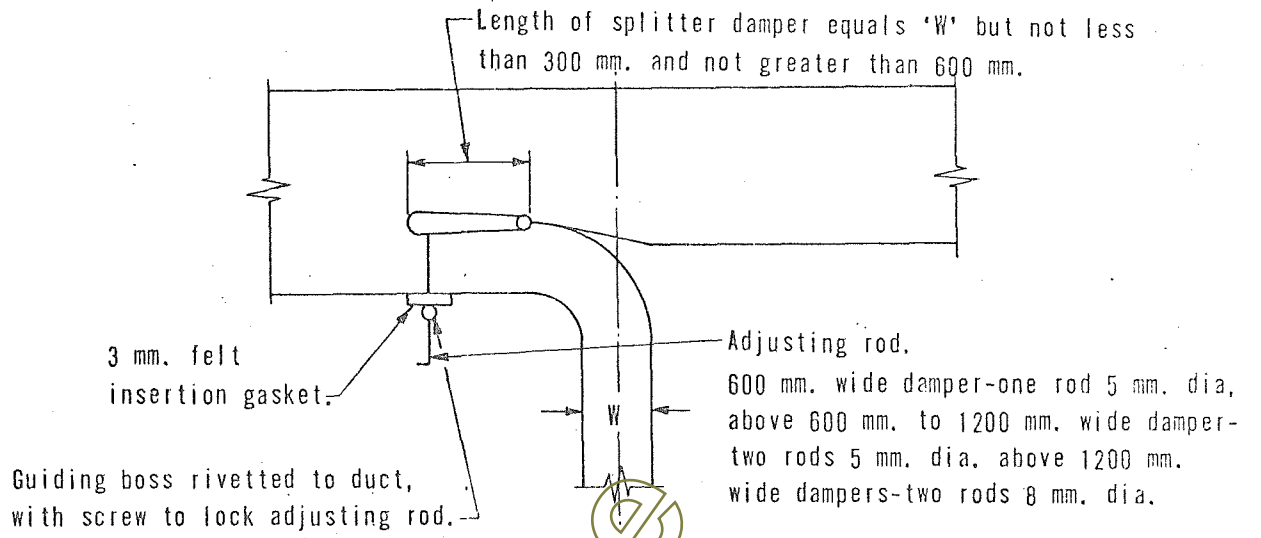


FIG. 2 SPLITTER DAMPER

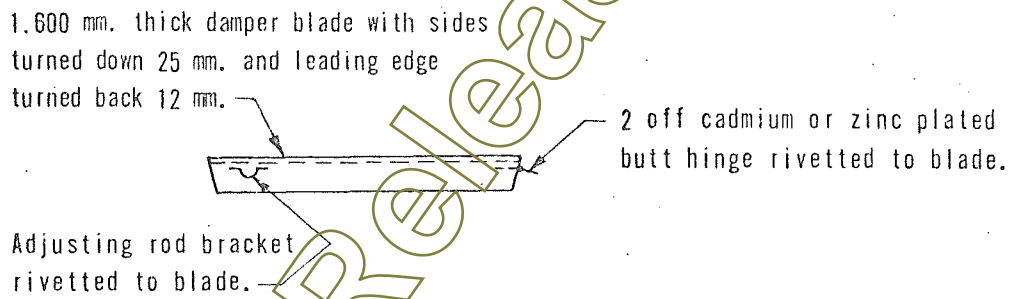


FIG. 3 DAMPER BLADE UP TO 450 mm. WIDE

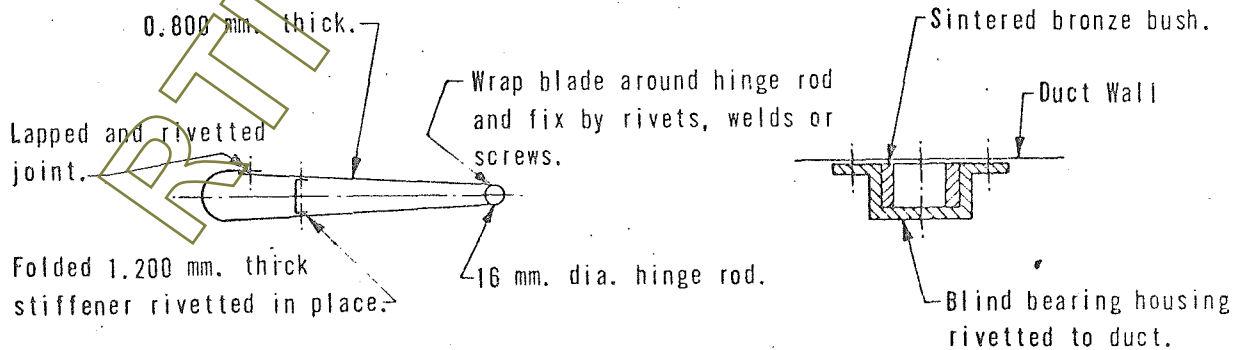
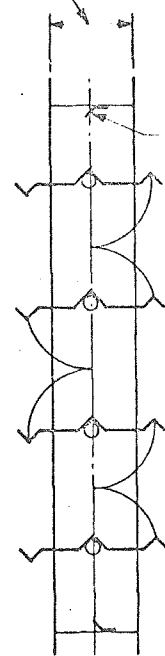


FIG. 4 DAMPER BLADE OVER 450 mm. WIDE.

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	DESIGN	<i>Mr</i>	<i>R. J. Y.</i> EXECUTIVE ENGINEER
STANDARD DETAIL LOW PRESSURE DUCTWORK VOLUME CONTROL DAMPERS	DRAWN	R. J. Y.	P M4931
	CHECKED	R. E. B.	
	DATE	25/7/26	

150 mm. min.



Blade strip and sealing strip to be full length of blade. Strip to be rivetted to frame at 75 mm. centres.

150 mm. min.

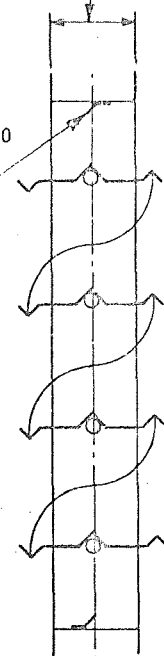


FIG. 1. - OPPOSED BLADE DAMPER

FIG. 2. - PARALLEL BLADE DAMPER

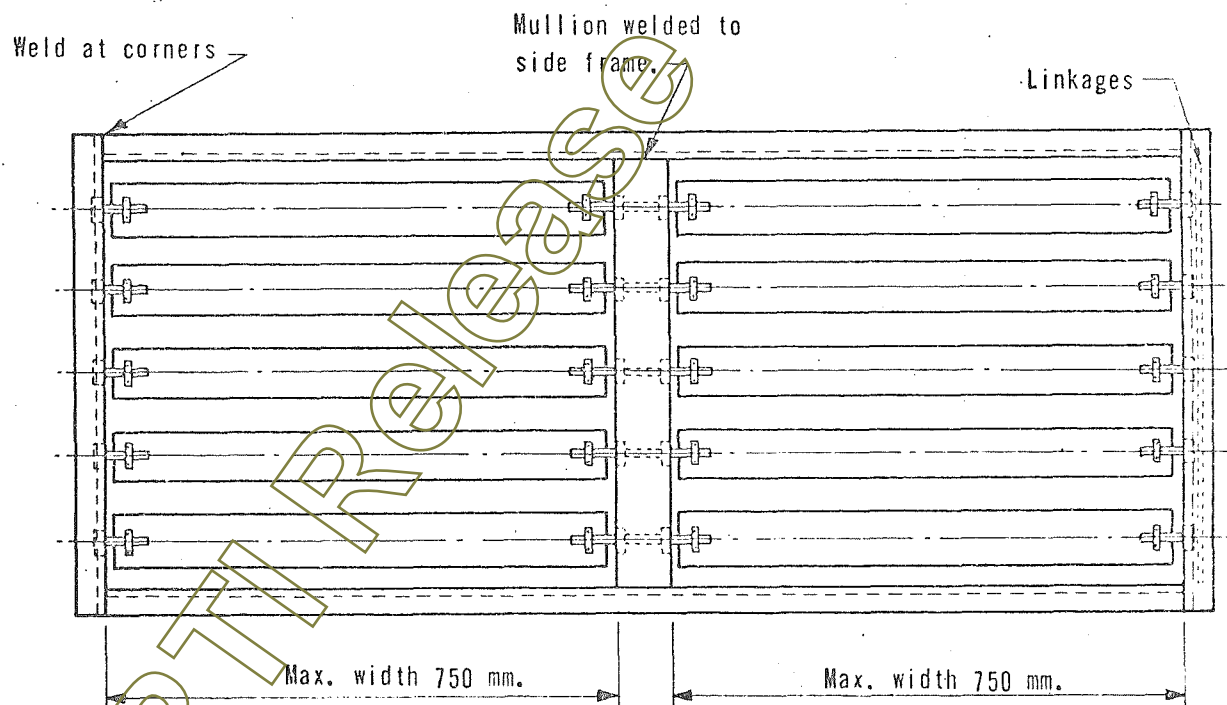


FIG. 3. - ELEVATION OF DAMPER SET

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	DESIGN	R.E.B.	
STANDARD DETAIL LOW PRESSURE DUCTWORK MULTIBLADE DAMPERS	DRAWN	J.A.H.	P M4932
	CHECKED	<i>M</i>	
	DATE	15/7/70	

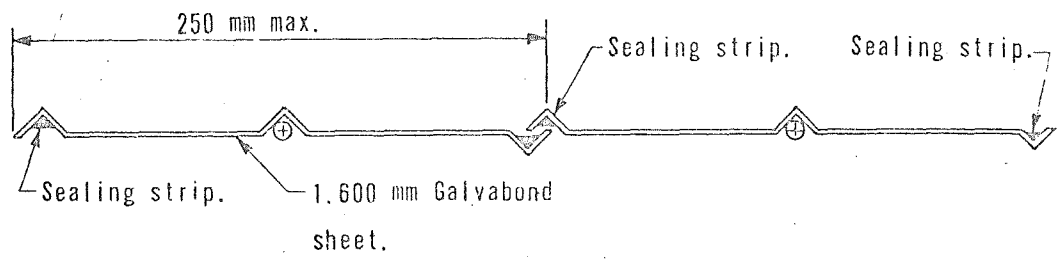


FIG. 1 - BLADE CONSTRUCTION

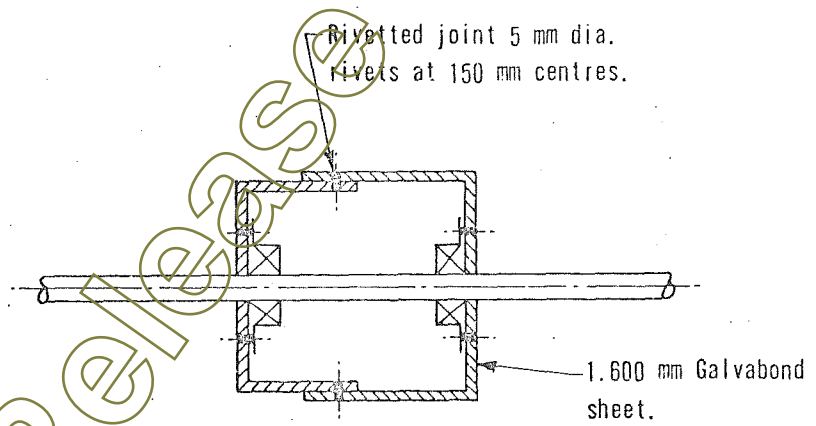


FIG. 2. SECTION THROUGH MULLION

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STANDARD DETAIL LOW PRESSURE DUCTWORK MULTIBLADE DAMPER CONSTRUCTION	DRAWN	J. A. H.	P M4933
	CHECKED	<i>[Signature]</i>	
	DATE	15/9/76	

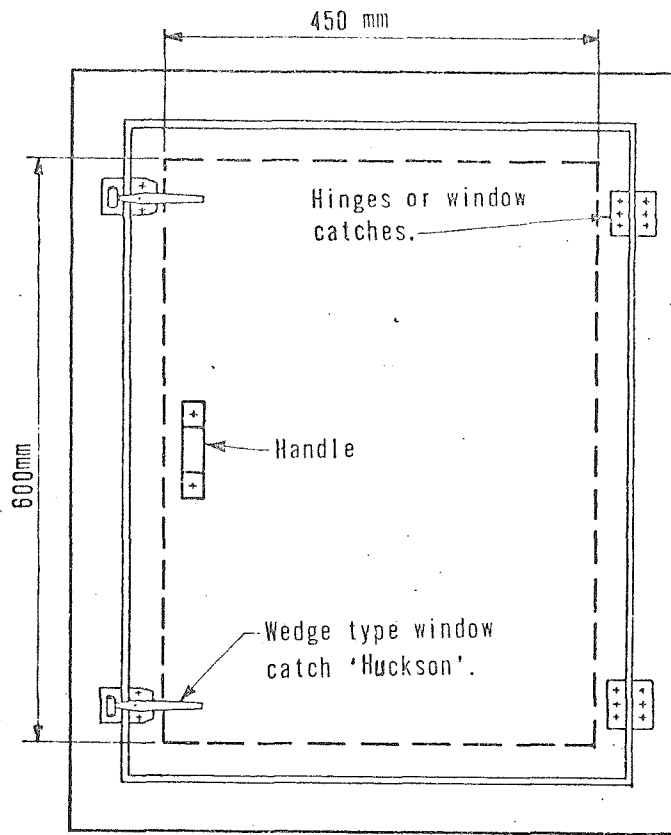


FIG. 1 TYPICAL MANHOLE

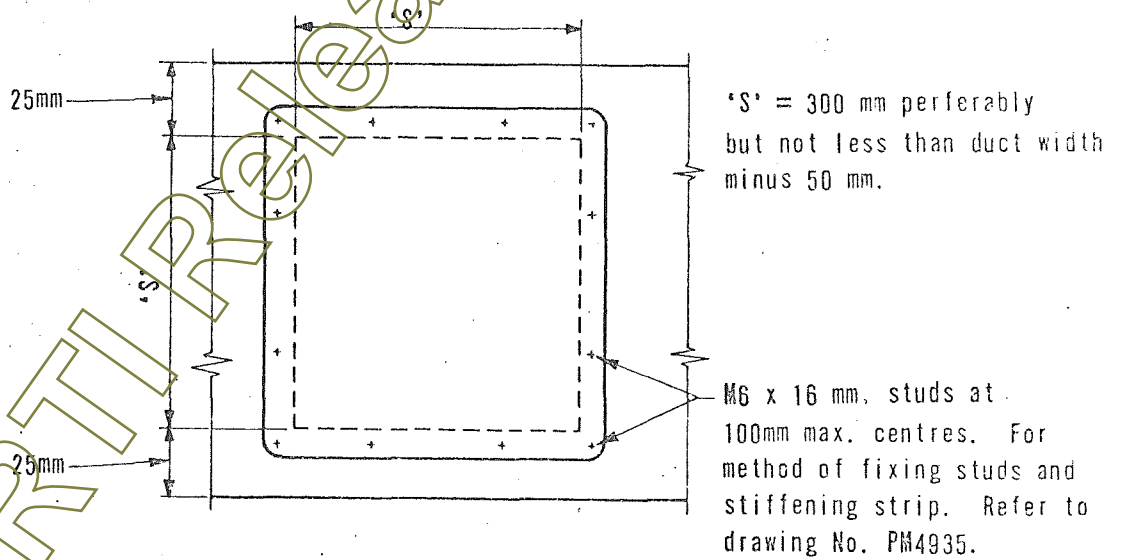
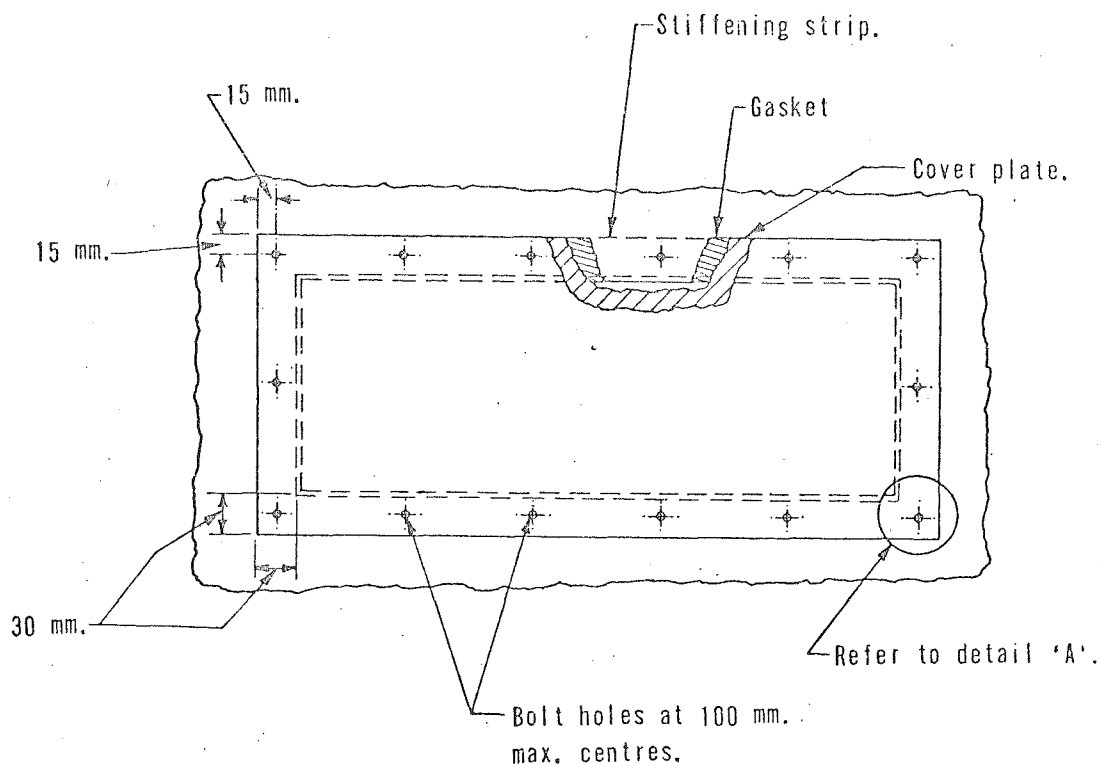
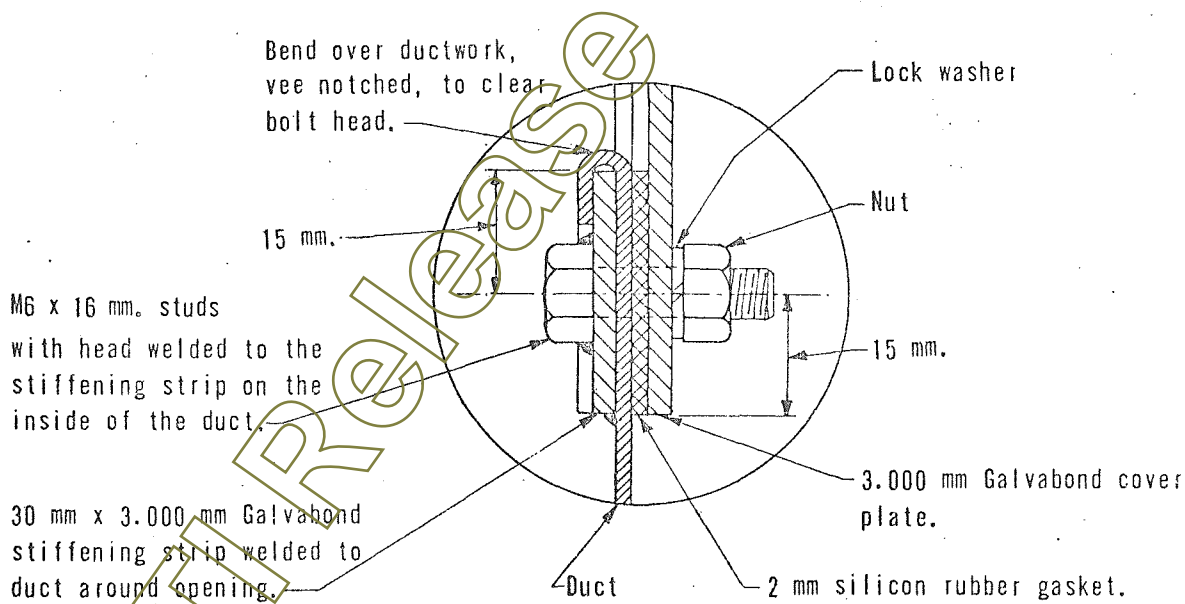


FIG. 2 TYPICAL HANDHOLE

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	DESIGN	REB.	<i>[Signature]</i>
STANDARD DETAIL LOW PRESSURE DUCTWORK MANHOLES AND HANDHOLES	DRAWN	J. A. H.	EXECUTIVE ENGINEER
	CHECKED	<i>[Signature]</i>	P M4934
	DATE	15/7/66	



ELEVATION



DETAIL 'A'

NOTE: After welding to be treated in accordance with Standard Specification SM6 - treatment No. 6.

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	DESIGN	<i>[Signature]</i>	<i>[Signature]</i>
STANDARD DETAIL LOW PRESSURE DUCTWORK SERVICE ACCESS FOR U.V. LAMPS	DRAWN	J.A.H.	EXECUTIVE ENGINEER
	CHECKED	R.E.B.	P M4935
	DATE	15/7/1953	

5 mm. rivets or
self tapping screws.

Hanger spacing at 2400 mm.
centres.

DUCT SEMI PERIMETER

Up to 750 mm.
above 750 mm. to 1000 mm.
above 1000 mm. to 1250 mm.

BAND

38 mm. x 3.000 mm. Galvabond
50 mm. x 3.000 mm. Galvabond
50 mm. x 5 mm. Black M.S.

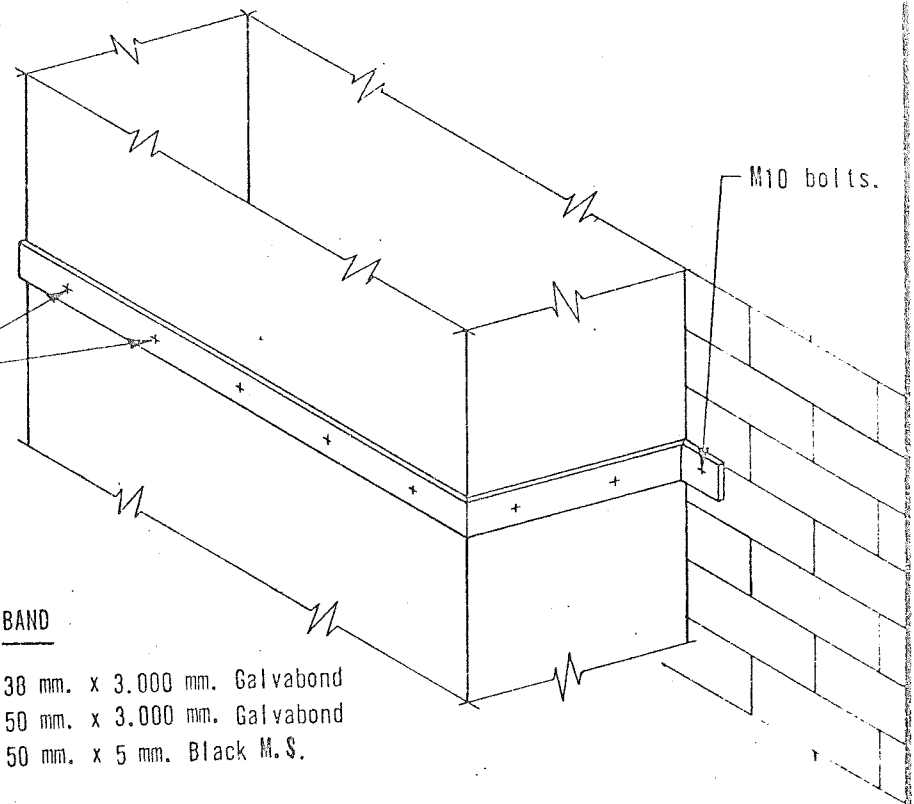


FIG. 1 - BAND HANGER FOR VERTICAL DUCT

Hanger spacing at
2400 mm. centres.

DUCT SEMI PERIMETER

Up to 1350 mm.
above 1350 mm. to 1750 mm.
above 1750 mm. to 2000 mm.
above 2000 mm.

ANGLE

38 mm. x 38 mm. x 3 mm.
51 mm. x 51 mm. x 5 mm.
64 mm. x 64 mm. x 5 mm.
As detailed in Work Specification.

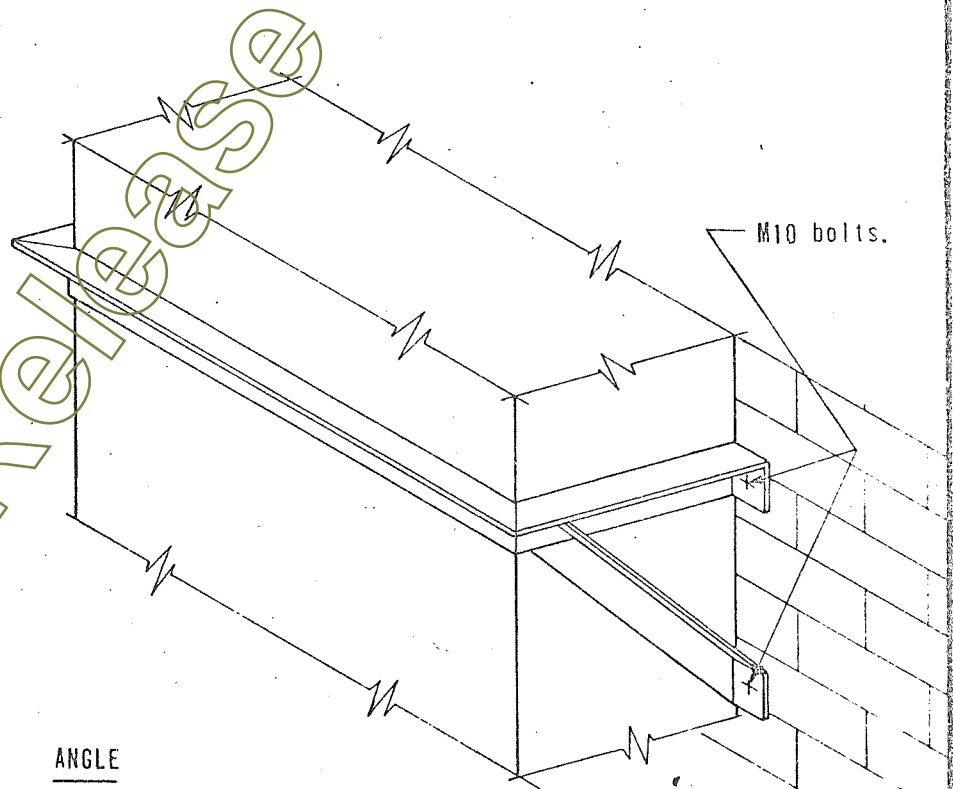
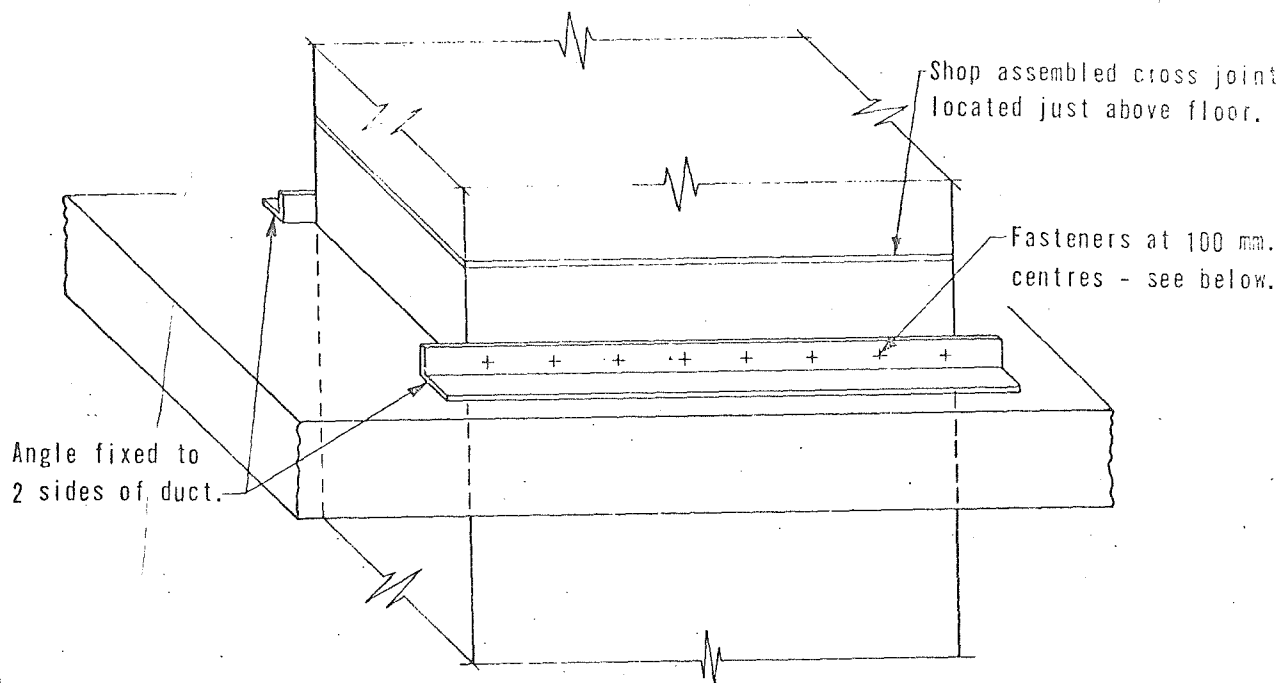


FIG. 2 - BRACKET HANGER FOR VERTICAL DUCT.

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STANDARD DETAIL LOW PRESSURE DUCTWORK HANGERS FOR VERTICAL DUCTS	DRAWN	R.J.Y.	P M4936
	CHECKED	<i>W.S.</i>	
	DATE	15/7/76	



DUCT SEMI PERIMETER

Up to 1350 mm.
 above 1350 mm. to 1800 mm.
 above 1800 mm. to 2250 mm.
 above 2250 mm.

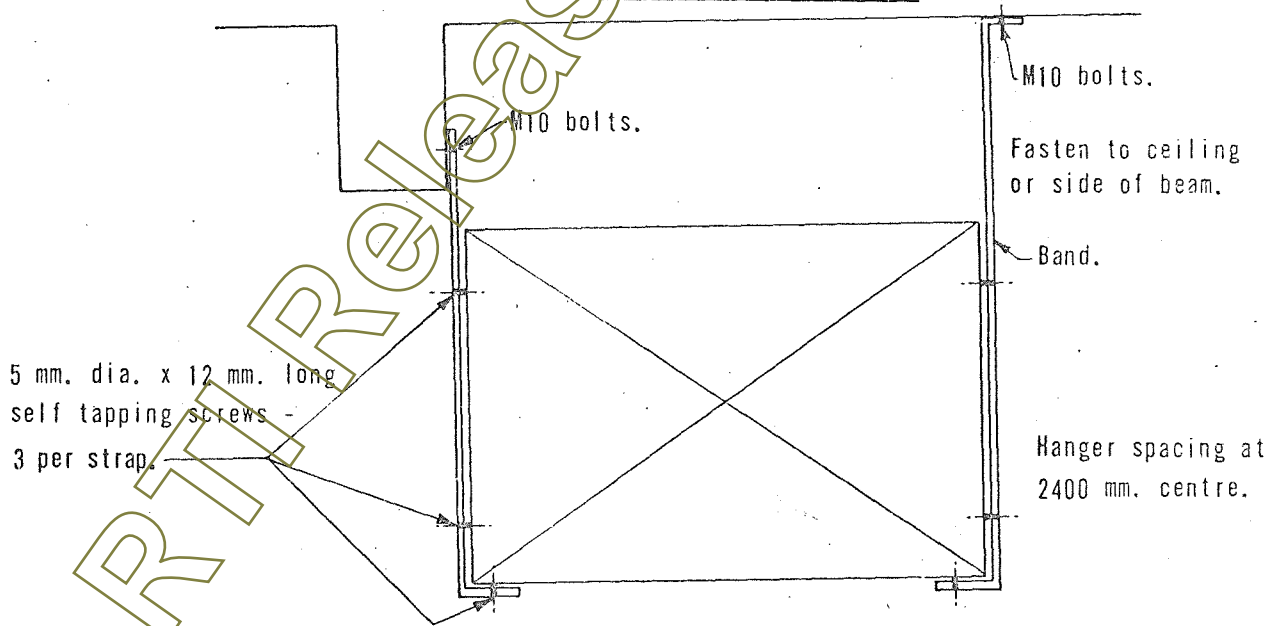
ANGLE

25 mm. x 25 mm. x 3 mm.
 38 mm. x 38 mm. x 3 mm.
 51 mm. x 51 mm. x 3 mm.
 As detailed in Work Specification.

FASTENERS

3 mm. self tapping screws.
 M6 bolts.
 M8 bolts.

FIG. 1 SUPPORT FOR VERTICAL DUCT THROUGH FLOOR
 WHERE NO FIRE DAMPER IS REQUIRED.



DUCT SEMI PERIMETER

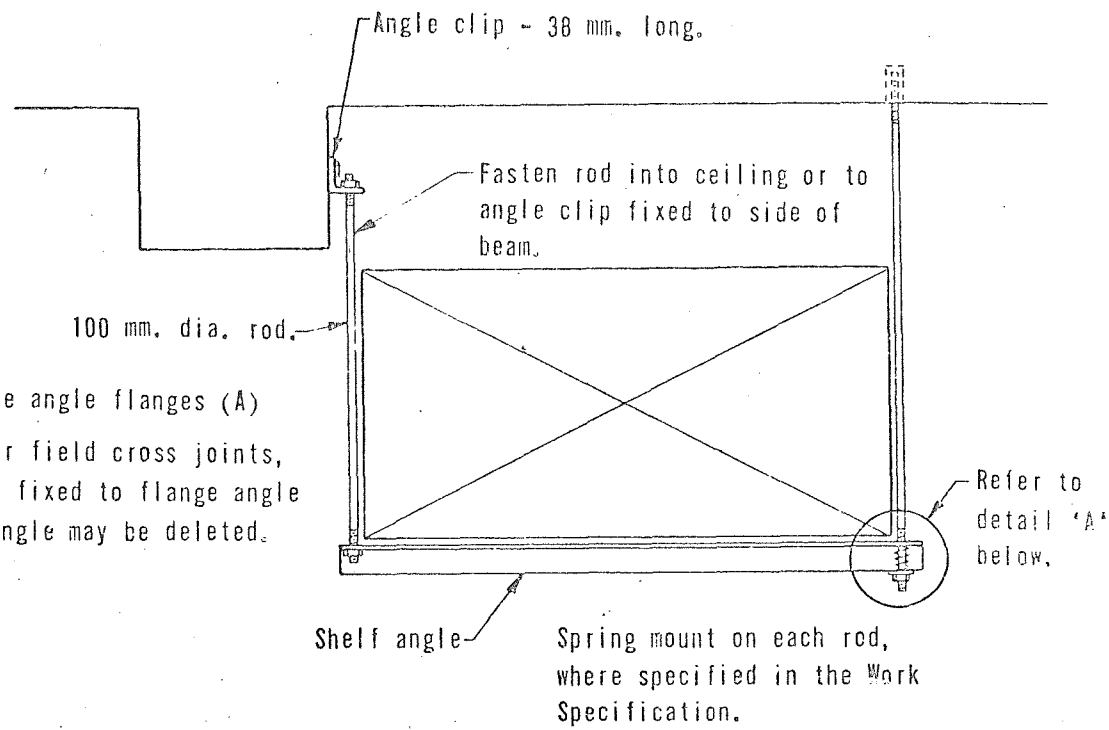
Up to 1350 mm.
 above 1350 mm. to 1650 mm.
 above 1650 mm.

BAND

25 mm. x 3.000 mm. Galvabond
 38 mm. x 3.000 mm. Galvabond
 - Use shelf angle and rod hanger. Refer to drawing No. PM 4938.

FIG. 2 - BAND HANGER FOR HORIZONTAL DUCT.

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	DESIGN	R.E.B.	
STANDARD DETAIL LOW PRESSURE DUCTWORK HANGERS FOR DUCTS	DRAWN	R.J.Y.	P M4937
	CHECKED	<i>AKS</i>	
	DATE	28/7/76	



NOTE: Where angle flanges (A) are used for field cross joints, rods may be fixed to flange angle and shelf angle may be deleted.

Hanger spacing at 2400 mm. centres.

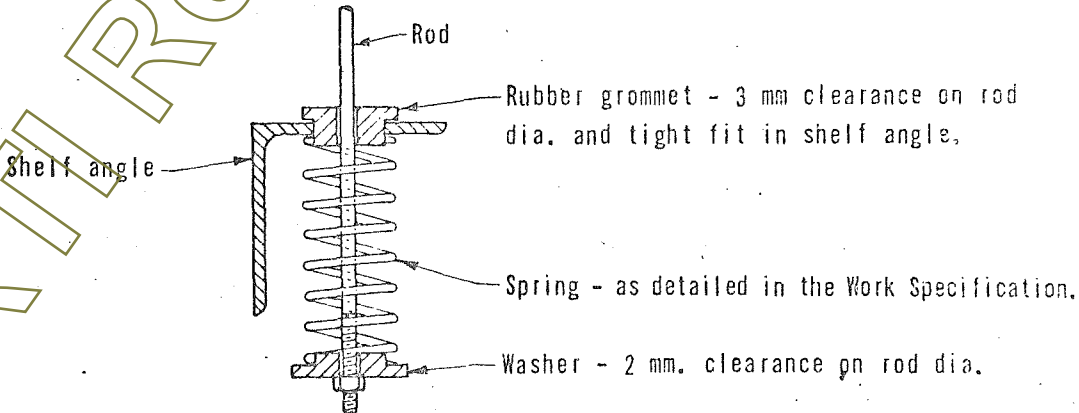
DUCT SEMI PERIMETER

Up to 1200 mm.
 above 1200 mm to 1650 mm.
 above 1650 mm. to 2100 mm.
 above 2100 mm. to 2700 mm.
 above 2700 mm.

SHELF ANGLE AND ANGLE CLIP

38 mm. x 38 mm. x 3 mm.
 51 mm. x 51 mm. x 3 mm.
 51 mm. x 51 mm. x 5 mm.
 51 mm. x 51 mm. x 6.5 mm.
 As detailed in the Work Specification.

SHELF ANGLE AND ROD HANGER



DETAIL 'A'

DEPARTMENT OF WORKS ENGINEERING BRANCH STANDARD DETAIL LOW PRESSURE DUCTWORK HANGERS FOR DUCTS	SCALE	N.T.S.	AUTHORISED FOR ISSUE
	DESIGN	R.E.B.	
	DRAWN	R.J.Y.	<i>R. J. Y.</i> EXECUTIVE ENGINEER
	CHECKED	<i>M.S.</i>	
	DATE	15-1-72	
		P	M4938

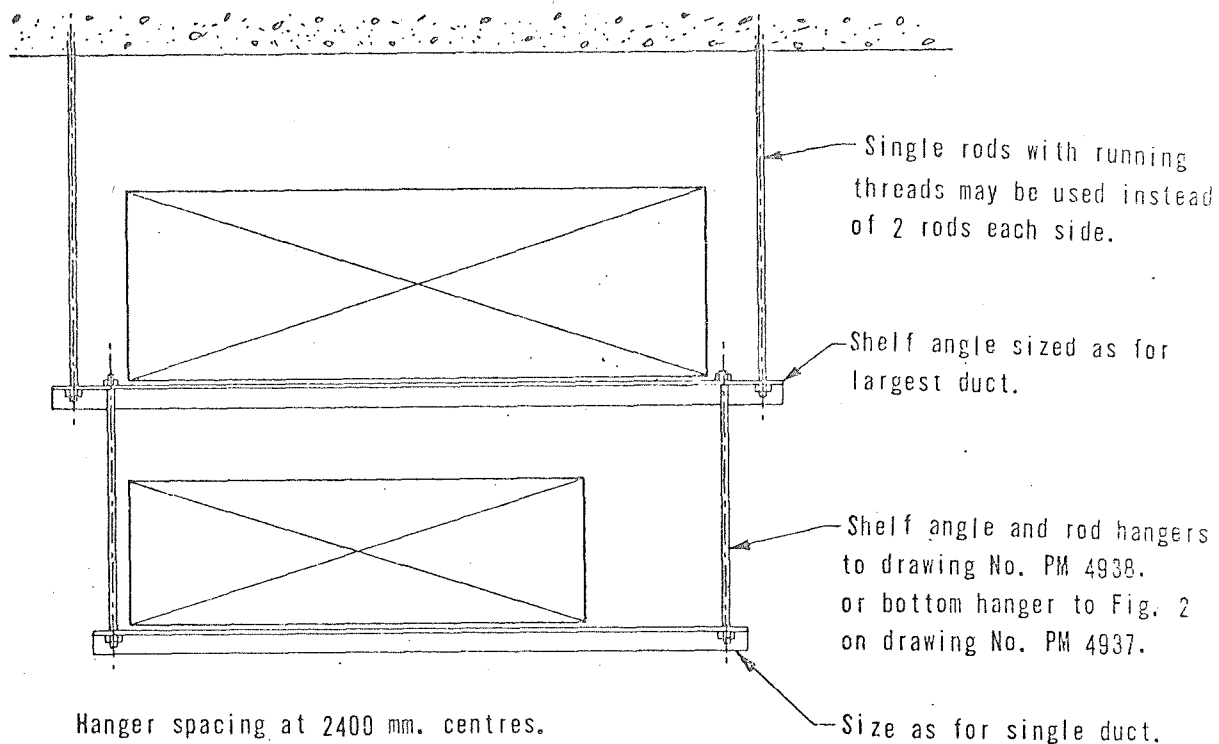


FIG. 1. - BOTTOM DUCT NARROWER OR EQUAL WIDTH TO TOP DUCT.

Hanger rods 10 mm. dia. when sum of semi-perimeters of ducts does not exceed 3000 mm, and 13 mm. dia. when sum of semi-perimeters exceeds 3000mm.

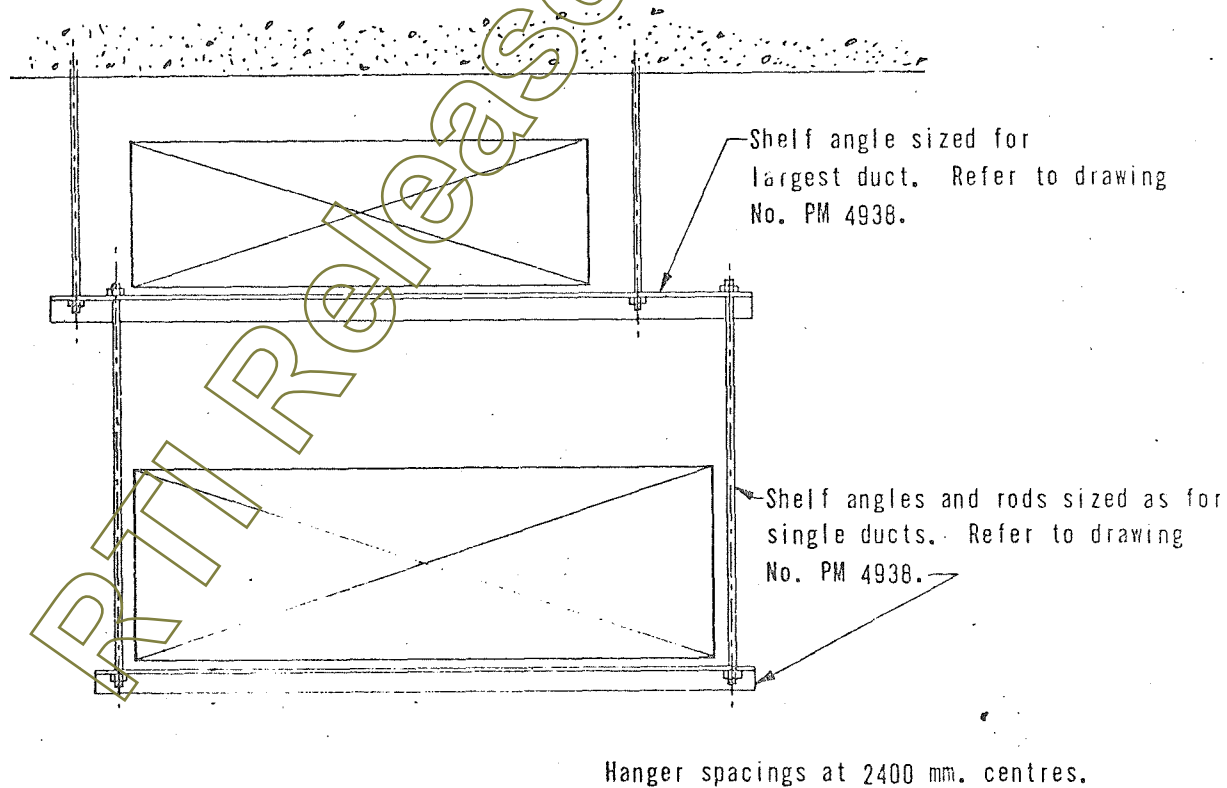
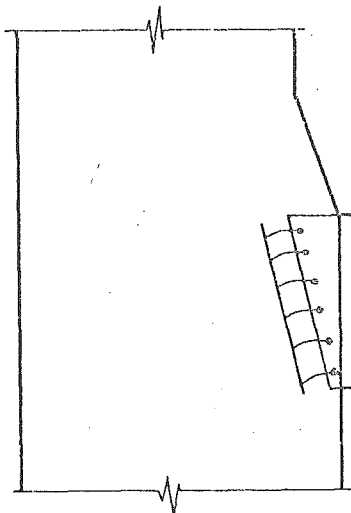


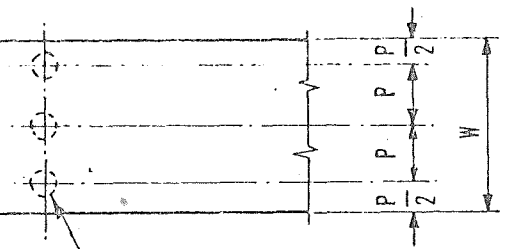
FIG. 2. - BOTTOM DUCT WIDER THAN TOP DUCT.

DEPARTMENT OF WORKS ENGINEERING BRANCH	SCALE	NTS	AUTHORISED FOR ISSUE <i>R.F. Alvey</i> EXECUTIVE ENGINEER
	DESIGN	R.E.B.	
STANDARD DETAIL LOW PRESSURE DUCTWORK HANGERS FOR DUCTS - TWO OR MORE DUCTS ABOVE EACH OTHER	DRAWN	J.A.H.	P M4939
	CHECKED	<i>W.S.</i>	
	DATE	18/7/55	

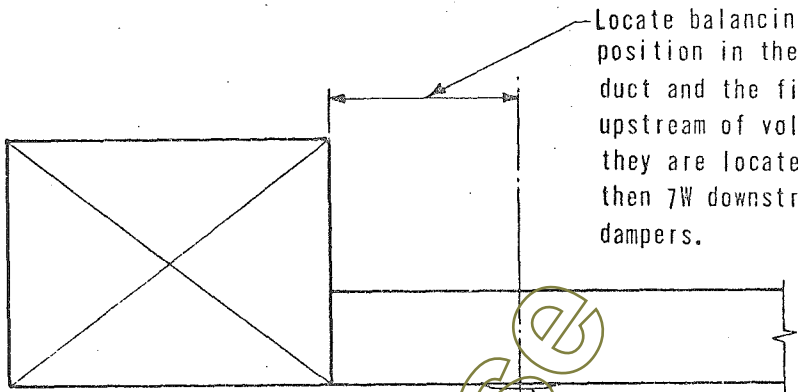


PLAN

$$P = \frac{W}{\text{No. of Points}}$$



Holes plugged with rubber grommet.
Refer to Detail A below.

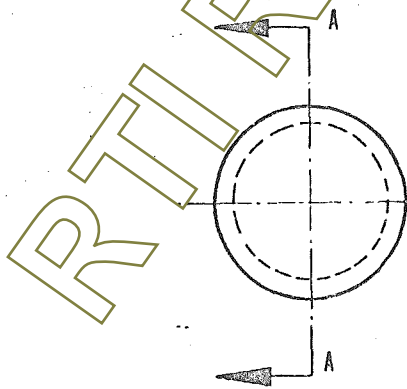


Locate balancing points in an accessible position in the branch between the main duct and the first air take off either upstream of volume control dampers where they are located in the branch or not less than 7W downstream of the volume control dampers.

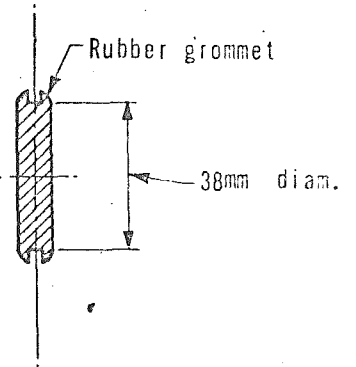
Balancing points

ELEVATION

LOCATION AND SPACING OF BALANCING POINTS.



ELEVATION



SECTION AA.

DETAIL A

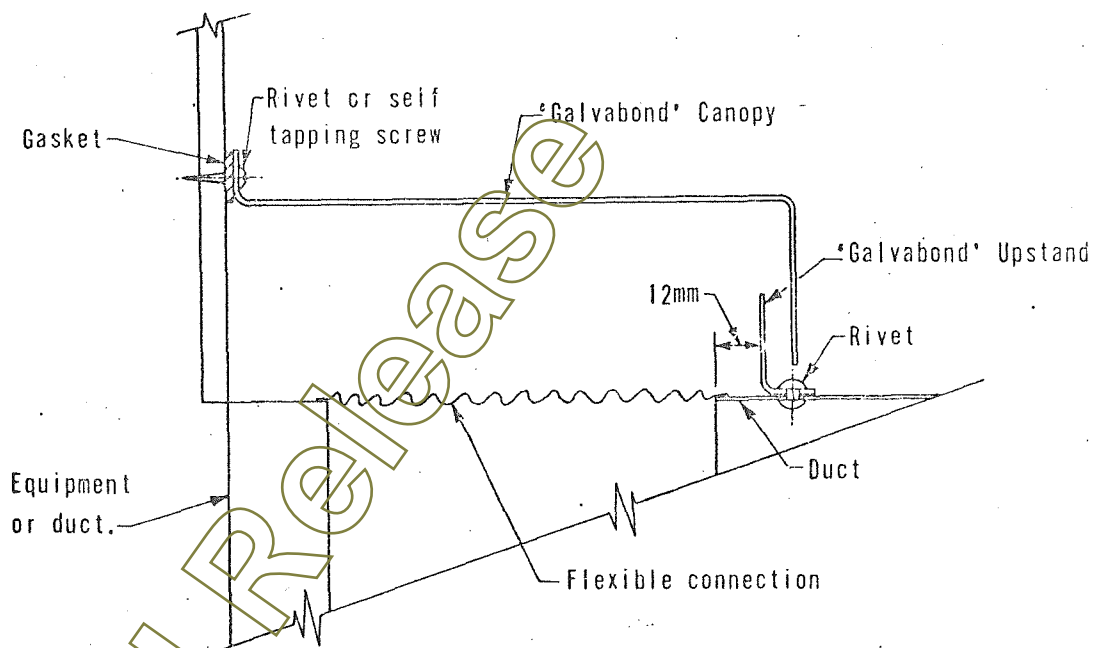
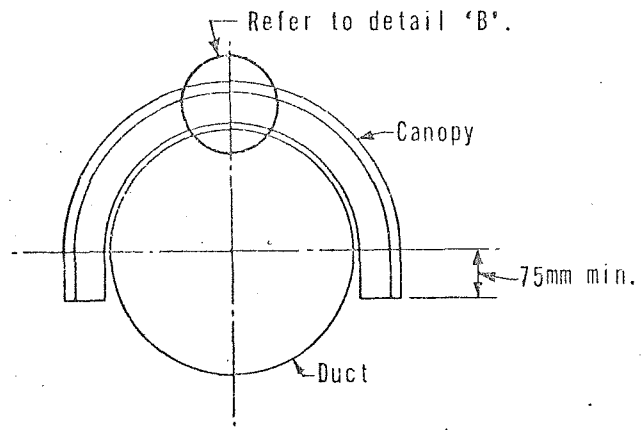
DEPARTMENT OF WORKS
ENGINEERING BRANCH

STANDARD DETAIL
LOW PRESSURE DUCTWORK
BALANCING POINTS

SCALE	N.T.S.
DESIGN	R.E.B.
DRAWN	J.A.H.
CHECKED	<i>M/S</i>
DATE	<i>15/7/91</i>

AUTHORISED FOR ISSUE
R. J. Alway
EXECUTIVE ENGINEER

P M4940



DETAIL 'B'

DEPARTMENT OF WORKS
ENGINEERING BRANCH

STANDARD DETAIL
LOW PRESSURE DUCTWORK
WEATHERPROOFING FLEXIBLE CONNECTIONS

SCALE	N. T. S.
DESIGN	REB.
DRAWN	R. J. K.
CHECKED	<i>[Signature]</i>
DATE	<i>[Signature]</i>

AUTHORISED FOR ISSUE
[Signature]
EXECUTIVE ENGINEER

P M4941

STANDARD SPECIFICATION SMS.

**INSULATION AND SOUND ABSORPTION
TREATMENT OF DUCTWORK AND AIR
HANDLING EQUIPMENT.**

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**DEPARTMENT OF WORKS,
ENGINEERING BRANCH.**

The use of basic material supplied by "The Thermal Insulation Contractors Association (Australia)", is gratefully acknowledged.

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STANDARD SPECIFICATION SM5.

INSULATION AND SOUND ABSORPTION TREATMENT
OF DUCTWORK AND AIR HANDLING EQUIPMENT

1.0 SCOPE

This Standard Specification sets out the Department's requirements in regard to the quality of materials and standards of workmanship which shall be adopted in the supply and erection of thermal and acoustic insulation for ductwork and air handling equipment such as fan chambers, conditioners and apparatus connections, handling air between 1° and 65°C.

2.0 USE OF THIS STANDARD SPECIFICATION

Where this Standard Specification describes various types of insulation materials and methods of providing a vapour barrier, the types and methods to be used in a particular project are described in the Work Specification.

3.0 ASSOCIATED SPECIFICATIONS, STANDARDS AND DRAWINGS

The following specifications, standards and drawings, including any subsequent amendments shall apply:-

3.1 SPECIFICATIONS

- (a) SM1 - Standard Requirements for Mechanical Installations
- (b) SM6 - Surface Preparation and Coating for Corrosion Protection.

3.2 STANDARDS

- (a) AS 1045 - 1971 Method of measurement of absorption coefficients in a reverberation room.
- (b) AS 1530 - Part III Tests for Early Fire Hazard Properties of Materials.
- (c) AS 1668 - 1974 Part 1 Fire Precautions in Buildings with Air-handling systems.
- (d) Building Act 1975
- (e) U.S. Underwriters Laboratory Standard U.L. 181.

3.3 DRAWINGS

Nil.

4.0 THICKNESSES OF INSULATION

The extent and thickness of insulation on the specific project shall be interpreted from the following table:

TABLE "A" - INSULATION THICKNESS

Position	Supply Air Duct	Return Air Duct Evaporative Cooling System Air Duct.	Fresh Air Intake Duct
Areas subject to ambient conditions not greater than 27°C e. g. concealed in Conditioned Areas such as false ceilings, boxed in etc.	25 mm	Nil	Nil
Areas subject to ambient conditions between 27°C and 38°C. e. g. exposed or concealed in unconditioned rooms	50 mm	25 mm	Nil
Areas subject to ambient conditions greater than 38°C or direct solar loads, e. g. roof spaces, external to building etc.	75 mm	50 mm	38 mm

5.0 INSULATING MATERIALS AND METHODS

5.1 GENERAL

(a) Where sheet metal ducts are exposed to view, exposed to the weather, within Plant Rooms, or where the risk of mechanical damage is indicated by the Department, internal insulation shall be used, or external insulation shall be metal sheathed. Refer to Clause 6.0 herein.

(b) Ductwork exposed in conditioned areas shall only be insulated where indicated in the Works Specification and Drawing/s.

(c) Materials used for Thermal Insulation and Sound Absorption Treatment, when tested for Early Fire Hazard Properties in accordance with Part III of A.S. 1530 and shall meet the following standards:-

- Spread of Flame Index shall not be greater than 0
- Smoke Developed Index shall not be greater than 3

Test certificates from a recognised Testing Laboratory to certify that the material offered has been tested and shown to have achieved these standards, shall be submitted.

(d) The insulation used for Sound Absorption Treatment shall have not less than the following Sound Absorption coefficients for the thickness shown below, when tested in a Reverberation Chamber in accordance with AS 1045 - 1971 with the specimen laid flat on the floor of the chamber, using mounting No. 4 as specified by the U.S. Acoustical and Insulating Materials Association.

TABLE "B" SOUND ABSORPTION COEFFICIENTS

Thickness	Frequency - Hertz			
	250	500	1000	2000
mm				
25	0.25	0.50	0.70	0.70
50	0.50	0.75	0.80	0.70

Test certificates from a recognised Testing Laboratory to certify that the material has the specified sound absorption coefficients when tested by the method specified, shall be submitted.

(e) All joints in the insulation shall be tightly butted and in the case of horizontal ductwork longitudinal joints shall be on the underside

5.2 TYPE 1 DUCT INSULATION (for use on outside of duct carrying heated air only).

(a) Insulation

The insulation shall:

- (i) Be resin bonded mineral wool or glass fibre
- (ii) Be in flexible blanket form
- (iii) Have a thermal conductivity at 20°C of not more than 0.04 W/mK.

(b) Fixing

The insulation shall be wrapped around the outside of the duct and held in place with 25 mm mesh 0.50 mm galvanised wire netting wrapped around the insulation and tied with galvanised wire at all joints.

Additional support shall be provided on the bottom surface only by rust resistant welded pins placed as follows:-

Duct width up to 400 mm - No support

Above 400 mm to 800 mm - one row of pins along centre line at approximately 400 mm centres.

Above 800 mm - staggered formation at a maximum of 400 mm spacing.

With vertical ducts exceeding 600 mm in width, the insulation blanket shall have additional support by welded pins along the centre line at maximum 400 mm centres. The blanket shall be secured onto the pins with nylon washer or metal speed clips not less than 20 mm in diameter.

5.3 TYPE 2 DUCT INSULATION (for use on outside of duct)

(a) Insulation

The insulation shall:

- (i) Be Type 1 duct insulation material
- (ii) Be factory-bonded to double sided, reinforced, fire-resistant, aluminium foil laminate

The reinforced aluminium foil shall be equivalent to 'Sisalation 450' but not 'Sisalation 420'. Bitumen adhesive shall not be used for the bonding medium.

(b) Fixing

On horizontal ductwork the insulation blanket shall be wrapped around the duct starting from a central position on the top side. Additional support shall be provided on the bottom surface only by rust resistant welded pins placed as follows:-

Duct width up to 400 mm - No support

Above 400 mm to 800 mm - one row of pins along centre line at approximately 400 mm centres

Above 800 mm - staggered formation at a maximum 400 mm spacing

With vertical ducts exceeding 600 mm in width, the insulation blanket shall have additional support by welded pins along the centre line at maximum 400 mm centres. The blanket shall be secured onto the pins with nylon washer or metal speed clips not less than 20 mm in diameter. Butt joints and stud penetrations shall be sealed with 100 mm strips of 'Sisalation 450' using a liberal application of a non-flammable adhesive.

The insulation shall then be banded with 13 mm wide galvabond sheet steel straps at 600 mm spacings. 0.80 mm thick galvabond sheet steel angles shall be placed on the corners under the straps. Corner angles shall be 38 mm x 38 mm for 25 mm thick insulation and 64 mm x 64 mm for 50 mm thick insulation.

Where flanged joints occur in the duct, the width of the sealing strip shall be increased to 150 mm.

5.4 TYPE 3 DUCT INSULATION (for use on inside of duct and suitable for air velocities up to and including 8 m/s)

(a) Insulation

The insulation shall:

- (i) Be resin bonded mineral wool or glass fibre
- (ii) Be in a semi-rigid batt or board form
- (iii) Be factory impregnated with a black resinous surface binder
- (iv) Have a thermal conductivity at 20°C of not more than 0.04 W/mK
- (v) Shall show no sign of progressive erosion when tested for the planned air velocity in accordance with U.S. Underwriters Laboratory Standard U.L. 181
- (vi) Have not less than the stated Sound Absorption coefficients for the thickness shown in Clause 5.1 (d) therein.

(b) Facings

The insulation material shall have the air surface face impregnated with a factory applied black synthetic resinous binder, such that the treated surface is an integral part of the insulation

(c) Fixing

The insulation shall be placed on the inside of the duct with adjacent sides overlapping at the corners.

Where dampers operate and where specified in the Work Specification the insulation shall be fixed behind 0.500 mm perforated zincanneal sheet having uniformly spaced perforations of 2.5 mm diameter providing 10% open space. The perforated sheet shall be spray painted on both sides with one coat of red oxide primer - Treatment No. 3' Clause 9.03 of the Standard Specification SM 6 before being fitted.

The perforated sheet shall be supported and fixed in the duct so that continuous insulation with a minimum of high conductivity bridges is obtained. The sheet shall be fixed to Z sections manufactured from 0.600 mm Galvabond steel or zincanneal. These Z sections shall be fastened with blind pop rivets or self tapping screws to the duct with a strip of 50 mm x 3 mm asbestos tape between the Z sections and the duct wall.

Elsewhere, the insulation shall preferably be secured by impaling it over stud-welded, rust proof pins not less than 3 mm diameter, or spot welded sheet metal split lugs. Pins or lugs shall be spaced at not less than 300 mm centres with a minimum of two rows of fastenings per duct side.

Pins shall be fixed with a stud welding gun and welding machine suitable for welding pins to light gauge steel sheet. The gun shall hold the pins to the duct under pressure, while it is being welded. At all times the welding machine shall be correctly set for the diameter of the pin being used so that the pin is securely welded to the duct without burning the galvanised coating on the duct. Fibre washers 32 mm outside diameter shall be fitted over the pins or lugs and fastened with rustproof speed clips or pins or by bending down the ends of split lugs.

The fastening and washers shall be applied flush to the face of the insulation without depressing the surface more than 6 mm.

Alternatively, on ducts up to and including 600 mm wide, the insulation may be secured by internal corner angles and internal bands.

The corner angles shall run the full length of the insulation and shall be not smaller than 38 x 38 x 1.200 mm Galvabond steel sheet. Bands shall be of not less than 25 mm x 3 mm Galvabond steel or 1,200 mm Galvabond steel sheet with both edges hemmed 6 mm for stiffening and of finished width not less than 25 mm. Bands shall be spaced at not more than 1200 mm centres, shall be sprung between corner angles and shall be fixed and supported if and where necessary.

5.5 TYPE 4 DUCT INSULATION (for use on inside of ducts and suitable for air velocities up to and including 13 m/s)

(a) Insulation

The insulation shall:

- (i) Be resin bonded mineral wool or glass fibre.
- (ii) Be in semi-rigid batt or board form
- (iii) Be factory-bonded to glass fibre matt, described in (b) below
- (iv) Have a thermal conductivity at 20°C of not more than 0.04 W/m K
- (v) Show no sign of progressive erosion when tested for the planned velocity in accordance with the U.S. Underwriters Laboratory Standard U.L. 181
- (vi) Have not less than the stated sound absorption coefficients for the thickness as shown in Clause 5.1 (d) herein.

(b) Facings

The insulation material shall have the air surface face faced with glass fibre matt, "Regina Type P. 450" or equal. This shall be factory bonded with a black synthetic resinous binder, such that the treated surface is an integral part of the insulation.

(c) Fixing

The insulation shall be fixed as specified in Clause 5.4 (c) herein.

5.6 TYPE 5 DUCT INSULATION (for use on inside of duct and suitable for velocities up to and including 13 m/s)

(a) Insulation

The insulation shall:

- (i) Be resin bonded mineral wool or glass fibre
- (ii) Be in a semi-rigid batt or board form
- (iii) Be factory-bonded to double sided, reinforced fire resistant, perforated aluminium foil laminate
- (iv) Have a thermal conductivity at 20°C of not more than 0.04 W/mK
- (v) Shall show no sign of progressive erosion when tested for the planned air velocity in accordance with the U.S. Underwriters Laboratory Standard U.L. 181.
- (v) Have not less than the stated Sound Absorption coefficients for the thicknesses shown in Clause 5.1 (d) herein.

(b) Facings

The insulation shall be faced on the air side face with double sided, reinforced, fire resistant, perforated aluminium foil laminate. The laminate shall be 'Sisalation 450' or equal, with 10% perforation area, factory bonded to the insulation. Bitumen type adhesive and 'Sisalation 420' shall not be acceptable.

(c) Fixing

The insulation shall be fixed as shown in 5.4 (c) herein.

5.7 TYPE 6 DUCT INSULATION (for use on inside of ducts and suitable for velocities up to and including 23 m/s)

(a) Insulation

The insulation shall:

- (i) Be resin bonded mineral wool or glass fibre
- (ii) Be in semi-rigid batt or board form
- (iii) Have a thermal conductivity at 20°C of not more than 0.04 W/mK
- (iv) Be intended for fixing behind perforated metal sheet as described in Clause 5.7 (b) herein
- (v) Show no sign of progressive erosion when tested for the planned velocity in accordance with the U.S. Underwriters Laboratory Standard U.L. 181.
- (vi) Have not less than the stated sound absorption coefficients for the thickness as shown in Clause 5.1 (d) herein.

(b) Fixing

The insulation shall be placed on the inside of the duct with adjacent sides overlapping at the corners.

The insulation shall be fixed behind 0.500 mm perforated zincanneal sheet having uniformly spaced perforations of 2.5 mm diameter providing 10% open space. The perforated sheet shall be spray painted on both sides with one coat of red oxide primer - "Treatment No. 3" Clause 9.03 of the Standard Specification SM 6 before being fitted.

The perforated sheet shall be supported and fixed in the duct so that continuous insulation with a minimum of high conductivity bridges is obtained. The sheet shall be fixed to Z sections manufactured from 0.600 mm Galvabond steel or zincanneal. These Z sections shall be fastened with blind pop rivets or self tapping screws to the duct with a strip of 50 mm x 3 mm asbestos tape between the Z sections and the duct wall.

5.8 VAPOUR BARRIER

Unless specified differently in the Work Specification, a vapour barrier shall be provided on the warm side of the insulation on ductwork or air handling equipment carrying refrigeration cooled air, to prevent condensation, sweating and waterlogging of the insulation.

The vapour barrier shall provide a complete seal, be completely free of perforations or leaks and shall be adequately insulated throughout from the cold side.

The vapour barrier and insulation shall be fixed over all joints and standing seams and shall be made continuous around access panels and doors by the use of gaskets. Where pipes and fittings pass through the vapour barrier, a seal shall be made continuous by the use of gaskets or other methods.

Where cold bridges are unavoidable, a copper drip tray shall be provided under the duct to collect water drops. Drip trays shall be fixed and drained.

The following methods of providing a vapour barrier for Departmental Works, and the particular one/s to be used are specified in the Work Specification, shall be as follows:-

Method 1

The insulation shall be placed inside the duct or equipment casing so that the duct or casing forms the vapour barrier

Type 3, Type 4, Type 5 or Type 6 Duct Insulation (see Clauses 5.4, 5.5, 5.6 and 5.7, respectively herein), shall be used with this method of vapour barrier.

Method 2

The insulation shall be placed on the outside of the duct or casing with the vapour barrier on the outside of the insulation. Type 2 Duct Insulation (see Clause 5.3 herein), shall be used with this method of vapour barrier.

5.9 INSULATION MATERIAL

(a) Types 1 and 2 (for use on outside of duct)

The following list of insulation materials or equal shall be used:

- (i) A.C.I. Fibreglass Flexible Duct Insulation
- (ii) B.I. Tuff-skin Fibreglass Flexible Duct Insulation
- (iii) Insulwood Fibreglass Duct Lagging

(b) Type 3 (for use on inside of duct, with velocities up to 8.00 m/s)

The following list of insulation materials or equal shall be used:

- (i) A.C.I. Fibreglass semi-rigid Duct Insulation (with air surface treatment)
- (ii) B.I. Blackseal Ductliner.
- (iii) Insulwool Fibreglass semi-rigid Duct Lagging (with air surface treatment)

(c) Type 4 (for use on inside of duct, with velocities up to 13 m/s)

The following list of insulation materials or equal shall be used.

- (i) B.I. Rockwool Ductliner or Linecoustic Ductliner.
- (ii) A.C.I. Matt Faced Ductliner.

(d) Type 5 (for use in inside of duct with velocities up to 13 m/s)

The following list of insulation materials, or equal, shall be used.

- (i) B.I. Tuff-skin Fibreglass semi-rigid Duct Insulation Faced with Perforated Foil Laminate or Rockwool Fibretex Faced with Perforated Foil Laminate.
- (ii) A.C.I. Fibreglass Semi-rigid Duct Insulation Faced with Perforated Foil Laminate.
- (iii) Insulwool Fibreglass semi-rigid Duct Lagging faced with Perforated Foil Laminate.

(e) Type 6 (for use on inside of duct with velocities up to 23 m/s)

The following list of insulation materials, or equal shall be used.

Insulation material as specified for Type 3 fixed behind Perforated Sheet Metal.

6.0 METAL SHEATHING OF INSULATION ON THE OUTSIDE OF DUCTS

6.1 MECHANICAL DAMAGE PROTECTION

Where required by the Work Specification, and Clause 5.1 (a) herein insulation on the outside of ducts or air handling equipment shall be sheathed for protection against mechanical damage.

Sheathing shall be 0.600 mm Galvabond steel sheet, with all joints riveted with 3 mm diameter expanding solid end type rivets of 5% magnesium alloy, 'Timex' brand or equal, at 75 mm centres.

6.2 EXPOSED TO WEATHER

Insulated ductwork exposed to the weather shall be insulated in accordance with either of the two methods outlined below.

(a) Insulation Inside of Ductwork

All longitudinal joints and intermediate cross joints shall be sealed by soldering. Angle flanges and angle stiffeners on the duct shall be sealed with a "Butyl" rubber based plastic sealant, "Norton BM669" or equal. The top side of the duct shall be crowned, and the duct side shall be cross broken between the corners and the crown. Stiffening angles on the top side of the duct shall be bent to follow the set of the crown. On ducts above 1500 mm wide, a separate roof over the duct shall be provided so as to properly shed water.

(b) Insulation on Outside of Duct, and Metal Sheathed

Angle flanges and stiffeners shall be treated in accordance with Clause 9.05 of Standard Specification SM6. The metal sheathing shall be crowned on the top face and the crowned sheet shall be supported by a longitudinal member supported on the duct flange and stiffener angles. All joints in the metal sheathing shall be lapped not less than 40 mm and riveted with 3 mm diameter rivets at 75 mm centres. The joints on the top and vertical sides of the sheathing shall be sealed by soldering and joints in the bottom side of the sheathing shall be sealed with "Butyl" rubber based plastic sealant "Norton BM669" or equal. Sheathing shall be cross broken. On ducts above 1500 mm wide, a separate roof over the duct shall be provided so as to properly shed water.

Alternative methods to those described in (a) and (b) may be submitted for permission to use.

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STANDARD SPECIFICATION SWG.

**SURFACE PREPARATION AND COATING
FOR CORROSION PROTECTION.**

RTI Release

**DEPARTMENT OF WORKS,
ENGINEERING BRANCH.**

The use of basic material, from the Australian Government's Department of Works Standard Specification "Surface Preparation and Coating for Corrosion Protection", is gratefully acknowledged.

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STANDARD SPECIFICATION SM6
SURFACE PREPARATION AND COATING
FOR CORROSION PROTECTION

1.00 SCOPE

This Standard Specification sets out the Department's requirements in regard to the standards of surface preparation, quality of materials, treatments and application requirements for corrosion protection of equipment for mechanical engineering services.

The type of installation and items of equipment to be supplied under the Contract shall be as set out in the Work Specification and Drawing/s defining the extent of the works.

2.00 USE OF THIS STANDARD SPECIFICATION

Where this Standard Specification describes various methods of corrosion protection under one heading, the method to be used is that described in the Work Specification.

3.00 ASSOCIATED SPECIFICATIONS, STANDARDS AND DRAWINGS

The following specifications, standards and drawings, including any subsequent amendments, shall apply:

3.01 SPECIFICATIONS

Nil.

3.02 STANDARDS

- (a) AS1169-1973 - S.A.A. Medical Agents and Gases Safety Code.
- (b) AS 1318-1972 - S.A.A. Industrial Safety Colour Code.
- (c) AS 1319-1972 - S.A.A. Code for Industrial Accident Prevention Signs.
- (d) AS 1345-1972 - Rules for the identification of piping, conduits and ducts.
- (e) AS CB4-1969 - Supplement No. 2 - 1957 - Identification of Medical Gas Cylinders.
- (f) AS 1627 - Part 1 - 1974 - Degreasing of metal surfaces using solvent or alkaline solutions.
- (g) AS 1627 - Part 2 - 1975 - Power tool cleaning of steel surfaces.
- (h) AS 1627 - Part 4 - 1974 - Abrasive Blast cleaning of steel surfaces.
- (i) AS 1627 - Part 5 - 1975 - Pickling steel surfaces.
- (j) AS CK9 - Part VII - 1967 - Hand cleaning of steel surfaces.
- (k) AS K2-K6 - 1928 - Linseed oil.
- (l) AS 1700 - 1974 - Mineral turpentine.
- (m) AS 1701 - 1974 - White spirit.
- (n) AS K38 - 1933 - Orange shellac.
- (o) AS K53 - 1960 - Methods for testing zinc coating on hot dip galvanised articles.
- (p) AS K108 - 1963 - Metal priming paint, anti-corrosive.
- (q) AS K110 - 1964 - Undercoat, oil base.
- (r) AS K118 - 1964 - Enamelised paint for exterior use.
- (s) AS K126 - 1964 - Full gloss enamel, oil and petrol resistant.
- (t) AS K127 - 1964 - Undercoat for oil and petrol resistant enamels.
- (u) AS K145 - 1972 - Red lead based paint for structural steel.
- (v) BS 388 - 1972 - Aluminium flake pigments (powder and paste) for paints.
- (w) BS 458 - 1963 - Xylenes.
- (x) BS 2569 - Part I - 1964 - Protection of iron and steel by aluminium and zinc against atmospheric corrosion.
- (y) Health Acts 1937 - 1973

3.03 DRAWINGS

Nil

4.00 CONSTRUCTION REQUIREMENTS

4.01 CONTACT BETWEEN DISSIMILAR METALS

Direct contact between dissimilar metals in other than permanently dry locations is not permissible. In all moist locations the dissimilar metals shall be separated by an air gap of 3 mm or shall be joined using either red rubber, P. V. C. or polythene insertion packing of not less than 2 mm thick. Bolts or fasteners shall be fitted with isolating ferrules and washers having an electrical resistance not less than the jointing material used.

4.02 FASTENINGS

Fastening such as bolts, nuts, screws, clips, washers and rivets, used where corrosion protection is required shall have a corrosion resistance equivalent to the parts fastened, and shall be of the same or a more noble metal or alloy so that they will not be preferentially corroded.

Generally, fastenings of brass, monel metal and stainless steel will be acceptable.

Fastenings of mild steel, hot dip galvanised or electroplated zinc coated, may be used where the surface coating would not be damaged during the fastening operation (e. g. bolts and nuts sized for galvanising, and washers could be acceptable but not self tapping screws, speed clips and the like).

Cadmium plating shall only be used where specified.

Hard chrome plating will not be accepted.

4.03 WELDING OF CORROSION PROTECTED SURFACES

Where the Work Specification or Standard Specification/s call for surfaces to be corrosion protected by hot dip galvanising or metal flame spraying, all welding shall be carried out prior to the application of the protective coating. Welding will not be permitted after the coating has been applied.

Where other types of protective coatings are specified, welding will not be permitted after the corrosion protection coating has been applied, unless the coating is restored to its original condition after welding. Coating restoration shall be done in accordance with the specified requirements for the original coating.

Where welding of mill Galvabond sheets is permitted in the Work Specification or Standard Specification/s the damaged surface coating shall be repaired as specified in those specifications.

4.04 METAL SURFACES IN CONTACT

Surfaces of metal work that will be in contact with other metal work or concrete after assembly, shall be cleaned and primed before assembly, except as otherwise specified in Clauses 5.02 and 5.03 herein. The preparation and priming treatment shall be the same as specified for other surfaces of the same metal work.

5.00 GENERAL REQUIREMENTS

5.01 NO PARTICULAR TREATMENT SPECIFIED

Surfaces for which no specified treatment is specified in the Work Specification shall be treated with the manufacturer's standard finish providing that this conform to good trade practice.

5.02 SURFACES NOT TO BE PAINTED

Galvanised non-ferrous or stainless steel surfaces shall only be painted when specified in the Work Specification

Wire rope and machined surfaces, which will normally be lubricated, shall not be painted.

The interior surfaces of piping, heat exchangers, valves and other accessories shall only be painted when specified in the Work Specification.

Fibreglass and P. V. C. surfaces shall not be painted

Flexible duct connections to equipment, rubber hoses, flexible rubber mountings, and any other non metallic flexible connections shall not be painted.

5.03 METAL EMBEDDED IN CONCRETE

Metal surfaces to be embedded in concrete or against which concrete or grout is to be placed shall not be painted but shall be cleaned by degreasing and hand cleaning - Method B (Clause 6.03 herein.)

5.04 PAINTING BEFORE DESPATCH TO SITE

Wherever practicable, metalwork shall be painted in the shop before despatch to the site of the works. Metalwork that requires Blast Cleaning shall be fully primed before leaving the shop - Method C (Clause 6.04 herein)

5.05 HANDLING TREATED SURFACES

Treated surfaces shall be handled carefully to prevent damage to the coating

5.06 SURFACES INACCESSIBLE AFTER INSTALLATION

Surfaces to be painted, that will be inaccessible after installation, shall be completely painted as specified in the Work Specification prior to installation.

5.07 REPAIRS TO DEFECTIVE OR DAMAGED SURFACE COATINGS

The repair of defective or damaged surface coatings shall be at the Contractor's expense.

(a) Painted Surfaces

Paint that is loose, weakly bonded, blistered, abraded or otherwise defective shall be removed and the surface shall be recleaned and painted in accordance with the treatment originally specified.

Before applying subsequent coats of paint, the Contractor shall clean and repair all areas of previous coats which are defective or damaged. Cleaning and repair shall be in accordance with the treatment originally specified.

After installation of equipment, any damage to finished painted surfaces shall be made good. Repairs shall be in accordance with the treatment originally specified. Before applying the specified treatment the damaged coating should be roughened to provide a key.

(b) Galvanised or Metal Flame Sprayed Surfaces

Galvanised or metal flame sprayed surfaces which are scratched or damaged need not be repaired providing the exposed metal is not greater than 2 mm wide and provided that no two scratches are less than 12 mm apart.

Surface damaged more than described above will not be accepted. Surface shall be repaired on site.

5.08 IDENTIFICATION OF PIPES

Colour identification of pipes, conduits, ducts, and safety signs, shall be in accordance with Australian Standards 1169, 1318, 1319, 1345 and CB4 - Supplement No. 2 and in accordance with Tables "A" and "B" herein.

The ground colour shall be applied over a length of 400 mm or whatever is available. When the ground colour is used in conjunction with a safety colour, it shall be applied over a length of 150 mm on either side of the safety colour.

TABLE "A" COLOUR AND LETTERING DETAILS

<u>Service</u>	<u>Ground Colour</u>	<u>Safety Colour</u>	<u>Lettering</u>	<u>Flow Arrows</u>
Fresh Water	Emerald Green	Yes	Fresh Water	Yes
Chilled Water for Air Conditioning	Emerald Green	No	Chilled Water	Yes
Hot Water Heating	Emerald Green	Yes	Hot Water°C	Yes
Domestic Hot Water	Emerald Green	No	Domestic Hot Water	No
Cooling Water for Condensers and Engines	Emerald Green	No	Cooling Water	Yes
Fire Fighting Water Services	Emerald Green	Yes	Automatic Sprinkler Piping Fire Hydrant Piping	No
Condensate	Emerald Green	No	Condensate	Yes
Steam	Silver-Grey	Yes	Steam.....kPa	Yes
Fuel Oil - (mineral) vegetable and animal) Combustible Liquids	Golden Brown	Yes	Name the Grade of Oil or Lquid	Yes
Compressed Air	Arctic Blue	No	Compressed AirkPa	No

TABLE "A" (CONTD)

<u>Service</u>	<u>Ground Colour</u>	<u>Safety Colour</u>	<u>Lettering</u>	<u>Flow Arrows</u>
Industrial Oxygen	Biscuit	Yes	Industrial Oxygen	No
Town, L.P. or other heating Gas	Biscuit	Yes	Name of Gas	No
Halogenated Hydro Carbon Refrigerants R. 22, R. 113, R. 11 and R. 12	Biscuit	No	Refrigerant R.	Yes
Ammonia	Biscuit	Yes	Ammonia	Yes
Acids and Alkalis	Violet	Yes	Name of Acid or Alkali	Yes
Vacuum	Arctic Blue	No.	Vacuum	No
Electricity	Light Orange	Yes	Electrical	No
Medical Gases - Oxygen Vacuum Nitrous Oxide Breathing Air Spare Medical Gas	White Primrose Blue Black and White Biscuit	Yes	Name of Gas	No

TABLE "B" SAFETY COLOURS

<u>Pipeline Contents</u>	<u>Colour</u>
Fire fighting materials	Safety Red
Dangerous materials	Safety Yellow (with black stripes)
Ionizing radiation	Safety Yellow (with black trefoil)
Fresh Water (Potable)	Auxiliary Blue

6.00 SURFACE PREPARATION6.01 GENERAL

Surface preparation shall be in accordance with one of the following methods. The method to be used for each coating specified is indicated in the treatments schedule (Clause 9.00 herein).

Weld spatter, slag, burrs, or any other objectionable surface irregularities shall be carefully removed or repaired. Sharp edges shall be given a radius

6.02 METHOD A - DEGREASING

All oil, grease, wax, dirt, perspiration and other soluble and loosely adherent matter shall be removed from the surfaces by use of one of the methods described in AS 1627 - Part 1

6.03 METHOD B - HAND CLEANING AND POWER TOOL CLEANING

Following cleaning as in Method A above, remove all mill scale, and other foreign substances likely to affect the adherence and uniformity of the finished coating by cleaning in accordance with A. S. 1627 Part 2 or A. S. CK9 Part VII

Cast Iron surfaces shall be thoroughly cleaned of all moulding sand prior to cleaning by the methods described above.

6.04 METHOD C - BLAST CLEANING

Following cleaning as in Method A above, the surface to be treated shall be cleaned by grit or sand blast cleaning, in accordance with A.S. 1627 Part 4.

The surface roughness shall be appropriate for the specified treatment (i. e. whether it is to be painted or metal sprayed).

6.05 METHOD D - PICKLING

Following cleaning as in Method A and/or B above, to remove heavy deposits of oil, grease, dirt, and other matter not removable by pickling: the surface to be treated shall be cleaned free from scale and rust in accordance with A.S. 1627 - Part 5.

6.06 METHOD E - PREPARATION OF TIMBER SURFACES

Large resinous knots and pitch pockets shall be cut out and replaced by sound wood. Smaller knots and pitch streaks shall be given two coats of either shellac knotting or aluminium paint applied carefully and sparingly. The knotting shall be made from genuine orange shellac dissolved in industrial methylated spirits. The aluminium paint shall be made from aluminium powder (having good leafing properties and complying with B.S. 388) mixed with a high grade water resisting varnish.

Protruding or exposed nails shall be punched and then primed before puttying. Any defective putty or other fillers shall be cut out and reapplied prior to painting.

The surface shall be stopped and filled as required by the finish specified in the Work Specification, and thoroughly sanded.

Where "Polished Finish" is specified in the Work Specification, surfaces shall be sanded smooth and all holes filled with an approved coloured filler. Discolouration shall be removed and the affected areas stained so that the colour will be uniform throughout.

6.07 METHOD F - PREPARATION OF CONCRETE AND MASONRY SURFACES

Concrete and masonry shall be smoothed as far as possible during trowelling and shall be cured for the time recommended by the paint manufacturer before painting. Surfaces to be painted with water emulsion paint or enamelled paint shall be rubbed with a hardwood block and thoroughly dusted down.

7.00 PAINTS AND PAINT MATERIALS

7.01 GENERAL

All paint and/or painting materials used shall comply strictly with the requirements of the Australian or British Standard Codes and as specified below or in the Work Specification.

Materials not complying with the Codes or other Standards specified will be rejected and shall be removed from the premises at the Contractor's expense.

The Contractor, if and when called upon to do so, shall supply a certificate from the material manufacturer confirming that the material conforms to the Code specified.

All paint and painting materials shall be delivered to the site in the manufacturer's sealed metal containers bearing the manufacturer's printed label. In addition, the date of manufacture and batch number shall be stencilled or impressed onto the bottom of each container.

All paints shall be mixed and applied in strict conformity with the printed instructions of the manufacturer. The Department reserves the right to take samples of painting for testing, as and when it requires, to ensure that the quality of the paint is as specified.

Where possible, all paints used for one painting installation shall be supplied by one manufacturer.

The colour of the final coat of paint shall be as specified in the Work Specification (Refer to Clause 8.03 herein).

7.02 MINERAL TURPENTINE

Mineral Turpentine shall conform with the requirements of A.S. 1700.

7.03 LINSEED OIL

Linseed Oil shall conform to A.S. K2 to K6.

- 7.04 XYLENES
Xylenes shall comply with the requirements of B.S. 458.
- 7.05 WHITE SPIRIT
White Spirit shall comply with the requirements of A.S. 1701.
- 7.06 ORANGE SHELLAC
Orange Shellac shall comply with the requirements of A.S. K38.
- 7.07 RED OXIDE ZINC CHROMATE PRIMING PAINT
Red Oxide Zinc Chromate Priming Paint shall comply generally with A.S. K108. This paint shall not be used on any galvanised iron surfaces.
- 7.08 ZINC PHOSPHATE HIGH BUILD PRIMER
An acceptable type is "Luxaprime Zinc Phosphate Primer" manufactured by British Paints Limited, or equal.
- 7.09 GALVABOND PRIMING PAINT
Galvabond priming paints shall be "Luxaprime Vinyl Etch" and "Luxaprime Zinc Chromate Yellow" both manufactured by British Paints Limited, or equal.
- 7.10 SEALING COAT
Sealing Coats, for painting on primed galvabond, shall be as "Luxavin 200 Seal Coat" manufactured by British Paints Limited, or equal.
- 7.11 ZINC RICH PAINTS
Zinc rich paints shall be as "Zincanode 400" manufactured by British Paints Limited, or equal.
- 7.12 WASH PRIMER AND ETCHING SOLUTION
Wash primer and etching solutions shall be formulated to be compatible with subsequent primers, undercoats and finishing coats and should be procured from the same manufacturer as the subsequent coatings.
- 7.13 RED LEAD PRIMER
Red Lead Primer paints shall comply generally with A.S. K145.
- 7.14 ALUMINIUM FINISH BITUMINOUS PAINT
This paint shall be a hard setting aluminium pigmented bituminous paint, and shall be readily soluble in kerosene.
- 7.15 COAL TAR EPOXY ENAMEL
Coal tar epoxy enamels shall be as "Luxatar 5 High Build" manufactured by British Paints Limited, or equal.
- 7.16 BUTYL TITANATE BASE HEAT RESISTANT PAINT
The following brands or equal are acceptable.
(a) "Mirror" brand Butyl Titanate Surface Coating (aluminium) supplied by S. Smith and Co. Pty. Ltd. 1 Dynon Road, Kensington VIC.
(b) "Butyl Titanate Print" supplied by Dimet Corrosion Prevention Pty. Ltd., Agents in Australian States.
(c) "Dulux Titankote".
- 7.17 ENAMEL AND ENAMEL UNDERCOAT FOR EXTERIOR METAL SURFACES AND ALL INTERIOR SURFACES
These paints shall generally comply with A.S. K126 and A.S. K127.
- 7.18 ENAMELISED FINISHING PAINT AND UNDERCOATING PAINT FOR EXTERIOR TIMBER AND MASONRY SURFACES ONLY
These paints shall generally comply with A.S. K110 and A.S. K113.

7.19 VINYL PAINT

Vinyl paints shall not be used unless permission to use has been obtained.

7.20 SOLVENTLESS EPOXY RESIN SURFACE COATINGS

"Long Life Protective Finishes" are acceptable coatings.

7.21 CLEAR POLYURETHANE PLASTIC COATINGS

The clear polyurethane plastic coatings shall be of the "Two Pack" type.

8.00 PAINTING PRACTICES

8.01 GENERAL

All painting shall be performed in a neat, thorough and workmanlike manner and only by experienced tradesmen.

All paint shall be in a thoroughly mixed condition at the time of painting.

All cleaning and painting work shall be carried out to conform with the requirements of the Health Acts.

Paint and coating material may be thinned in accordance with the manufacturer's instructions.

Paint shall not be applied to surfaces upon which there is any moisture, nor to a surface whose temperature exceeds 38°C. Painting shall not be done in cold damp weather.

All dirt and dust shall be removed from surfaces with a soft brush prior to painting.

The first coat of paint shall be applied immediately after cleaning and the interval between subsequent coats shall not exceed the manufacturer's recommended period.

Alternate coats shall be of different shades to facilitate application and inspection.

Each coat of paint shall be uniform and shall be free from runs, sags and other imperfections.

Surfaces not required to be painted but adjacent to metal work that is to be cleaned and painted shall be adequately protected during cleaning and painting.

8.02 SPRAY PAINTING

Effective means shall be provided for removing all free oil and moisture from the supply lines of all spraying and blasting equipment.

8.03 ON-SITE PAINTING

Where the colour of the final coat of paint, specified in the Work Specification, is required to match the architectural surroundings, the Contractor shall be responsible for obtaining permission to use the matched colour selected.

8.04 CLEANING UP

Upon completion of painting work, any paint spots, oil or stains shall be removed from floors, walls, steelwork, concrete, machinery, glass and hardware, leaving assemblies and their finish in a clean and acceptable conditions.

9.00 SCHEDULE OF APPROVED TREATMENTS

9.01 TREATMENT NO. 1 - HOT DIP GALVANISING

Surface preparation: Method "D" - Pickling.

After pickling the work shall be inspected and any defects which will render the work unsuitable for galvanising shall be repaired at the Contractor's expense.

After such repairs have been executed, the work shall again be cleaned by pickling.

All galvanising shall be carried out by the hot dipping process. The zinc coating shall be applied so as to cover the whole surface with a smooth, uniform and continuous coat without unduly filling up the interstices of bolt threads and similar intricate surfaces. The coating shall adhere firmly to the material. Light blows with a 225 g hammer shall not cause the coating to peel adjacent to the area deformed by the hammer blows. The material shall be treated at the lowest possible temperature consistent with smoothly finished work. The zinc shall be free from lumps, blisters, gritty areas, uncoated spots, acid and black spots, dross, flux, and other imperfections.

After hot galvanising, all material shall be cooled to air temperature in such a manner that no embrittlement results. Bolt threads and nuts shall be brushed free of all surplus metal so that nuts may be fitted without the recutting of threads. The weight of the zinc coating, other than on nut and bolt threads, shall average 600 g/m^2 of surface and shall not be less than 450 g/m^2 . Weight of coating may be checked by stripping representative sections by the hydrochloric acid: antimony trichloride method as set out in AS K53.

The quality of zinc used for coating and the uniformity of the coating shall be tested by the copper sulphate dipping test as set out in A.S. K53. The coating shall be deemed acceptable if there is no sign of any adherent red deposit of metallic copper upon the base metal after four dips of one minute duration.

Any galvanising shown to be defective by inspection or by the tests set out in the foregoing clauses will be rejected. Any work so rejected shall be rectified by the Contractor, at his own expense. Any component distorted, cracked or otherwise structurally damaged during galvanising shall be replaced by the Contractor at his own expense.

9.02 TREATMENT NO. 2 - METAL FLAME SPRAYING

Surface preparation: Method C - Class 3 Blast Cleaning.

Zinc and aluminium spraying and surface roughness shall be in accordance with B.S. 2569 Part 1. The metal used and its average and minimum thickness shall be as specified in the Work Specification and its associated Standard Specifications.

Magnetic thickness gauging, to establish that the coatings are not less than those specified, shall be carried out, and adhesion tests on coupons shall test adhesion. Coupons shall be tack welded to main component. Places where coupons were attached shall be made good to the specified finish after grinding of weld marks.

9.03 TREATMENT NO. 3 - BLACK IRON OR STEEL, NOT EXPOSED TO WEATHER OR VIEW

Surface Preparation: Method B - Power tool cleaning.

Followed by - one (1) coat zinc phosphate high build primer to a minimum thickness of 3 mils.

9.04 TREATMENT NO. 4 - BLACK IRON OR STEEL, EXPOSED TO VIEW AND MILDLY CORROSIVE ATMOSPHERE

Surface Preparation: Method B - Power tool cleaning.

Followed by - one (1) coat of zinc phosphate high build primer and two (2) coats of enamelled finishing paint. The overall total thickness of paint shall be a minimum of 6 mils.

9.05 TREATMENT NO. 5 - BLACK IRON OR STEEL, EXPOSED TO VIEW AND OIL AND PETROL RESISTANT FINISH

Surface Preparation: Method C - Class 2 blast cleaning.

Followed by - one (1) coat of zinc phosphate high build primer and two (2) coats of oil and petrol resistant enamel. The overall total thickness of paint shall be a minimum of 6 mils.

9.06 TREATMENT NO. 6 - GALVANISED, ZINCANNEAL, COPPER OR ALUMINIUM, FOR APPEARANCE ONLY

One (1) coat of etch primer (galvanised iron).

One (1) coat of zinc chromate yellow primer.

One (1) coat of enamelled finishing paint.

The overall total thickness of paint shall be a minimum of 3 mils.

9.07 TREATMENT NO. 7 - TO IMPROVE CORROSIVE RESISTANCE OF GALVANISED, ZINCANNEAL, METAL FLAME SPRAYED ZINC OR ALUMINIUM SURFACE

One (1) coat of etch primer.

Two (2) coats of epoxy coal tar enamel.

The overall total thickness of paint shall be a minimum of 12 mils.

9.08 TREATMENT NO. 8 - AS FOR TREATMENT NO. 7 BUT WHERE EXPOSED TO CHEMICAL OR A HARSH CORROSIVE ATMOSPHERE

One (1) coat of etch primer.

One (1) sealing coat.

One (1) coat of high build vinyl paint.

One (1) coat of vinyl paint.

The overall total thickness of paint shall be a minimum of 7 mils.

9.09 TREATMENT NO. 9 - BLACK IRON OR STEEL WHERE HOT DIP GALVANISING OR METAL FLAME SPRAYING IS NOT POSSIBLE

Surface Preparation: Method C - Class 2, 1/2 blast cleaning.

Followed by - one (1) coat of zinc rich paint to a minimum thickness of 3 mils.

- 9.10 TREATMENT NO. 10 - HOT METAL SURFACES
 Surface Preparation: Method C - Class 3 blast cleaning.
 Aluminium metal flame spray as per Treatment No. 2 to a minimum thickness of 5 mils.
 Followed by - two (2) coats of butyl titanate base heat resistant aluminium paint (allow 24 hours drying between coats) to a total minimum thickness of 5 mils.
- 9.11 TREATMENT NO. 11 - MACHINED SURFACES REQUIRING OCCASIONAL REMOVAL FROM MACHINE
 Surface preparation: Method A - Degreasing.
 Followed by - one (1) coat of hardsetting aluminium finish bituminous paint.
- 9.12 TREATMENT NO. 12 - INDOOR TIMBER
 One (1) under coat.
 Two (2) coats of enamellised paint.
 The overall total thickness of paint shall be a minimum of 4 mils.
- 9.13 TREATMENT NO. 13 - OUTDOOR TIMBER
 Surface preparation: Method E - Timber.
 Followed by - one (1) coat of red lead priming paint.
 one (1) undercoat.
 two (2) coats of enamellised paint.
 The overall total thickness of paint shall be a minimum of 5 mils.
- 9.14 TREATMENT NO. 14 - INDOOR TIMBER, BETTER FINISH THAN TREATMENT NO. 12
 Surface preparation: Method E - Timber.
 Followed by - three (3) coats of clear polyurethane plastic finish.
 The overall total thickness of paint shall be a minimum of 5 mils.
- 9.15 TREATMENT NO. 15 - SEALER ON METAL FLAME SPRAYED ZINC OR ALUMINIUM, NOT EXPOSED TO VIEW
 One (1) coat of wash primer.
 One (1) coat of red oxide zinc chromate primer.
 The overall total thickness of paint shall be a minimum of 3 mils.
- 9.16 TREATMENT NO. 16 - CONCRETE
 Surface preparation: Method F - Concrete or Masonry.
 Followed by - one (1) coat of cement sealer.
 one (1) coat undercoat.
 one (1) coat of enamellised paint.
 The overall total thickness of paint shall be a minimum of 3 mils.
- 9.17 TREATMENT NO. 17 - CONCRETE SUBJECT TO OIL SPILLAGE
 Surface preparation: Method F - Concrete or Masonry.
 Followed by - Coat or coats of solventless epoxy resin surface coating to a minimum total thickness of 7 mils.
- 9.18 TREATMENT NO. 18 - STEEL IN IMMersed CONDITIONS
 Surface preparation: Method C - Class 3 blast cleaning.
 Followed by - two (2) coats of epoxy coal tar enamel to a total minimum thickness of 16 mils.
- 9.19 TREATMENT NO. 19 - TIMBER DIRECT IN THE GROUND
 Surface preparation: Dress Timber.
 Followed by - one (1) liberal application of creosote from butt of timber to 150 mm above ground level.
 The creosote shall be puddled into the ground just below the surface at the base of the timber.

DEPARTMENT OF WORKS
CONDITIONS OF QUOTING FOR
NOMINATED SUB CONTRACT TO BUILDING CONTRACT

1. The plans and specifications are and shall remain the property of the Minister for Works and Housing hereinafter in the Special Conditions of Sub-Contract called the Principal Quoters will be supplied with a copy of the plans and specifications as the case may be on payment of such sum as may be specified in the advertisement calling for quotations. The amount charged will be refunded upon the return of the plans and specifications prior to the closing date of quotations or upon the return of the plan and specification and the receipt of a bona fide quotation.
2. Every quotation shall set forth the full Christian names, surnames and address of the Quoter and when the Quotation is in the name of a firm, the names in full of each member and their and each of their respective addresses. If the quotation is by or on behalf of a Company the quotation shall show, in addition to the full name of the company, the address of the registered office of the company.
3. (a) Quotations are to be submitted direct to the Director of Contracts, Department of Works, Executive Building, 100 George Street, Brisbane. All envelopes containing quotations must be addressed to the Director of Contracts and have legibly endorsed thereon the name of the work for which the quotation is submitted.

(b) Quotations may be lodged by post or by a recognised carrier providing a direct delivery service to the public office of the Department of Works but otherwise shall be lodged in the tender box at the public office of the Department of Works by being placed therein before 2 p.m. on the date specified for the closing of quotations and any quotation not in the tender box before the specified closing time will not be considered unless in the opinion of the Principal there is satisfactory evidence that such quotation -
 - (i) was delivered to the Department of Works before the specified closing time;
 - (ii) was either posted, or despatched by a recognised public carrier providing a direct delivery service to the public office of the Department of Works, in sufficient time to reach the Department of Works under normal circumstances before the specified closing time but was still in course of delivery by post or by the recognised public carrier at that time.

(c) No quotation received by telephonic or telegraphic advice will be considered.

4. The Principal shall, as soon as practicable after the quotations have been opened, cause to be exhibited in a conspicuous position in the office of the Department of works, a full statement of the quotations received, showing the work, the names of the quoters and the amount of each quotation.
5. No Preliminary Deposits are required to be forwarded by Quoters.
6. In no case shall a Quoter amend his quotation after it has been opened and the amount announced.
7. Any quotation which shall have been improperly completed or in respect of which the Quoter has not complied with these Conditions of Quoting may be deemed to be informal and may be rejected.
8. The lowest or any quotation will not necessarily be accepted.
9. Unless stated otherwise in the Special Conditions, the sub-contract arising out of the acceptance of the successful quotation, if any, shall not be subject to any variation of price contingent on variation in rates of wages, price of materials or other local factor provided however that, if there shall be any variation in the price (obtaining at the date of acceptance of a quotation as aforesaid) of any materials, machinery or other goods required to be imported from overseas sources for the purpose of the sub-contract which variation is directly attributable to any alteration in the rate of exchange or increase or decrease in the rates of duty, freight or insurance on any such materials, machinery or goods, the sub-contract price shall be varied accordingly.
10. All goods, unless otherwise specified shall be in accordance, with specifications and codes of the Standards Association of Australia, where such exist and, in their absence, with the specifications and codes of the British Standards' Association.
11. Where a successful quotation has been based on transport of materials and equipment to be used in these works by means other than the Queensland Government Railways, the quoter shall make available details of such transport, costs to the Commissioner for Railways and afford him an opportunity to quote charges for the transport of such materials and equipment. If the amount of charges quoted by the Commissioner for Railways is equal to or less than such transport costs as aforesaid, preference shall be given to the Queensland Government Railways.
12. Schedule of Technical Details
 - (a) If required by the Specification the Quoter shall -
 - (1) Complete the Schedule of Technical Details and supply all relevant information together with necessary catalogues or brochures of items of proprietary manufacture and forward them with his quotation;

- (2) State in the Schedule the description, number off and price of any spare parts that are recommended to be held in stock by the Department of works for the Installatic.; and
 - (3) Include in the Schedule the name and address of the local supplier of such spare parts and whether or not the local supplier carries a full range of parts in stock.
- (b) If the Schedule of Technical Details is not completed and the information required by this Clause is not supplied with the Quotation, the Quotation may be rejected.

13. Alternative Quotations.

Quotations shall be submitted conforming to the requirements of the Specification.

Quoters may submit alternative quotations for an installation of a different type to that specified, providing that such alternative installation is at least equal in quality and performance to that specified and will in all other ways satisfy the requirements of the Specification.

Where a price is submitted for the supply of an installation of a type which differs in any way from that specified, such price shall include full details of the alternatives. Details of its departure from the Specification shall be provided, together with any reasons why the installation offered may be considered superior to the specified requirements.

SPECIAL CONDITIONS OF SUB CONTRACT.
BETWEEN CONTRACTOR AND NOMINATED SUB CONTRACTOR.

S.1. INVITATION OF QUOTATIONS.

Quotations are invited by the Department of Works for works, as defined in the attached Conditions of Quoting, Specification, Schedules and Drawings, and these Special Conditions of Sub-Contract, to be carried out under sub-contract to the Contractor.

Contractor: _____

Address: _____

Building: _____

Site: _____

Time for completion of Building Contract: * _____ from date of acceptance of the Contract.

(*This time is furnished for information only. The quoters shall be responsible for obtaining the proposed work programme from the Contractor. See Clause 5 herein).

S.2. INTERPRETATION.

In these Special Conditions and in the Specification annexed hereto unless the context otherwise indicates, the following terms shall have the meanings set against them, respectively, that is to say -

"Contractor" The Contractor who has entered into a contract with the Principal for the erection of a building of which the works the subject of this sub contract form part.

"Contract" The said contract between the Contractor and the Principal.

"Sub-contractor" The person or corporation performing the works contained in the attached specification, drawings and schedules under sub-contract to the Contractor.

"Installation" Every item of apparatus, machinery or service (whether gaseous, liquid or electrical) or any such service attaching to such apparatus or machinery supplied to, forming part of or comprising the contract, together with all necessary and appropriate requisites for the proper functioning of any such apparatus, machinery or service as stipulated in the Specification.

S.3. CONDITIONS PRECEDENT TO ACCEPTANCE OF QUOTATION.

The successful quoter shall, as a condition precedent to the acceptance of his quotation, agree to enter into a

sub-contract with the Contractor whereby the Sub-contractor is bound to the Contractor by the like obligations in respect of the subject matter of the Sub-contract as the Contractor by the Contract assumes in respect of such subject matter to the Principal and whereby, without limiting the generality of the foregoing, the Sub-contractor agrees to -

- (i) accept the decisions of the Superintendent or the Arbitrator as far as they concern the subject matter of the Sub-contract;
- (ii) accept certification by the Superintendent as a condition precedent to payment by the Contractor.

S.4. NOTES FOR INFORMATION OF QUOTERS.

(i) Payment to Contractor.

The payments to be made to the Contractor under the Contract shall be as set out in Clauses S.07, S.08, S.09 of Special Conditions of Contract (Buildings) as shown below.

S.07 Progress Payments - Retention Moneys.

The amount of retention monies to be deducted from the total gross value shown in a progress payment certificate, pursuant to Subclause 41.1 of the General Conditions of Contract, shall be ten per centum (10%) of the said total gross value or five per centum (5%) of the contract sum, whichever is the less.

S.08 Payment on Certificate of Practical Completion.

Pursuant to the provisions of subclause 41.3 of the General Conditions of Contract -

- (a) The moneys payable in respect of the issue of the Certificate of Practical Completion for the Works shall be the total gross value shown in the said Certificate of Practical Completion less -
 - (i) defects liability retention moneys in the amount equal to two and one half per centum (2.1/2%) of the contract sum; and
 - (ii) any progress payments already made in respect of work covered by the said Certificate of Practical Completion; and
 - (iii) any other amount that the Principal may be entitled to deduct from the moneys due under the said Certificate of Practical Completion.
- (b) The issue of a Certificate of Practical Completion for a separable part of the Works will not entitle the Contractor to a payment on that account, but the value of work completed in respect thereof will be included in progress payments in accordance with the provisions of the Contract.

S.09 Alternative Form of Retention.

(a) Retention from Progress Payments:

If the Contractor has elected in his tender to provide an unconditional bank undertaking in lieu of retention moneys prescribed by subclause 41.1. of the General Conditions of Contract, the following provisions shall apply, notwithstanding the provisions of the said subclause 41.1 relating to retention moneys.

Such undertaking, to be effective, shall be for an amount equal to five per centum (5%) of the contract sum and in a form approved by the Superintendent and shall be lodged with the Superintendent.

Unless and until such undertaking is so lodged, the amounts of progress payments shall be determined in accordance with the provisions of the said subclause 41.1.

Following the lodgement of such undertaking as aforesaid, retention moneys shall not be deducted from the moneys otherwise payable to the Contractor in respect of progress payments.

(b) Defects Liability Retention:

If, before the Issue of the Certificate of Practical Completion for the Works, the Superintendent receives from the Contractor a written request that the Principal accept an unconditional bank undertaking in lieu of defects liability retention moneys, the following provisions shall apply, notwithstanding the provisions of clause S.08 of these Special Conditions of Contract relating to defects liability retention moneys.

Such undertaking, to be effective, shall be in a form approved by the Superintendent and in the prescribed amount of the defects liability retention moneys and shall be lodged with the Superintendent.

Following the lodgment of such undertaking as aforesaid, defects liability retention moneys shall not be deducted from the moneys otherwise payable to the Contractor in respect of the issue of the Certificate of Practical Completion for the Works or, if they have been so deducted, shall be paid to the Contractor.

(ii) Documents

The General Conditions of Contract (N.P.W.C. Edition 1) and Special Conditions of Contract contained in the Contract between the Contractor and Principal are obtainable from the offices of the Department of Works.

S.5. TIME FOR COMPLETION OF WORK

The Contractor has entered into an undertaking that all building work will be completed by the time stated herein. The installation work under the sub-contract shall proceed concurrently with the construction work of the building and shall be carried out as and when required to prevent any delay to the building progress.

S.6. REGULATIONS

The Sub-contractor shall comply with the provisions of the S.A.A. Wiring Rules and other Specifications and Codes of Practice of the Standards Association of Australia applicable to the Works, where not otherwise specified.

Further to the express provisions of Clause 14.0 of the General Conditions of Contract, the Sub-contractor shall obtain, from all authorities having jurisdiction over the Works, all consents necessary to enable the Works to be carried out.

S.7. VARIATIONS, EXTRAS AND/OR OMISSIONS

Any alterations, deductions and/or additions to the sub-contract shall be made and carried out only on the written authority of the Contractor.

S.8. EXAMINATION AND TESTING

The Sub-contractor, at his own expense except where otherwise provided in subclause 31.3 of the General Conditions of Contract, shall furnish all facilities for the examination and/or testing of materials, fixed or unfixed work and performance.

The Sub-contractor at his own expense shall carry out all tests required by the Specification and such other tests as are determined by the Superintendent to be necessary to ensure that all building services and equipment, including electrical installations and installations powered by electricity, gas or other means, conform to the requirements of the Specification, and shall furnish all facilities and provide all apparatus required for the carrying-out of such tests. Such tests shall be carried out progressively and before the work to which they relate is covered up or put out of sight.

The Contractor after receipt of notice in writing from the Sub-contractor shall give the Superintendent not less than

seven (7) days' notice in writing of the date upon which each such test is proposed to be made. Should the Contractor not give such notice, he shall be deemed not to have given the reasonable notice required by subclause 31.5 of the General Conditions of Contract. Such notice shall include sufficient information to facilitate the attendance of the Superintendent or his representative at the test to which such notice relates.

The Sub-contractor at his own expense shall submit to the Contractor for submission to the Superintendent within seven (7) days after the completion of any test, a type written report complete with all relevant details of the results of such test and any test certificate which may have been issued certifying that the materials, workmanship or performance are in accordance with the requirements of the Specification.

S.9. INSPECTION.

The Sub-contractor shall provide necessary assistance and access for inspections of work to be made when required by the Department of Works' nominated Superintendent's Representative shall advise the Contractor of the progress of the work so that inspections can be arranged without interference to finished work.

S.10. ATTENDANCE UPON NOMINATED SUB-CONTRACTORS.

The Contractor shall supervise and co-ordinate the work of Nominated Sub-contractors and shall ensure that the requirements of such work are carried out in proper sequence. He shall ascertain from each Nominated Sub-contractor with regard to the order of its execution and the positions in which chases, holes, recesses and similar items will be required, before the work is put in hand, and no claim will be allowed for the cost of cutting away work already executed in consequence of failure by the Contractor to ascertain such particulars beforehand, whether such failure results from any act or omission on the part of the Contractor or the Nominated Sub-contractor.

In respect of the work of each Nominated Sub-contractor, the Contractor shall be deemed to have included in the contract sum, in addition to the provisional sum for such work, for his profit and for all his costs in connection with such work, including the costs of the following (unless otherwise specified) -

- (a) securing all fixings (which shall be supplied by the Nominated Sub-contractor) and building in all items required for the work of the Nominated Sub-contractor after such items have been located and/or placed in final position by the Nominated Sub-contractor, providing holes, chases and recesses and similar items for that purpose, and making good;
- (b) taking delivery of the Nominated Sub-contractor's materials and equipment, hoisting them to and placing them in position as close as possible to their required locations in the Works;
- (c) providing all scaffolding for the use of the Nominated Sub-Contractor;

- (d) providing amenities and sanitary accommodation on the site for the use of the Nominated Sub-Contractor and his employees;
- (e) providing water, electric lighting and power and other reasonable facilities necessary for the execution of the Nominated Sub-Contractor's work on the site; and
- (f) waterproofing any part of the Works penetrated by the work of the Nominated Sub-Contractor, by flashing to the collar, flashing skirt or similar attachment provided by the Nominated Sub-Contractor.

Where the completion of the work of a Nominated Sub-Contractor is contingent upon the passing of tests requiring electricity supply or other service, the Contractor shall ensure that the permanent electricity supply or other service is installed in sufficient time to allow such tests to be made within the specified or extended time for completion of the Contract.

S.11. WARRANTY

If the specification stipulates that a warranty is to be provided to the Principal that any materials, goods or installation will satisfactorily meet and comply with the performance requirements of the specification and that such warranty shall be supported by security, such warranty and security shall be in the forms as shall be stated in the specification and the Special Conditions of Contract contained in the Contract between the Principal and the Contractor and shall be lodged by the Sub-contractor with the Contractor.

S.12. SUBSTITUTION OF GOODS ETC.

Where a Quotation is accepted on the basis of brand name articles of machinery, goods or apparatus or suppliers of such machinery, goods or apparatus contained in technical schedules or letters accompanying and forming part of the Quotation, substitution of other machinery, goods or apparatus or suppliers shall not be made unless such substitution is approved in writing by the Contractor.

S.13. DOCUMENTS TO BE SUPPLIED BY THE NOMINATED SUB-CONTRACTOR.

Where the permission of the Superintendent is required for the use of Drawings and other written information supplied by the nominated Sub-Contractor, the Contractor shall give the Superintendent written notice of the requirement of such permission, and the period of such notice shall be three (3) weeks or such longer period as is in the circumstances reasonable.

Without limiting the effect of the foregoing, the nominated Sub-Contractor shall submit a minimum of four (4) copies each of shop drawings, details and specifications in sufficient time to ensure that perusal, alterations (if any), return and fabrication and construction, as hereinafter provided, can be effected without incurring delay in the completion of Works.

Upon receipt of such drawings and other written information, the Superintendent shall, within reasonable time, peruse them and indicate where he requires alterations, if any. Where alterations to any such drawings or other written information are so required, then on receipt of such indication the nominated Sub-contractor shall promptly return to the Contractor four (4) copies of all amended drawings or other written information.

When the Superintendent considers that the drawings and other written information may be used for the purpose of the contract, he shall advise the Contractor to that effect and, thereafter, the drawings and other written information shall not be departed from in any way without the written consent of the Superintendent.

Except as otherwise provided by sub-clause 8.4 of the General Conditions of Contract, the nominated Sub-contractor shall be responsible for and shall pay for all alterations to the Works due to any discrepancies, errors or omissions in the drawings or other written information supplied by him whether such drawings have or have not been perused by the Superintendent and such perusal shall not in any way negate the nominated Sub-contractor's responsibility to meet the guaranteed performance requirements of the Sub-contract in respect of the work to which such drawings and other written information relate.

In respect of any Installation, the nominated Sub-Contractor shall supply to the Contractor two (2) copies of all such final working drawings and other written information as may be necessary to enable the Superintendent to maintain, dismantle, reassemble and adjust all part of the Installation.

Such final working drawings and other written information shall include all amendments and shall be supplied after completion of the Installation and before the expiration of the maintenance period.

S.14. RISE AND FALL (For Rise and Fall Contracts)

The Sub-contract price shall be subject to Rise and Fall adjustment in the same manner as the main contract except that such adjustment shall be based on the clause S.49 attached hereto, in place of the formula included in the main contract.

RTI Release

SPECIAL CONDITIONS OF SUB-CONTRACT BETWEEN
CONTRACTOR AND NOMINATED SUB-CONTRACTOR.

NOTE - Clause 15 - 46

Not applicable.

RTI Release

ME.-SC.-7.77.

SPECIAL CONDITIONS OF CONTRACT (MECHANICAL/ELECTRICAL)

S. 47 RISE AND FALL (MECHANICAL/ELECTRICAL)

1. Subject to the sub-clauses that follow the Contractor shall be entitled to a payment or shall allow to the Principal an amount calculated in accordance with this clause.
2. For the purposes of this clause the Interpretation of terms shall be as follows:-

"Formula (A)" is -

$$Aw = \frac{NW - TW}{TW} \times Vw \times \frac{X}{100};$$

"Formula (B)" is -

$$AM = \frac{NM - TM}{TM} \times Vm \times \frac{Y}{100};$$

(a) In respect of Formula (A);

"Aw" is the amount which shall be added to or subtracted from the contract sum;

"Vw" is the value of work carried out in accordance with the Contract, as determined by the Superintendent, during the period for which NW is applicable; provided that such value shall be based on rates applicable at the Adjusted Tender Date as determined by the Superintendent and shall not include values derived from previous applications of Formula (A) or Formula (B); provided further that such value shall exclude the value of work carried out in respect of portions of the Works to which provisional or prime cost sums relate.

"TW" is the loaded weekly wage rate determined in the manner set out in Schedule 'R' from the wage rates, allowances and loadings nominated in Schedule 'R' which are effective at the Adjusted Tender Date.

"NW" is the new loaded weekly wage rate, determined in the manner set out in Schedule 'R' and based on the wage rates, allowances and loadings obtained by -

- (i) adjusting the wage rates, allowances and loadings incorporated in "TW" by adding thereto or subtracting therefrom (as the case may require) any increase, decrease or deletion which results from a variation to an Award or other statutory prescription upon which "TW" is based; and
- (ii) including in Schedule "R", in the manner determined by the Superintendent the effect of any variation, in any Award nominated in Schedule "R", in the number of working hours constituting one working week; and
- (iii) including in Schedule "R", in the manner and to the extent determined by the Superintendent any new allowance which is introduced by a variation to an Award upon which "TW" is based and which is applicable to the work under the Contract and thereafter adjusting such allowance pursuant to Award variations thereto, in the manner prescribed in (i) above.

Provided that any adjustment or new inclusion under (i), (ii) or (iii) above -

- (a) shall be made only insofar as it is of general application throughout the industry or industries to which it relates and is not exclusively related to a particular contract or contractor or to a particular contract site;
- (b) shall not include long service leave or any form of overhead or charge levied on wages which is not included in Schedule "R";
- (c) shall not include the value of any portion of a wage or allowance or loading which is payable or paid under an agreement (whether registered or otherwise) at the Adjusted Tender Date and which at that date is not included in an Award notwithstanding that the value thereof or its equivalent is subsequently included in an Award nominated in Schedule "R".

"X" is the Labour Factor stated in Schedule "R" or; if not so stated, is 35.

The period for which "NW" is applicable shall be the period between the date at which the Award or other variation which establishes "NW" becomes effective and the date at which the Award or other variation next in time becomes effective.

SPECIAL CONDITIONS OF CONTRACT (MECHANICAL/ELECTRICAL)

(b) In respect of Formula (B):

(i) "Am" is the amount which shall be added to or subtracted from the contract sum;

"Vm" is the value of work carried out in accordance with the contract, as determined by the Superintendent, during each Calendar month, subject to the same provisos as are stated hereinabove in respect of "Vw".

"TM" is the Materials Index for the month which includes the Adjusted Tender Date.

"NM" is the Materials Index for the month immediately preceding the month in respect of which Vm is determined, provided that, if the month in respect of which "NM" is published precedes the month in respect of which "TM" is published, "NM" shall be taken as "TM".

"Y" is the Materials Factor stated in Schedule "R" or if not so stated, is 55.

(ii) "Materials Index" for any month means the Wholesale Price Index, under the heading prescribed in Schedule "R", first published for that month by the Australian Bureau of Statistics.

(c) Where the term "stated in Schedule "R" appears hereinabove in respect of "X", "Y" and "Materials Factor", it shall be taken to mean "stated in Schedule "R" issued by the Principal for the purpose of tendering".

3. Subject to sub-clause (4) of this Clause - Formula (A) shall be applied in respect of each change which occurs in the Loaded Weekly Wage after the Adjusted Tender Date; and

Formula (B) shall be applied in respect of each change which occurs in the Materials Index after the Adjusted Tender Date; and the Contractor, in respect of any sum resulting from the application of each Formula -

(i) shall be entitled to receive payment of that sum if the Loaded Weekly Wage or the Materials Index has increased; or

(ii) shall pay or allow that sum to the Minister if the Loaded Weekly Wage or the Materials Index has decreased.

4. If the Contractor fails to complete the Works, or a separable part of the Works, as the case may be, by the due date for completion thereof, including any extensions of time granted or allowed under the Contract -

(a) Formula (A) shall be applied in respect of changes in the Loaded Weekly Wage occurring before that date but not in respect of subsequent changes in the Loaded Weekly Wage.

(b) Formula (B) shall be applied in respect of changes in the Materials Index to and including the change which establishes the Materials Index for the month immediately preceding the month which includes the said due date for completion, but not in respect of subsequent changes in the Materials Index.

5. Adjustments to the contract sum under this Clause will be made and incorporated in progress payments to the Contractor, insofar as is practicable.

6. Calculations made in accordance with this Clause, including the calculation of the value of work carried out in any period, shall be subject to re-calculation by the Superintendent prior to the issue of the Final Certificate.

7. For the purpose of this clause, "Adjusted Tender Date" means midnight seven (7) days before the midnight immediately preceding the date on which tenders closed.

8. When Schedule "R" issued by the Principal for the purpose of tendering requires the contract sum to be divided into two sums representing the values of Parts A and B defined in the first page of such Schedule "R", Formula (A) and Formula (B) shall each be applied separately to Part A and Part B using the appropriate part of Schedule "R" and using, for Vw and Vm, the values of work appropriate to the Part for which the calculation is made.

(d) Air Conditioning Installation

The Rates set forth in this Schedule are the rates applicable to the relevant Awards stated therein at(Date) If any Award stated in the Schedule is not applicable to the Tenderer's tender or if there is any change in the date stated in the Schedule between the date stated above and the Adjusted Tender Date, the Tenderer shall (1) alter any such item so affected (and initial every such alteration), so that the Awards and rates stated in the Schedule submitted by the Tenderer shall be those applicable to his tender at the Adjusted Tender Date; or (2) submit a separate Schedule completed by him to the same effect.

1. Classification of Labour	Sheet Metal Worker (1st Class) (Air Conditioning Industry)
2. Title of Award	Metal Industries Award (Federal)
3. Weekly Hours	
4. Weekly Award Wage	
5. Weekly Air Conditioning Allowance	
6. Weekly Multi-Storey Building Allowance	
7. Sub-Total, being the addition of Lines 4, 5, 6.	
8. Extra payment of Annual Leave + $\frac{a \times b}{52}$ % of Line 7	
9. $\frac{n}{260 - n} \times$ line 7 and 8 # Sick Leave, Annual Leave and Statutory Holiday Loading	
10. Sub-Total being the addition of Lines 7, 8, and 9	
11. Weekly Fare Allowance	
12. Pay Roll Tax % of lines 10 and 11	
13. Worker's Compensation % of line 10	
14. Loaded Weekly Wage being the addition of lines 10, 11, 12 and 13	

* If the Weekly Award Wage already has allowed for the factors in lines 5 and 6

then line 7 shall not be completed in respect of the relevant allowance

+ a represents the percentage 'loading' on pay for Annual Leave.

b represents the number of weeks Annual Leave per year.

n represents the total number of working days per year allowed for statutory holidays, annual leave and sick leave entitlement under the relevant Award.

Materials Index as defined in Sub Clause 2 (b)(ii) of Clause S, 49 shall be -

The Group Index Number for Brisbane under the heading "Mechanical Services Components" in Table 3, Price Index of Materials used in Buildings other than House Building (ref. 9, 6)

X (Labour factor) = 35
Y (Material factor) = 55

.....Signature of Tenderer

.....Date

SPECIFICATION

APPENDIX (SUB-CONTRACT)

This Appendix forms part of the Specification.

PLACE: ROYAL BRISBANE HOSPITAL
BUILDING: QUEENSLAND INSTITUTE OF MEDICAL RESEARCH
WORK: AIR CONDITIONING AND MECHANICAL SERVICES INSTALLATION

1. WARRANTY

Works for which a warranty is required	Period of Warranty	Percentage of Sub-Contract value as security for Warranty
Q.I.M.R. - Air Conditioning and Mechanical Services Installation	12 Months	5

Reference also to Clause S15 of Special Conditions of Contract (Building).

2. The Sub-Contractor is to carry out the following works:-
(a) A Service Visit every³... months (Clause).
(b) A Filter Cleaning Service every³... months.

3. The Sub-Contractor to provide skilled operators for Nil days (Clause).

Sub-Contractor to complete:-

4. SERVICE VISITS

- (a) The sum of \$..... has been allowed in the Total Quotation Price for the above Services as follows:

<u>Item</u>	<u>Cost per Service</u>	<u>No. of Services</u>	<u>Total Cost of Item</u>
(i) Service Visits	\$.....	\$.....
(ii) Filter Cleaning	\$.....	\$.....

Sum as allowed in Total Quotation Price \$

- (b) If Service Visits are not to be undertaken directly by the Sub-Contractor, the name and address of the nominated local representative of the Sub-Contractor is to be stated hereunder:

Name

Address

Firm

Address

Signature

Date

Witness

ME. - SC. - 5.75.

D24

S.R.B

1249 ⇒ 1795.

IR. 13.9.82.

VARIATION TO AGREEMENT
dated 20TH MARCH 1973

between

THE NORTH BRISBANE HOSPITALS BOARD

and

JENNINGS INDUSTRIES LIMITED

This page, the attached letter dated 4th March and the following pages numbered 2 to 16 inclusive, form the agreement which varies the terms of the contract between the North Brisbane Hospitals Board and Jennings Industries Limited for erection of Block 7 at the Royal Brisbane Hospital.

Date 22ND APRIL 1976

Signed by the Principal

} *J. B. Doherty*

In the presence of

Name:

J. Palmer J.P.

Address:

*34 Duncraig Street
Stafford*

Signed by the Contractor

} JENNINGS INDUSTRIES LIMITED
Block 7

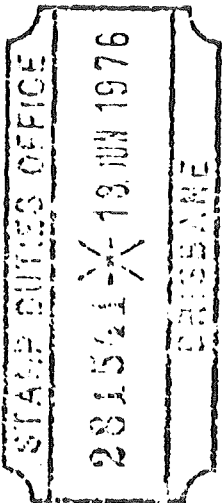
In the presence of

Name:

J. Palmer

Address:

*35 Bay St
Woolloongabba Hill*



NOTE: Page numbers shown in this letter have been extended due to the incorporation of the completed rise and fall schedules.

4th March, 1976.

The Manager - Queensland,
Construction Division,
Jennings Industries Limited,
P.O. Box 172,
HAMILTON CENTRAL. QLD. 4007.

Dear Sir,

Re: BLOCK 7 - ROYAL BRISBANE HOSPITAL:
Fire Sprinklers & Completion Date:

Contractual matters affected by authorizations and Variation Orders on these matters and referred to in our letter to you of 4th February, 1976, are detailed out hereinafter, pages 2 to 12, on the basis agreed with you as meeting the stipulations made in your quotation and letter dated 20th January, 1976.

The contractual matters are:-

- (a) "Rise & Fall";
- (b) Programme of Work;
- (c) Time for Completion & Damages for Delay;
- (d) Extension of Time.

It is proposed that this letter and the following pages numbered 2 to 12, inclusive, form the agreement which varies the terms of the Contract for erection of Block 7 at the Royal Brisbane Hospital.

Yours faithfully,
CONRAD, GARGETT & PARTNERS PTY. LTD.

Per: W. H. 111

Call: baw

cc. Mr. C.F. Hotz - Health Department.
Mr. R. Pavlyshyn - Department of Works.
Mr. D. Palmer - Nth. B'ne Hospitals Board,
Messrs. Allan Butler, Wright & Co.
Messrs. A.E. Axon and Associates
Messrs. W.E. Bassett and Partners Pty. Ltd.

BLOCK 7 .. ROYAL BRISBANE HOSPITAL:"RISE & FALL":

The method of calculation of "Rise & Fall" adjustment applicable to this Contract, which is set out in Special Conditions of Contract and forms part of the Specification, is no longer applicable.

"Rise & Fall" adjustment for the Contract shall be calculated from the original adjusted tender date for the duration of the adjusted Contract Time by the formula as set out in the current Special Conditions of Contract (Buildings) Clause S.40 (Edition A.12.75) which includes Schedule "R" (Buildings) (12/75), incorporated herewith.

The ratios, Labour - Materials, shall be:-

X (Labour factor)	=	52
Y (Material factor)	=	138

Nominated Sub-Contracts listed hereunder shall have "Rise & Fall" adjustment on the terms stated above, except that the Schedule "R" used shall in each case be that specifically provided for and identified with the trade in question.

Fire Alarm & Sprinkler Services:
(Fire Control (Qld.) Pty. Ltd.)

Mechanical Services:
(A.E. Smith & Son Pty. Ltd.)

Air Conditioning & Mechanical Ventilation:
(T.O'Connor & Sons Pty. Ltd.)

Equipment:
(Athertons (Qld.) Pty. Ltd.)

SPECIAL CONDITIONS OF CONTRACT (BUILDINGS)S. 40 RISE AND FALL (BUILDINGS)

1. Subject to the sub-clauses that follow the Contractor shall be entitled to a payment or shall allow to the Minister an amount calculated in accordance with this clause.
2. For the purposes of this clause the Interpretation of terms shall be as follows:-

"Formula (A)" is -

$$A_w = \frac{NW - TW}{TW} \times V_w \times \frac{X}{100}$$

"Formula (B)" is -

$$A_m = \frac{NM - TM}{TM} \times V_m \times \frac{Y}{100}$$

(a) In respect of Formula (A):

"A_w" is the amount which shall be added to or subtracted from the contract sum;

"V_w" is the value of work carried out in accordance with the Contract, as determined by the Superintendent, during the period for which NW is applicable; provided that such value shall be based on rates applicable at the Adjusted Tender Date as determined by the Superintendent and shall not include values derived from previous applications of Formula (A) or Formula (B); provided further that such value shall exclude the value of work carried out in respect of portions of the Works to which provisional or prime cost sums relate.

"TW" is the average loaded weekly wage rate determined in the manner set out in Schedule 'R' from the wage rates, allowances and loadings nominated in Schedule 'R' which are effective at the Adjusted Tender Date.

"NW" is the new average loaded weekly wage rate, determined in the manner set out in Schedule 'R' and based on the wage rates, allowances and loadings obtained by -

- (i) adjusting the wage rates, allowances and loadings incorporated in "TW" by adding thereto or subtracting therefrom (as the case may require) any increase, decrease or deletion which results from a variation to an Award or other statutory prescription upon which "TW" is based; and
- (ii) including in Schedule 'R', in the manner determined by the Under Secretary, the effect of any variation, in any Award nominated in Schedule 'R', in the number of working hours constituting one working week; and
- (iii) including in Schedule 'R', in the manner and to the extent determined by the Under Secretary, any new allowance which is introduced by a variation to an Award upon which "TW" is based and which is applicable to the work under the Contract and thereafter adjusting such allowance pursuant to Award variations thereto, in the manner prescribed in (i) above.

Provided that any adjustment or new inclusion under (i), (ii) or (iii) above -

- (a) shall be made only insofar as it is of general application throughout the industry or industries to which it relates and is not exclusively related to a particular contract or contractor or to a particular contract site;
- (b) shall not include long service leave or any form of overhead or charge levied on wages which is not included in Schedule 'R';
- (c) shall not include the value of any portion of a wage or allowance or loading which is payable or paid under an agreement (whether registered or otherwise) at the Adjusted Tender Date and which at that date is not included in an Award notwithstanding that the value thereof or its equivalent is subsequently included in an Award nominated in Schedule 'R'.

"X" is the Labour Factor stated in Schedule 'R' or, if not so stated, is 35.

SPECIAL CONDITIONS OF CONTRACT (BUILDINGS)

The period for which "NW" is applicable shall be the period between the date at which the Award or other variation which establishes "NW" becomes effective and the date at which the Award or other variation next in time becomes effective.

(b) In respect of Formula (B):

(i) "Am" is the amount which shall be added to or subtracted from the contract sum ;

"Vm" is the value of work carried out in accordance with the contract, as determined by the Superintendent, during each Calendar month, subject to the same provisos as are stated hereinabove in respect of "Vw".

"TM" is the Materials Index for the month which includes the Adjusted Tender Date.

"NM" is the Materials Index for the month immediately preceding the month in respect of which "Vm" is determined, provided that, if the month in respect of which "NM" is published precedes the month in respect of which "TM" is published, "NM" shall be taken as "TM".

"Y" is the Materials Factor stated in Schedule 'R' or if not so stated, is 55.

(ii) "Materials Index" for any month means the Wholesale Price Index, under the heading stated in Schedule 'R', first published for that month by the Australian Bureau of Statistics.

(c) Where the term "stated in Schedule 'R'" appears hereinabove in respect of "X", "Y" and "Materials Factor", it shall be taken to mean "stated in Schedule 'R' issued by the Principal for the purpose of tendering".

3. Subject to sub-clause (4) of this Clause - Formula (A) shall be applied in respect of each change which occurs in the Average Loaded Weekly Wage after the Adjusted Tender Date; and

Formula (B) shall be applied in respect of each change which occurs in the Materials Index after the Adjusted Tender Date; and the Contractor, in respect of any sum resulting from the application of each Formula -

(i) shall be entitled to receive payment of that sum if the Average Loaded Weekly Wage or the Materials Index has increased; or

(ii) shall pay or allow that sum to the Minister if the Average Loaded Weekly Wage or the Materials Index has decreased.

4. If the Contractor fails to complete the Works, or a separable part of the Works, as the case may be, by the due date for completion thereof, including any extensions of time granted or allowed under the Contract -

(a) Formula (A) shall be applied in respect of changes in the Average Loaded Weekly Wage occurring before that date but not in respect of subsequent changes in the Average Loaded Weekly Wage,

(b) Formula (B) shall be applied in respect of changes in the Materials Index to and including the change which establishes the Materials Index for the month immediately preceding the month which includes the said due date for completion, but not in respect of subsequent changes in the Materials Index.

5. Adjustments to the contract sum under this Clause will be made and incorporated in progress payments to the Contractor, insofar as is practicable.

6. Calculations made in accordance with this Clause, including the calculation of the value of work carried out in any period, shall be subject to re-calculation by the Under Secretary prior to the issue of the Final Certificate.

7. For the purpose of this clause, "Adjusted Tender Date" means midnight seven (7) days before the midnight immediately preceding the date on which tenders closed.

SCHEDULE "R" (BUILDINGS)

The tenderer shall submit a copy of the following schedule fully completed and signed by him, and returned with his tender.

1	Classification of Labour	Carpenter	Labourer (Assisting Tradesman)
2	Title of Awards	M.B.T.C.A. Federal	
3	Weekly Hours	40	40
4	Weekly Award Wage	82.28	71.20
5	Extra payment of Annual Leave + $\frac{a \times 1}{52}$ % of line 4 or lines 4 & 8 where applicable	-	-
6	Sick Leave, Annual Leave & Statutory Holiday Loading $\frac{n}{260 - n} \times \text{lines 4 \& 5}$ $\frac{25}{225} \times \$78.58$	8.36 ✓	7.57 ✓
7	Sub-total, lines 4, 5 & 6	90.64 ✓	78.77 ✓
8	Weekly Allowance for Fares and Travelling Time	3.50 ✓	4.25 ✓
9	Pay Roll Tax $3\frac{1}{2}$ % of lines 7, 8	3.29 ✓	2.91 ✓
10	Worker's Compensation $3\frac{1}{4}$ % of line 7	3.14 ✓	2.73 ✓
11	Loaded Weekly Wage - Total of lines 7, 8, 9, 10	100.57 ✓	88.66 ✓

*Weekly Award Wage means the hourly rate for the relevant tradesman or labourer as defined by the Award, multiplied by 40.

a represents the percentage 'loading' on pay for Annual Leave.

b represents the number of weeks Annual Leave per year.

n represents the total number of working days per year allowed for sick leave annual leave and statutory holidays under the relevant Award.

\$3.50 9/69 - 29/10/72.
\$4.25 From 30/10/72.

AVERAGE WAGE RATE =

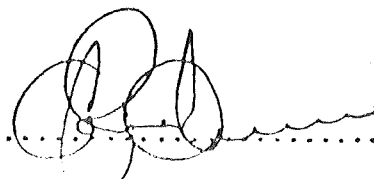
$$\frac{(4 \times \text{line 11 (Carpenter)}) + (1 \times \text{line 11 (Labourer)})}{5}$$

= \$98.188 (Calculated to the nearest one tenth of a cent, one twentieth of a cent being taken as one tenth of a cent).

MATERIALS Index as defined in Sub-clause (2) (b) (ii) of this clause

The Group Index number for Brisbane under the Heading 'Special Purpose Index (C)' in Table 3, Price Index of Materials used in building other than House Building (Ref. 9.6)

X (Labour factor) = 52
Y (Material factor) = 39



..... Signature of Tenderer

(b) Electric Fire Alarm Installation

SCHEDULE 12

The Rates set forth in this Schedule are the rates applicable to the relevant Awards stated therein at 20.2.73 (Date). If any Award stated in the Schedule is not applicable to the Tenderer's tender or if there is any change in the rate stated in the Schedule between the date stated above and the Adjusted Tender Date, the Tenderer shall (1) alter any item so affected (and initial every such alteration), so that the Awards and rates stated in the schedule submitted by the Tenderer shall be these applicable to his tender at the Adjusted Tender Date; or (2) submit a separate Schedule completed by him to the same effect.

1	Classification of Labour	Electrical Mechanic
2	Title of Award	Electrical Engineering Award (State)
3	Weekly Hours	40
4	Weekly Award Wage	\$ 82.67
5	Weekly Tool Allowance	\$ 1.00 ✓
6	Weekly Building Construction (On Site) Allowance	\$ 2.70 ✓
7	Western Allowance	N/A
8	Sub-Total being the addition of Lines 4, 5, 6 and 7	\$ 86.37 ✓
9	Extra Payment on Annual Leave $\frac{a \times b}{52} \% \times \text{line 8.}$	N/A
10	$\frac{n}{260 - n} \times \text{lines (8 + 9)}$	
11	Sick Leave, Annual Leave and Statutory Holiday Loading	\$ 12.55
12	Pay Roll Tax % of lines 8, 9 and 10. 3.5% ✓	\$ 3.46 ✓
13	Worker's Compensation % of lines 8, 9 and 10. 1.74% ✓	\$ 1.72 ✓
13	Loaded Weekly Wage being the additions of lines 8, 9, 10, 11 and 12.	\$104.10 ✓

Price 13/11/72.
\$83.97 Price 19/2/73.
If the Weekly Award Wage already has allowed for the factors in lines 5, 6 and 7 or any of them, then lines 5, 6 and 7 shall not be completed in respect of the relevant allowances.

n represents the total number of working days per year allowed for statutory holidays, annual leave and sick leave entitlement under the relevant Award.

a represents the percentage 'loading' on pay for Annual Leave.

b represents the number of weeks Annual Leave per year.

Materials Index as defined in Sub. Clause 2 (b) (ii), of this Clause shall be :-

The Group Index number for Brisbane under the heading 'Electrical Installation Materials (b)' in Table 3.

Price Index of Materials used in Building other than House Building (ref. 9.6)

FIRE CONTROL (QLD) PTY LTD
Per

Still applicable

The Rates set forth in this Schedule are the rates applicable to the relevant Awards stated therein at 20. 2.73(Date). If any Award stated in the Schedule is not applicable to the Tenderer's tender or if there is any change in the rate stated in the Schedule between the date stated above and the adjusted Tender Date, the Tenderer shall (1) alter any such item so affected (and initial every such alteration), so that the Awards and rates stated in the Schedule submitted by the Tenderer shall be those applicable to his tender at the Adjusted Tender Date; or (2) submit a separate Schedule completed by him to the same effect.

1	Classification of Labour	Sprinkler Fitter (1st Class)
2	Title of Award	Sprinkler Pipe Fitters Award
3	Weekly Hours	40
4	All Purpose Rate per week	\$ 82.20 ✓
5	Extra payment of Annual Leave + $\frac{a \times b}{52}$ % of line 4 and 7	Nil
6	$\frac{n}{260 - n}$ x line 4 and 5 # Sick Leave, Annual Leave and Statutory Holiday Loading	\$ 10.72
7	Fares and Travelling Time - Minimum Allowance	\$ 14.27 ✓
8	Pay Roll Tax % of lines 4, 5, 6 and 7 3.5 % ✓	\$ 3.75 ✓
9	Worker's Compensation % of lines 4, 5 and 6 1.83 % ✓	\$ 1.96 ✓
10	Loaded Weekly Wage - Total of lines 4, 5, 6, 7, 8 and 9	\$ 112.90 ✓

Rate 1/1/73

n represents the total number of working days per year allowed for statutory holidays, annual leave and sick leave entitlement under the relevant award.

+ a represents the percentage "loading" on pay for Annual Leave.

b represents the number of weeks Annual Leave per year.

Materials Index as defined in Sub. Clause 2 (b) (ii) of Clause S. 49 shall be -

The Group Index Number for Brisbane under the heading "Mechanical Services Components" in Table 3 Price Index of Materials used in Building other than House Building (ref. 9.6).

FIRE CONTROL (QLD) PTY LTD
per

X (Labour factor) = 52 52

Y (Material factor) = 57 38

[Signature]
..... Signature of Tenderer
30/1/73 Date

ACCOUNTS
MAR 1976

THE AUSTRALIAN SCHEMATIC (COMPANIES) ACT 1967

(c) Engineering Division of the Department

SCHEDULE 107

REVISED SCHEDULE PREPARED FOR BREEZE / MECHANICAL SERVICES.

The Rates set forth in this Schedule are the rates applicable to the relevant Award stated therein at (Date). If any Award stated in the Schedule is not applicable to the Tenderer's tender or if there is any change in the rate stated in the Schedule between the date stated above and the Adjusted Tender Date, the Tenderer shall (1) alter any such item so affected (and initial every such alteration), so that the Award and rates stated in the Schedule submitted by the Tenderer shall be those applicable to his tender at the Adjusted Tender Date; or (2) submit a separate Schedule completed by him to the same effect.

1	Classification of Labour	Plumber	
2	Title of Award	B. T. A. (State)	
3	Weekly Hours	40	40
4	Weekly Award Wage	80.80	152.40 ✓
5	Extra payment of Annual Leave $\frac{a \times b}{52}$ % of line 4	NIL	2.05 ✓
6	Holiday Loading $\frac{n}{260 - n} \times$ lines 4 and 5	8.60 ✓	20.15 ✓
7	Sub-total, lines 4, 5 and 6	89.40 ✓	174.60 ✓
8	Weekly Allowance for Fares and Travelling Time	3.50 ✓	7.00 ✓
9	Pay Roll Tax % of lines 7 and 8	3.5% 3.25	5% 9.08 ✓
10	Worker's Compensation % of line 7 2.86%	2.56	7.82 ✓
11	Loaded Weekly Wage - Total of lines 7, 8, 9 and 10	98.71 ✓	198.50 ✓

n represents the total number of working days per year allowed for Statutory Holidays and Annual Leave under the relevant Award.

a represents the percentage "loading" on pay for Annual Leave.
b represents the number of weeks Annual Leave per year.

Weekly Award Wage means the ordinary wage plus Tool Allowance, Disabilities (on-site) Allowance, Sick Leave Payment and Western Allowance, as applicable.

At Adjusted Tender Date 16/2/76
Date 13/9/72.

Materials Index as defined in Sub-Clause 2 (b) (ii) of Clause 25 shall be:-
The Group Index Number for Brisbane under the heading "Mechanical Services Components" in Table 3, Price Index of Materials used in Buildings other than House Building (ref. 9.6).

A. E. SMITH Son & Co. Signature of Tenderer

X (Signature) 3532

ad 500

#65.90 still applicable.

18.9.72 (Date)

The rates set forth in this Schedule are the rates applicable to the relevant Awards stated therein at the date stated in the Schedule. If any Award stated in the Schedule is not applicable to the Tenderer's tender or if there is any change in the rate stated in the Schedule between the date stated above and the Adjusted Tender Date, the Tenderer shall (1) alter any such item so affected (and initial every such alteration), so that the Awards and rates stated in the Schedule notified by the Tenderer shall be those applicable to his tender at the Adjusted Tender Date; or (2) submit a separate Schedule completed by him to the same effect.

1. Classification of Labour	Sheet Metal Worker (1st Class) (Air Conditioning Industry)
2. Title of Award	Metal Industries Award (Federal)
3. Weekly Hours	40
4. Weekly Award Wage	65.90
5. Weekly Air Conditioning Allowance	-
6. Weekly Multi-Storey Building Allowance	4.50
7. Sub-Total, being the addition of Lines 4, 5, 6.	70.40
8. Extra payment of Annual Leave + $\frac{a \times b}{52}$ % of Line 7	
9. $\frac{n}{260 - n} \times$ line 7 and 8 # Sick Leave, Annual Leave and Statutory Holiday Loading	10.23
10. Sub-Total being the addition of Lines 7, 8, and 9	80.63 ✓
11. Weekly Fares Allowance	-
12. Pay Roll Tax % of lines 10 and 11 3.5%	2.82 ✓
13. Worker's Compensation % of line 10 1.9%	1.53 ✓
14. Loaded Weekly Wage being the addition of lines 10, 11, 12 and 13	84.98 ✓

→ Rate 19/5/72

If the Weekly Award Wage already has allowed for the factors in lines 5 and 6

then line 7 shall not be completed in respect of the relevant allowance

a represents the percentage 'loading' on pay for Annual Leave.

b represents the number of weeks Annual Leave per year.

n represents the total number of working days per year allowed for statutory holidays, annual leave and sick leave entitlement under the relevant Award.

Materials Index as defined in Sub Clause 2 (b)(ii) of Clause S. 49 shall be -

The Group Index Number for Brisbane under the heading "Mechanical Services Components" in Table 3, Price Index of Materials used in Buildings other than House Building (ref. 9.6)

X (Labour factor) = 52
Y (Material factor) = 33

U'CONNOR & JOYNTY LTD.

RIE AND FALL SCHEDULE - (MECHANICAL/ELECTRICAL)

(g) Engineering Pipework Installation

SCHEDULE "R"

The Rates set forth in this Schedule are the rates applicable to the relevant Awards stated therein at (Date). If any Award stated in the Schedule is not applicable to the Tenderer's tender or if there is any change in the rate stated in the Schedule between the date stated above and the Adjusted Tender Date, the Tenderer shall (1) alter any such item so affected (and initial every such alteration), so that the Awards and rates stated in the Schedule submitted by the Tenderer shall be there applicable to his tender at the Adjusted Tender Date; or (2) submit a separate Schedule completed by him to the same effect.

1	Classification of Labour	Plumber
2	Title of Award	B. T. A. (State)
3	Weekly Hours	40
4	Weekly Award Wage	380.80
5	Extra payment of Annual Leave * $\frac{a \times b}{52}$ % of line 4	
6	Holiday Loading # $\frac{n}{260 - n} \times$ lines 4 and 5	3.60
7	Sub-total, lines 4, 5 and 6	384.40
8	Weekly Allowance for Fares and Travelling Time	3.50
9	Pay Roll Tax 3 1/2% of lines 7 and 8	3.25
10	Worker's Compensation 2.86 % of line 7	2.56
11	Loaded Weekly Wage - Total of lines 7, 8, 9 and 10	398.71

n represents the total number of working days per year allowed for Statutory Holidays and Annual Leave under the relevant Award.

* a represents the percentage "loading" on pay for Annual Leave.
b represents the number of weeks Annual Leave per year.

• Weekly Award Wage means the ordinary wage plus Tool Allowance, Disabilities (on-site) Allowance, Sick Leave Payment and Western Allowance, as applicable.

Materials Index as defined in Sub-Clause 2 (b) (ii) of Clause 25 shall be :-

The Group Index Number for Brisbane under the heading "Mechanical Services Components" in Table 3, Price Index of Materials used in Buildings other than House Building (ref. 9.6).

..... Signature of Tenderer

..... Date

RISE AND FALL
SCHEDULE "F"

We submit with this tender two Rise and Fall, Schedule "F". One being based on (G) Engineering Pipework Installation - Plumber - B.T.A. (State) and the other being based on (C) Ventilation/Sheet Metal Fabrication Installation - Sheet Metal Worker (First Class) - Metal Industries Award (Federal).

For the basis of calculating Rise and Fall we have taken the average loaded weekly wage based on a ratio of three sheet metal workers to one plumber as we feel the contract constitutes a labour factor of 75% Sheet Metal Fabrication/Installation and 25% Engineering Pipework Installation.

Therefore the average loaded weekly wage is calculated on the following formula.

Loaded Weekly Wage B.T.A. Plumber	98.77 x 1	\$ 98.77	<i>Based on weekly rate of \$80.80</i>
Loaded Weekly Wage M.I.A. Sheet Metal Worker	284.98 x 3	\$254.94	
		\$353.73	<i>Based on weekly rate of \$65.90</i>
		<u>65</u>	

$\frac{353.73}{4} = 88.43$ (Average Loaded Weekly Wage)
#88.43

Future Rise and Fall calculations would therefore be calculated on this formula.

B. S. Wilson

ATHERTONS (QUEENSLAND) PTY. LTD.

ATHERTONS (QLD.) PTY. LTD.
RAYNHAM ST., ROCKLEA
P.O. BOX 111,
SALISBURY NORTH, 4107
TELEPHONE 471321

BLOCK 7 .. ROYAL BRISBANE HOSPITAL:PROGRAMME OF WORK:

The provisions regarding Programme of Work contained in Clause A.22 of the Specification shall be varied by the additional requirements set out hereafter, which shall take precedence over the existing provisions.

The Contractor shall have prepared a network showing the intended progress of the work and shall provide therefrom a computer print-out which contains time, sequence, critical path and any other information necessary to provide a fully detailed critical path programme for completion of the works within the Contract Time.

The programme shall provide necessary times for decision making and approvals to be obtained and shall in all respects be a realistic working document.

The Contractor shall work to the programme and secure that all Sub-Contractors and Suppliers do likewise.

The programme shall be available to all concerned in the administration and execution of the works of the contract.

When required and so directed by the Architects, which is anticipated to be approximately monthly intervals, the Contractor shall prepare all necessary data and have the programme re-run by Computer and up-dated to the current situation. Any revision of programme resulting shall be given effect to at once.

Applications for extensions of time under Clause 33 of the General Conditions of Contract (and amendments thereto) shall be supported by data based on the current network analysis and computer print-out which demonstrate how the contract completion date is affected.

A Provisional Amount of \$32,500.00 shall be provided to meet the cost of computer services required in the provision of the programme and subsequent up-dating as directed.

BLOCK 7 . . . ROYAL BRISBANE HOSPITAL:TIME FOR COMPLETION AND DAMAGES FOR DELAY:

Time for Completion and Damages for Delay as set out in Clause A.8 of the Specification and Clauses 36 and 37 of the General Conditions and also in the Appendix to the Conditions shall be varied as hereinafter set out and in the event of conflicting provisions, this document shall prevail.

Limits to sums expended in given time periods are now withdrawn.

Dates for Progressive Completion and handover shall be as set out in Variation Order No.42 (issued 4th February 1976) and are as follows:-

- i) 30th June, 1977:
Part Lower Ground Floor (including Reception and P.A.B.X.) A (part only), B, C, E, F, G, H, I, J, K, N, O;
- ii) 30th September, 1977:
Balance Lower Ground Floor, A (balance), D, L, M;
- iii) 31st March, 1978:
Renovations to Block 3.

Liquidated Damages for failure to complete the parts of the Contract by the due dates as set out above shall be as follows:-

i) 30th June, 1977	...	\$7,000.00	✓
ii) 30th September, 1977	...	\$2,500.00	
iii) 31st March, 1978	...	\$ 500.00	

In each case the amounts stated are for each week or part thereof until the whole of each part of the Contract is completed.

BLOCK 7 . . ROYAL BRISBANE HOSPITALEXTENSION OF TIME:

The provisions relating to Extension of Time as set out in Clause 38 of the General Conditions of Contract shall be varied as follows:-

- (1) Sub-Clause (3) of Clause 38 of the Conditions shall no longer apply;
- (2) The following extract from Clause 34 of the N.P.W.C. Edition 1 Conditions of Contract shall apply and shall override the original Conditions in the event of conflict:-

34.0 PROGRESS AND SUSPENSION OF THE WORKS

34.1 Rate of Progress

34.2 Suspension by Architect

Where the suspension of the works or any part of the works becomes necessary -

- (a) because of an act, default or omission of -
 - (i) the Principal or an employee or professional consultant or agent of the Principal, or
 - (ii) the Contractor or an employee or agent of the Contractor; or
 - (iii) a sub-contractor or an employee or agent of that sub-contractor, or
- (b) for the protection or safety of -
 - (i) the employees or agents of the Contractor or of a sub-contractor or the employees, professional consultants or agents of the Principal or any other person concerned in the performance of the works or any part of the works, or
 - (ii) the executed work or any part of the executed work, or
 - (iii) the public or any property.

the Architect may order the Contractor to suspend the progress of the works or any part of the works specified in the order for such time or times as the Architect may think fit.

34.3 Suspension by Contractor

Should the Contractor wish to suspend the progress of the works or any part of the works he shall in writing notify the Architect and explain the reasons for the suspension. The Architect shall thereupon, if he thinks it necessary or reasonable so to do, grant permission for a suspension of the works or any part of the works for such time or times as he may think fit.

34.4 Recommencement of Work

The Architect shall, when the reason for any suspension no longer exists, direct the Contractor to recommence work on the works or on the relevant part of the works and the Contractor shall comply with the direction promptly.

34.5 Cost of Suspension

- ^ The extra cost, if any, of completing the works incurred by the Contractor by reason of any suspension under subclause 34.2 or subclause 34.3 shall be borne and paid for by the Contractor provided however that if the suspension is due to an act, default or omission of the Principal or an employee, professional consultant or agent of the Principal the Contractor shall be entitled to payment of the amount of any extra cost of completing the works incurred by him that is attributable to such an act, default or omission.

34.6 Effect of Suspension

The suspension of the progress of the works or any part of the works under this clause shall not affect the obligation of the Contractor to complete the works within the period or by the date stated in the Appendix hereto with reference to subclause 35.2 or within any extended time allowed by the Architect pursuant to subclause 35.4