

Australian Standard[®]

Ductwork for air-handling systems in buildings

Part 2: Rigid duct



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- Air Conditioning & Mechanical Contractors Association
 - Australasian Fire and Emergency Service Authorities Council
 - Australian Building Codes Board
 - Australian Industry Group
 - Australian Institute of Refrigeration Air Conditioning and Heating
 - Chartered Institution of Building Services Engineers
 - Climate Control Companies Association
 - Consumer Electronics Suppliers Association
 - Department of Health and Human Services Tasmania
 - Engineers Australia
 - Facility Management Association of Australia
 - Fire Protection Association Australia
 - Institute of Refrigeration Heating & Air Conditioning Engineers of New Zealand
 - Plastics and Chemicals Industries Association
 - Plumbing Industry Commission
 - Property Council of Australia
-

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Ductwork for air-handling systems in buildings

Part 2: Rigid duct

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-062, Mechanical Ventilation and Air Conditioning, to supersede, in part, AS 4254—2002, *Ductwork for air-handling systems in buildings*.

This Standard is Part 2 of a series on ductwork for air-handling systems, as follows:

AS

4254 Ductwork for air-handling systems in buildings

4254.1 Part 1: Flexible duct

4254.2 Part 2: Rigid duct

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard.

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STANDARDS AUSTRALIA

Australian Standard

Ductwork for air-handling systems in buildings

Part 2: Rigid duct

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for materials, construction, and installation, including some aspects of performance, for ductwork for air-handling systems in buildings and facilities, including systems designed in accordance with the requirements of AS/NZS 1668.1 and AS 1668.2.

1.2 OBJECTIVE

The objective of this Standard is to provide standardized requirements for the manufacture and installation of ducts and associated equipment for the use of designers, manufacturers and installers of air-handling systems for buildings.

The objective of this 2012 revision is to update the standard to reflect current industry practices.

1.3 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS

1397	Continuous hot-dip metallic coated steel sheet and strip—Coatings of zinc and zinc alloyed with aluminium and magnesium
1443	Carbon and carbon-manganese steel—Cold finished bars
1530	Methods of fire tests on building materials, components and structures
1530.4	Part 4: Fire-resistance test of elements of construction
1668	The use of ventilation and airconditioning in buildings
1668.2	Part 2: Mechanical ventilation in buildings
1682	Fire dampers (all parts)
2338	Preferred dimensions of wrought metal products

AS/NZS

1530	Methods for fire tests on building materials, components and structures
1530.3	Part 3: Simultaneous determination of ignitability, flame propagation, heat release and smoke release
1668	The use of ventilation and airconditioning in buildings
1668.1	Part 1: Fire and smoke control in multi-compartment buildings
1734	Aluminium and aluminium alloys—Flat sheet, coiled sheet and plate
1866	Aluminium and aluminium alloys—Extruded rod, bar, solid and hollow shapes

AS/NZS

3666 Air-handling and water systems of buildings—Microbial control

3666.1 Part 1: Design, installation and commissioning

3679 Structural steel

3679.1 Part 1: Hot-rolled bars and sections

4200 Pliable building membranes and underlays

4200.1 Part 1: Materials

4859 Materials for the thermal insulation of buildings

4859.1 Part 1: General criteria and technical provisions

ASTM

A480 Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip

NCC National Construction Code

UL

UL 181 Factory-made Air Ducts and Air Connectors

1.4 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

1.4.1 Adhesive

Material used to bond surfaces by adhesion.

1.4.2 Airflow rate

The volumetric flow rate that describes the rate of airflow; measured in litres per second or cubic metres/hour (L/s or m³/h).

1.4.3 Air-handling plant

A component part of an air-handling system that includes equipment that provides air movement, as well as equipment for the purpose of controlling the direction, rate of airflow, division of airflow and condition of air.

1.4.4 Air-handling system

A system for the purpose of directing air in a controlled manner to or from specific enclosures by means of an air-handling plant, ducts, plenums, air-distribution devices and automatic controls.

1.4.5 Air leakage

Air, other than exhaust air, return air and relief air, that escapes from an air-handling system in an uncontrolled manner.

1.4.6 Air terminal device

Any opening or device through which air is discharged, exhausted or introduced, including but not limited to a grille, diffuser, outlet, chilled beam or variable air volume (VAV) diffuser, and to which a duct is attached.

1.4.7 Approved and approval

Approved by, or the approval of, the regulatory authority having jurisdiction.

1.4.8 Duct

A component part of an air-handling system, intended for the passage of air from one part of an air-handling system to another; *see also* definition of 'plenum'.

1.4.9 Duct liner

Internal lining of duct usually provided for thermal or acoustic insulation, or both, including the facing material thereon.

1.4.10 Exhaust air

Air, other than return air, removed from an enclosure by mechanical means and discharged to atmosphere.

1.4.11 Exhaust outlet

An opening or device discharging to atmosphere from an air-handling system.

1.4.12 Facing material

Thin flexible material (e.g. reflective foil laminate) used for the facing of duct liner or insulation, or for the manufacture of duct.

1.4.13 Fire damper

A complete assembly complying with AS 1682.1.

1.4.14 Fire-isolated

Separated by fire-resistant construction.

1.4.15 Fire resistance level (FRL)

The grading periods, in minutes, determined in accordance with AS 1530.4, for—

- (a) structural adequacy;
- (b) integrity; and
- (c) insulation,

expressed in that order.

1.4.16 Flexible connection

A section of flexible material used at junctions between ductwork and items of plant that are subject to vibration.

1.4.17 Flexible duct

A factory-made, preformed duct that can be bent or compressed by hand.

NOTE: Flexible ducts are covered by AS 4254.1.

1.4.18 Hood

A component part of a local exhaust system intended for collecting effluents.

1.4.19 Insulation

Material provided for thermal resistance or acoustic attenuation insulation, or both, including any facing material thereon.

1.4.20 Joint

Any surface connection, other than a seam, made on the perimeter of a duct.

1.4.21 May

Indicates—

- (a) a course of action permissible within the limits of the Standard; or
- (b) the existence of an option.

1.4.22 Effluent

Any unwanted airborne constituents that may reduce the acceptability of air quality.

1.4.23 Outdoor air

Air outside the building.

1.4.24 Outdoor air intake

Any opening or device through which outdoor air is admitted to an air-handling system of a building.

1.4.25 Plant room

A room that contains any items of plant or machinery.

1.4.26 Plenum

An air compartment or chamber, intended for the passage of air, to which one or more ducts may be connected and which forms part of an air-handling system.

1.4.27 Recycle air

That portion of indoor air removed from enclosures as return air and returned as part of the supply air, by mechanical means.

1.4.28 Regulatory authority

An authority having statutory powers to control design, construction, installation, operation or testing of air-handling systems in buildings.

1.4.29 Relief air

Air that flows from an enclosure in a controlled manner by other than mechanical means.

1.4.30 Required

Required by Standard or building regulation.

NOTE: Fire insurance underwriters and other bodies may have requirements in excess of those required by regulatory authorities.

1.4.31 Return air

Air removed from an enclosure by mechanical means.

NOTE: All of the return air may be expelled as spill air, or all or part of it may be recycled.

1.4.32 Sealing media/Sealant

Material used in a duct or insulation seam or joint, or connection between rigid duct and flexible duct.

1.4.33 Seam

Any surface connection joining two longitudinally oriented edges of duct surface material occurring between two joints.

1.4.34 Shall

Indicates that a statement is mandatory.

1.4.35 Should

Indicates a recommendation.

1.4.36 Spill air

That portion of return air that is not recycled.

1.4.37 Supply air

Air introduced into an enclosure by mechanical means.

1.4.38 Upstream

Against the direction of airflow.

1.5 GENERAL REQUIREMENTS

A duct system is a structural assembly, the primary function of which is to convey air between specific points. To fulfill this function, the duct assembly has to perform satisfactorily with regard to certain fundamental performance characteristics.

Elements of the assembly are fabricated duct (duct envelope), reinforcement, seams and joints. With regard to the duct assembly and its elements, theoretical or practical limits shall be established for the following:

- (a) Dimensional stability (deformation and deflection) under positive or negative pressure applications or static loads.
- (b) Leakage under positive or negative pressure.
- (c) Vibration.
- (d) Support (including any supplemental loads).

In establishing limitations for these factors, consideration shall be given to the effects of pressure differential across the ductwork, airflow friction losses, air velocity, infiltration or exfiltration, as well as the inherent strength characteristics of the duct components.

The following are not covered in detail in this Standard, but are included for information:

- (i) Noise generation and transmission.
- (ii) Exposure to damage from—
 - (A) transportation and handling;
 - (B) weather and temperature extremes;
 - (C) flexure cycle;
 - (D) chemical corrosion; and
 - (E) other in-service conditions specific to the installation.
- (iii) Impact loading such as—
 - (A) fire;
 - (B) earthquake; or
 - (C) sudden stoppage of airflow.
- (iv) Cleanability.
- (v) Resistance to airflow.

1.6 STATIC PRESSURE CLASSIFICATION

The pressure classification number denotes construction suitable for a maximum level not less than the maximum operating pressure in the portion of the system. The pressure classifications shall be as given in Table 1.6.

TABLE 1.6
PRESSURE CLASSIFICATIONS

Static pressure/Positive or negative	
Pressure class	Operating pressure range, Pa
125	≤125
250	126 to 250
500	251 to 500
750	501 to 750
1000	751 to 1000
1500	1001 to 1500
2500	1501 to 2500

1.7 GALVANIZED STEEL THICKNESS

All galvanized steel thicknesses nominated in this Standard shall be read as ‘total coated thickness’.

Uncoated steel, pre-painted steel, steel with metal coating, such as aluminium or aluminium-zinc compounds, and stainless steel may be used, provided a minimum corresponding base metal thickness and material strength is provided. Lock-forming grades of such material shall be used.

1.8 MATERIALS TESTING

Where insulation, facing materials and rigid ductwork material are required to be subjected to fire tests, all such testing shall be carried out by a registered testing authority in accordance with the NCC. Samples submitted for prototype testing shall be identical to manufactured product supplied under a fire test certificate. In order for supplied manufactured product to be identified with supplied test certificates, the certificates shall include the following minimum product data:

- Manufacturer’s name or registered trademark and product name.
- Thickness, R value, density of insulation and all flame retardants used.
- Nominal grammage (g/m^2) of facing or lining material and all flame retardants used.
- For facings and lining materials of a composite nature that are bonded together with fire-retardant adhesives, the adhesive type, all flame retardants used in the adhesive and the weight of adhesive applied (g/m^2).

Tested product shall comply with all of the test requirements of this Standard.

1.9 NEW DESIGNS AND INNOVATIONS

Any alternative materials, designs, methods of assembly, and procedures that do not comply with specific requirements of this Standard, or are not mentioned in it, would need to be assessed by the appropriate regulatory authority.

NOTE: Refer to NCC Volume 1, Section A2 for the approval process of New Designs and Innovations.

SECTION 2 DUCT CONSTRUCTION AND INSTALLATION

2.1 DUCTWORK

2.1.1 General

The construction and installation specifications in this Standard include the following:

- (a) Single prescription method requirements.
- (b) Alternatives.
- (c) Performance requirements for specific items that are independent of illustrations, stated as depicting items representative of a class of items too broad to be comprehensively illustrated.

If ductwork is required to have a fire resistance level (FRL), the ductwork and applied fire protection system shall be identical to a prototype that has been submitted to a fire resistance test in accordance with AS 1530.4, or satisfies the requirements of the NCC. This may require ductwork design to exceed the minimum requirements of this Standard.

All ductwork shall be installed allowing clearances for access when carrying out testing, commissioning and maintenance routines.

Where ducts penetrate walls that are required to have an FRL, walls shall be protected by fire dampers complying with AS 1682 series of Standards.

NOTE: During recent years, fire collars have been used to protect openings in riser shafts where ventilation ducts penetrate the fire-resistant shaft wall, in lieu of mechanical or intumescent fire dampers. Typically, the ducts are PVC pipes not greater than 200 mm in diameter and are used as bathroom exhaust, laundry exhaust, fume cabinet exhaust or outdoor air supply. Such arrangements are not acceptable under this Standard.

2.1.2 Rigid ductwork

Materials used for the construction of rigid ductwork shall comply with the following requirements:

- (a) The assembled duct system shall have a smoke development index not greater than '3' and spread of flame index not greater than '0' when separately tested in accordance with AS/NZS 1530.3.
- (b) The assembled duct system shall pass the UL 181 burning test.

2.1.3 Kitchen exhaust ductwork

Ductwork used in kitchen exhaust systems shall be constructed from galvanized sheet steel or stainless steel. An internal masonry finish shall not be permitted.

Vertical take-off ducts shall not be located directly over hood exhaust openings.

Liquid-tight cleanouts, easily accessible and large enough to enable access to clean the internal surfaces of the duct or plenum, shall be provided—

- (a) at each change in direction of ductwork;
- (b) at each duct junction;
- (c) in horizontal runs at intervals of not more than 3 m; and
- (d) at such other positions as may be specified.

Horizontal ducts shall be installed with a rise in the direction of airflow of at least 1 in 200.

Where required, flexible connections shall be of woven ceramic fibre with impervious smooth linings or similar non-collapsible grease-proof and fire-resistant material, and shall not exceed 300 mm in length.

2.2 DUCT SEALING

2.2.1 General

Where sealing is a requirement of this Standard, the following criteria apply to the sealing of ducts:

- (a) Adhesives, mastics, gaskets, or combinations thereof shall be used to close openings in the surface of the ductwork through which air leakage would otherwise occur.
- (b) Where welding is used for sealing, it shall be continuous.
- (c) All duct surface connections made on the perimeter of the duct (excepting helical lock seams) shall be deemed to be seams or joints. This includes, but is not limited to, seams, transverse joints, girth joints, branch and sub-branch intersections, fitting subsections, air terminal connections, access doors, access panel frames and joints, duct, plenum and casing abutments to building structures.
- (d) Sealing shall apply equally to positive and negative pressure modes.
- (e) Ducts that are located on the exterior of buildings shall be sealed prior to application of internal or external insulation, being insulated as though they were inside.
- (f) Ductwork that is located on the exterior of buildings and exposed to the elements shall be sealed against air leakage and water ingress with exterior grade duct sealant, and shall comply with the following:
 - (i) The top of the ductwork shall be cross-broken or installed to shed water, and all seams and connectors shall be sealed.
 - (ii) All connecting flanges shall have full width cleats or top hat sections, or equivalent.
 - (iii) All rivets shall be sealed.
 - (iv) All screws shall be sealed or include rubber grommets under the head.

Exterior duct sealant treatment shall consist of the supplemental application of a product or products marketed specifically as forming an airtight and watertight seal, bonding well to the metal involved, remaining watertight with metal movement and having a suitable service temperature range (−10°C to 78°C). If exposed to direct sunlight, it shall also be UV stable or, after curing, shall be painted with a compatible coating that provides resistance to ultraviolet light. Asphalt-based compounds shall not be used for sealing ducts.

- (g) Duct shall be sealed in accordance with Table 2.2.1.
- (h) Duct systems shall not be pressurized prior to the curing of sealant systems. The sealant manufacturer's recommendations for curing shall be followed.

NOTE: The sealing requirements within this Standard do not contain provisions for—

- (a) resistance to chemical attack;
- (b) dielectric isolation;
- (c) containment of atomic radiation or service in other safety-related construction;
- (d) electrical grounding;
- (e) maintaining leakage integrity at pressures in excess of the duct classification herein;
- (f) burial underground below the water table;
- (g) submersion in liquid;

- (h) withstanding continuous vibration visible to the naked eye;
- (i) total absence of leaking within an encapsulating vapour barrier;
- (j) creating closure in portions of the building structure used as ducts (e.g. ceiling plenums, shafts, pressurized compartments); and
- (k) withstanding temperatures outside the range of -10°C to 78°C , except for ducts mounted outside the building.

The following apply to sealing media:

- (i) *Mastics* Mastics (putty-like materials, the plasticity of which makes them suitable for sealing where they can be moulded to suit the conformation of the area to be sealed) shall be used in a joint where either the metal surfaces are lapped or the two surfaces are compressed.
- (ii) *Liquids* Liquid sealants shall be applied by brush or pump and shall be used only where they are held in the joint where either the metal surfaces are lapped or the two surfaces are compressed.
- (iii) *Gaskets*:
 - (A) *Closure seal* Gaskets shall be used to seal between two surfaces under compression that are to be released periodically. The material for the gasket shall be chosen so that its elastic memory and compressibility suit the degree and frequency of compression at the joint to be sealed.
 - (B) *Permanent seal*:
 - (1) Foam sealant tape gaskets may be used to seal between the two adjoining faces on rigid duct flanges. The foam sealant tape shall be made from a closed cell polyethylene foam with a minimum density of 30 kg/m^3 and be a minimum of 15 mm wide and 5 mm thick. The foam tape shall not have any surface coating on the non-adhesive side, which could crease and prevent an airtight seal. Care shall be taken when fitting gaskets to ensure corner leaks do not occur.
 - (2) Elastic butyl rubber strip may be used to seal between the two adjoining faces on rigid duct flanges.
 - (3) Silicone sealant gaskets may be used to seal between the two adjoining faces on rigid duct flanges.

All mastics and liquids shall be resistant to oil and water after curing, and shall maintain their elasticity and adhesive properties through the temperature range -10°C to 78°C .

NOTE: Where special considerations are required, as in the pharmaceutical industry, the designer should stipulate the type of sealant to be used.

TABLE 2.2.1
DUCT SEALING REQUIREMENTS

Seal class	Sealing required	Static pressure classification, Pa
A	All transverse joints, longitudinal seams and duct wall penetrations	≥ 1000
B	All transverse joints and longitudinal seams	501–999
C	Transverse joints and longitudinal seams for 50 mm from the end of each piece of duct.	≤ 500

2.2.2 Kitchen exhaust ductwork sealing

Ductwork used in relation to kitchen exhaust systems shall be sealed as follows:

Joints and seams shall be grooved or lapped and fully sealed by—

- (a) continuous weld;
- (b) rivet and solder; or
- (c) liquid sealant or mastic that is unaffected by grease, water or cleaning agents when held under compression between surfaces of joints and seams.

2.2.3 Surface preparation

Surfaces to receive sealant shall be adequately cleaned and shall be free from oil, dust, dirt, rust, moisture and other substances that could inhibit bonding.

2.2.4 Air leakage

All duct systems with a capacity of 3000 L/s or greater shall be tested for air leakage. Duct systems with a capacity of 3000 L/s or greater shall be tested for air leakage at a static pressure of a minimum of 1.25 times the calculated design operating pressure in the tested duct section. Leakage shall not exceed 5% of the design air quantity for the duct system.

Type testing of sections of each duct system shall be undertaken as construction progresses and shall be used to project likely air leakage of the overall system and to prove the effectiveness of the relevant section construction. A minimum of 10% of each duct system, longitudinal seams length and total circumferential joints length shall be tested, inclusive of floor distribution, riser and plant room duct, and of each seam, joint and sealing construction type (see Note 2).

Records shall be kept of each test result, inclusive of seam, circumferential joint and sealant type and length, calculated section operating pressure, test pressure and air leakage.

All duct construction shall meet the requirements of the Standard of the tested section type.

NOTES:

- 1 Leakage is a function of static pressure, of manufacturing, of sealing, and of installation techniques and occurs through longitudinal seams, transverse joints and at duct wall penetrations. The amount of leakage in a system is related to the clearances within the seam or joint and the effectiveness of sealant applied thereto. The greater the number of seams and joints in a duct section, the greater will be the leakage per unit face area, per unit length of duct or per unit of airflow through the duct.
- 2 The intent of testing is to ensure that leakage is within the required limit so that design airflows are assured to all air terminals and energy use and CO₂ emissions criteria are not prejudiced by air leakage (see Note 1).
- 3 Testing should be undertaken using procedures and test equipment outlined in the Heating and Ventilating Contractors Association publication DW/143, *A Practical Guide to Ductwork Leakage Testing*.
- 4 Airtightness in ducts cannot be absolute; however it has to be minimized within practical limits in order to meet the energy use and CO₂ emissions criteria imposed on buildings and to which air-conditioning systems have been designed.
- 5 Duct air leakage involves energy loss, and associated CO₂ emissions, through loss of thermal energy contained in the leaked air (essentially the outside component thereof, but also part or all of the supply air leaked, depending on the system application) and additional fan power to convey additional air to or from the air terminals and ensure design air quantity is delivered to or extracted from the space.
- 6 Designers, in assessing systems heat loads, energy use and CO₂ emissions, will need to include in their computations for the loss of thermal energy and increased fan power associated with duct air leakage.

2.3 RECTANGULAR DUCT REINFORCEMENT

2.3.1 General

The following apply to rectangular duct reinforcement:

- (a) Unless specified otherwise, rectangular ducts shall be constructed and reinforced in accordance with the following:
 - (i) Tables 2.3(A) to 2.3(G) for minimum duct metal thickness and minimum joint reinforcement.
 - (ii) Table 2.3(H) for types of joints and joint rating.
 - (iii) Table 2.3(I) for types of intermediate reinforcement and reinforcement ratings.
 - (iv) Figures 2.3(A) and 2.3(B) for longitudinal seams and seam locations.
 - (v) Figure 2.3(C) for tie rod details.
 - (vi) Figures 2.3(D) to 2.3(Q) for rectangular duct construction.

NOTES:

- 1 Joint reinforcements are classified as 'J' for joint with ratings of 1 to 12 (see Appendix B for EI values).
 - 2 Intermediate reinforcements are classified as 'I' for ratings of 1 to 12 (see Appendix B for EI values). For example, a section of duct 1500 mm wide × 1000 mm deep made in a length of 1500 mm with a specified static rating of 750 Pa would require—
 - (a) if constructed without intermediate reinforcement, a metal thickness of 1.6 mm and a minimum joint reinforcement with a rating of J8; or
 - (b) if constructed with intermediate reinforcement at 750 mm centres, a metal thickness of 0.6 mm with a joint rating of J7 and intermediate reinforcement with a rating of I7.
- (b) Unless specified otherwise, the requirements of, Tables 2.3(A) to 2.3(I) are based on using prime quality lock-forming galvanized steel, Grade G2 or G3 to AS 2338 with Z275 coating to AS 1397. Unless specified otherwise, uncoated steel, pre-painted steel, steel with metal coating such as aluminium or aluminium-zinc compounds and stainless steel may be used, provided the base metal thickness and sheet metal material strength are both equal to or greater than that of the specified material. Lock-forming grades of such material shall be used. The surface conditions, hardness, ductility, corrosion resistance and other characteristic features of such materials shall be judged acceptable for the service planned by the designer.
NOTE: The use of alternative materials requires independent specification or approval for structural adequacy.
 - (c) Unless specified otherwise, reinforcement components may be uncoated steel or galvanized steel.
 - (d) A reinforcement rating higher than indicated shall be substituted where Tables 2.3(A) to 2.3(I) do not provide the specific construction details for a lower classification. A higher-rated construction member may otherwise be substituted for convenience.
 - (e) Joint spacing on unreinforced ducts is unlimited. On ducts that require reinforcement, joint spacing is unrestricted, except that the joint itself shall qualify for the minimum rating associated with the reinforcement spacing.
 - (f) Fittings shall be reinforced similarly to sections of straight duct. On size change fittings, the greater fitting dimension determines the duct metal thickness and reinforcement. Where fitting curvature or internal member attachments provide equivalent rigidity, such features shall be credited as reinforcement.
 - (g) Duct wall thickness, joints, seams and reinforcements shall be related practicably to provide proper assembly.

2.3.2 Longitudinal seams (LSs) for rectangular ductwork

The following requirements apply to longitudinal seams (LSs) for rectangular ductwork [see Figure 2.3(A)]:

- (a) LSs shall be suitable for the material, pressure classification and other construction detail applicable for the service.
- (b) LSs shall be formed and assembled with proper dimension and proportion for tight and secure fit-up. Notching shall be minimal and consistent with transverse joint make-up needs.
- (c) LSs shall be lapped in order to allow sealant to set between two surfaces. Sealant shall be applied to all seams for at least 50 mm from the end of each piece of duct. Raw edges shall not be permitted unless fully welded.
- (d) LSs and joint corner notching shall be as illustrated in Figure 2.3(A).

NOTES:

- 1 Seams may be of butt-weld, corner-weld, tack-weld or spot-weld design. They may also be of spiral lock-seam type.
- 2 Pittsburgh seam (LS-1): Pocket depth varies from 6 mm to 15 mm depending on metal thickness and roll form equipment. The most common sizes are 6 mm and 10 mm. Used on straight duct and fittings.
- 3 Button punch snaplock (LS-2): 12 mm pocket depth is recommended for ducts where the metal thickness does not exceed 1.0 mm; it is not recommended for aluminium or other soft metal duct. The seam may be used for 750 Pa static or less; however, where the duct is over 1200 mm in width, screws or rivets have to be added at the ends of the seams on all ducts. Not recommended for pressures above 750 Pa, or for any ductwork in riser shafts.
- 4 Grooved seam (LS-3): Also known as pipelock, flat lock.
- 5 Double corner seam (LS-4): Machines are available to automatically close this seam. In some localities it is known as a slide lock seam.
- 6 Standing seam (LS-5): Unless otherwise required by the application, a 20 mm seam is normally used up to 1200 mm duct width, with 35 mm seams for larger ducts. May be used on interior of the duct with due consideration for velocity level. The seam is fastened together at ends and at 200 mm intervals.
- 7 Single corner seam (LS-6): The seam is fastened at ends and intervals.

2.3.3 Notching for longitudinal seams at transverse joints

For 'step-in' arrangement at transverse joint, notching shall be in accordance with Figure 2.3(B), Detail (a) or equivalent, which will allow overlap of two surfaces in both the 'step-in' and 'longitudinal corner' seam. The same notching principle shall apply for longitudinal or pittsburgh joints as shown in Figure 2.3(b).

The manufacturing process shall ensure the following:

- (a) For slide joints:
 - (i) Notching back on the female side of the longitudinal seam shall be limited to a maximum of 15 mm the end of the finished duct.
 - (ii) Notching back on the male side of the longitudinal seam shall be limited to a maximum of 3 mm from the end of the finished duct.
 - (iii) A consistent and even 12 mm fold-back all around the perimeter of the joint and the notching of the non-longitudinal joint corners shall be limited to 15 mm from the row edge or 2 mm from the finished end of the duct.

- (b) For transverse duct connector (TDC), transverse duct flange (TDF) or other machine-rolled joints:
 - (i) Notching of non-longitudinal joint corners shall be limited to depth of the factory-rolled flange plus 3 mm, or 3 mm from the finished end of the duct.
 - (ii) Notching back on the female side of the longitudinal seam shall be limited to a maximum of 20 mm from the end of the finished duct.
 - (iii) Notching back on the male side of the longitudinal seam shall be limited to a maximum of 3 mm from the end of the finished duct as shown in Figure 2.3(B), Detail (b).
- (c) For MSA flanges or propriety flanges joints:
 - (i) Notching of the non-longitudinal joint corners shall be limited to 3 mm from the finished end of the duct.
 - (ii) Notching back on the female side of the longitudinal seam shall be limited to a maximum of 15 mm from the end of the finished duct.
 - (iii) Notching back on the male side of the longitudinal seam shall be limited to a maximum of 3 mm from the end of the finished duct.

2.3.4 Tie rods (t)

Where required, tie rods shall be in accordance with the following [see Figure 2.3(C)]:

- (a) The areas of use shall be in accordance with Tables 2.3(A) to 2.3(G).
- (b) Tie rods shall be attached to one of the members of the transverse joints when proprietary made flanges or matching angle flanges are used, as shown in figure 2.3(C)(d).
- (c) When proprietary made flanges or matching angle flanges are not used, tie rods shall be attached to the wall of the duct at a position not exceeding 50 mm from the transverse joint. Backing plates or plate washers shall be used on both sides of the duct wall and the locking nuts or spacers as shown in Figure 2.3(C)(a), (b) and (c).

Flat bar spacers may be used in lieu of tie rods, as shown in Figure 2.3(C)(e).

TABLE 2.3(A)
METAL RECTANGULAR DUCT REINFORCEMENT—125 Pa STATIC
POSITIVE OR NEGATIVE PRESSURE

Minimum duct metal thickness/minimum reinforcement rating, mm Maximum spacing between joints or intermediate reinforcement, mm						
Duct dimensions, mm	3000	2400	1500	1200	750	600
0 to 250	0.6	—	—	—	—	—
251 to 350	0.6	—	—	—	—	—
351 to 450	0.6	—	—	—	—	—
451 to 600	0.6	—	—	—	—	—
601 to 750	0.6 J1	—	—	—	—	—
751 to 900	0.8 J2	0.6 J2	—	—	—	—
901 to 1050	1.0 J3	0.6 J3	0.6 J3	0.6 J3	—	—
1051 to 1200	1.0 J5	0.8 J4	0.6 J4	—	—	—
1201 to 1350	1.2 J5	1.0 J5	0.6 J4	—	—	—
1351 to 1500	1.2 J7	1.0 J6	0.6 J5	0.6 J5	—	—
1501 to 1800	1.6 J8	1.2 J7	0.8 J6	0.6 J6	—	—
1801 to 2100	—	1.6 J8	0.8 J8	0.6 J7	—	—
2101 to 2400	—	1.6 J9 or J6+t	1.0 J8 or J6+t	0.8 J8 or J6+t	—	—
2401 to 3000	—	—	1.2 J8+t	1.2 J8+t	—	—

NOTE: 't' denotes tie rod at centre of transverse joint or intermediate reinforcement at a maximum of 1200 mm centres, whichever is the smaller.

TABLE 2.3(B)
METAL RECTANGULAR DUCT REINFORCEMENT—250 Pa STATIC POSITIVE
OR NEGATIVE PRESSURE

Minimum duct metal thickness/minimum reinforcement rating, mm Maximum spacing between joints or intermediate reinforcement, mm						
Duct dimensions, mm	3000	2400	1500	1200	750	600
0 to 250	0.6 J1	—	—	—	—	—
251 to 350	0.6 J1	—	—	—	—	—
351 to 450	0.6 J1	—	—	—	—	—
451 to 600	0.6 J1	0.6 J1	0.6 J1	—	—	—
601 to 750	0.6 J3	0.6 J3	0.6 J2	—	—	—
751 to 900	0.8 J4	0.6 J4	0.6 J3	—	—	—
901 to 1050	1.0 J5	0.6 J4	0.6 J4	—	—	—
1051 to 1200	1.0 J6	0.8 J5	0.6 J5	0.6 J4	—	—
1201 to 1350	1.2 J7	1.0 J6	0.8 J5	0.6 J5	—	—
1351 to 1500	—	1.0 J7	0.8 J6	0.6 J6	—	—
1501 to 1800	—	—	1.0 J8 or J6+t	0.8 J7 or J6+t	0.6 J7 or J6+t	—
1801 to 2100	—	—	1.2 J9 or J6+t	1.0 J8 or J6+t	1.0 J8 or J6+t	0.8 J8 or J6+t
2101 to 2400	—	—	1.6 J10	1.2 J9	1.0 J9	0.8 J9
2401 to 3000	—	—	—	—	1.2 J10 or J8+t	1.2 J10 or J8+t

NOTE: 't' denotes tie rod at centre of transverse joint or intermediate reinforcement at a maximum of 1200 mm centres, whichever is the smaller.

TABLE 2.3(C)
METAL RECTANGULAR DUCT REINFORCEMENT—500 Pa STATIC POSITIVE
OR NEGATIVE PRESSURE

Minimum duct metal thickness/minimum reinforcement rating, mm; Maximum spacing between joints or intermediate reinforcement, mm						
Duct dimensions, mm	3000	2400	1500	1200	750	600
0 to 250	0.6 J1	—	—	—	—	—
251 to 350	0.6 J1	—	—	—	—	—
351 to 450	0.8 J1	0.6 J1	—	—	—	—
451 to 600	1.0 J3	0.8 J3	0.6 J2	—	—	—
601 to 750	1.0 J3	0.8 J3	0.6 J2	—	—	—
751 to 900	1.2 J4	1.0 J4	0.8 J4	0.6 J3	—	—
901 to 1050	—	1.2 J5	0.8 J5	0.6 J4	—	—
1051 to 1200	—	1.6 J7	0.8 J6	0.8 J5	—	—
1201 to 1350	—	—	1.0 J7	1.0 J6	—	—
1351 to 1500	—	—	1.2 J8	1.0 J7	0.6 J7	—
1501 to 1800	—	—	1.6 J9 or J6+t	1.2 J8 or J6+t	0.8 J8 or J6+t	0.6 J8
1801 to 2100	—	—	—	1.2 J10 or J6+t	1.0 J9 or J6+t	0.8 J9 or J6+t
2101 to 2400	—	—	—	1.6 J11 or J7+t	1.0 J10 or J7+t	1.0 J10 or J7+t
2401 to 3000	—	—	—	—	1.2 J8+t	1.2 J8+t

NOTE: 't' denotes tie rod at centre of transverse joint or intermediate reinforcement at a maximum of 1200 mm centres, whichever is the smaller.

TABLE 2.3(D)
METAL RECTANGULAR DUCT REINFORCEMENT—750 Pa STATIC POSITIVE
OR NEGATIVE PRESSURE

Minimum duct metal thickness/minimum reinforcement rating, mm Maximum spacing between joints or intermediate reinforcement, mm						
Duct dimensions, mm	3000	2400	1500	1200	750	600
0 to 250	0.8 J1	0.6 J1	—	—	—	—
251 to 350	1.0 J2	0.8 J1	0.6 J1	—	—	—
351 to 450	1.2 J2	0.8 J1	0.6 J1	—	—	—
451 to 600	1.2 J3	1.0 J3	0.6 J2	0.6 J2	—	—
601 to 750	1.2 J4	1.2 J4	0.6 J3	0.6 J3	—	—
751 to 900	—	1.6 J5	1.0 J5	0.6 J4	—	—
901 to 1050	—	—	1.0 J5	0.8 J5	0.6 J5	—
1051 to 1200	—	—	1.2 J7	1.0 J6	0.6 J5	—
1201 to 1350	—	—	1.2 J8 or J6+t	1.2 J8 or J6+t	0.6 J5 or J6+t	—
1351 to 1500	—	—	1.6 J8 or J6+t	1.2 J8 or J6+t	0.6 J7 or J6+t	—
1501 to 1800	—	—	—	1.6 J9 or J6+t	0.8 J8 or J6+t	0.6 J8 or J6+t
1801 to 2100	—	—	—	—	1.0 J10 or J6+t	0.8 J9 or J6+t
2101 to 2400	—	—	1.6 J8	1.6 J8	1.2 J11 or J7+t	1.0 J10 or J7+t
2401 to 3000	—	—	—	—	1.2 J8+t	1.2 J8+t

NOTE: 't' denotes tie rod at centre of transverse joint or intermediate reinforcement at a maximum of 1200 mm centres, whichever is the smaller.

TABLE 2.3(E)
METAL RECTANGULAR DUCT REINFORCEMENT—1000 Pa STATIC POSITIVE
OR NEGATIVE PRESSURE

Minimum duct metal thickness/minimum reinforcement rating, mm; Maximum spacing between joints or intermediate reinforcement, mm						
Duct dimensions, mm	3000	2400	1500	1200	750	600
0 to 250	0.6 J1	—	—	—	—	—
251 to 350	0.8 J2	—	0.6 J1	—	—	—
351 to 450	1.0 J2	1.0 J2	0.6 J1	—	—	—
451 to 600	1.2 J3	1.0 J3	0.6 J2	—	—	—
601 to 750	1.6 J4	1.2 J5	0.8 J3	0.6 J3	—	—
751 to 900	—	—	1.0 J5	0.8 J5	—	—
901 to 1050	—	—	1.2 J6	1.0 J6	0.6 J5	—
1051 to 1200	—	—	1.2 J7	1.2 J7	0.8 J6	0.6 J5
1201 to 1350	—	—	1.6 J8	1.2 J8	0.8 J7	0.6 J6
1351 to 1500	—	—	1.6 J9 or J6+t	1.6 J9 or J6+t	0.8 J8 or J6+t	0.6 J7 or J6+t
1501 to 1800	—	—	—	—	1.0 J9 or J6+t	0.8 J8 or J6+t
1801 to 2100	—	—	—	—	1.2 J10 or J6+t	1.0 J10 or J6+t
2101 to 2400	—	—	—	—	1.6 J12 or Jt+t	1.0 J11 or J7+t
2401 to 3000	—	—	—	—	1.6 J8+t	1.2 J8+t

NOTE: 't' denotes tie rod at centre of transverse joint or intermediate reinforcement at a maximum of 1200 mm centres, whichever is the smaller.

TABLE 2.3(F)
METAL RECTANGULAR DUCT REINFORCEMENT—1500 Pa STATIC POSITIVE
OR NEGATIVE PRESSURE

Minimum duct metal thickness/minimum reinforcement rating, mm Maximum spacing between joints or intermediate reinforcement, mm						
Duct dimensions, mm	3000	2400	1500	1200	750	600
0 to 250	0.8 J1	0.8 J1	0.6 J1	—	—	—
251 to 350	1.0 J1	1.0 J1	0.8 J1	0.6 J1	—	—
351 to 450	1.2 J3	1.2 J3	0.8 J2	—	—	—
451 to 600	—	1.2 J4	0.8 J3	0.6 J3	0.6	—
601 to 750	—	1.6 J5	1.0 J3	0.8 J4	0.6 J3	—
751 to 900	—	—	1.2 J6	1.0 J4	0.6 J3	—
901 to 1050	—	—	1.6 J7	1.2 J7	0.8 J4	—
1051 to 1200	—	—	—	1.2 J8	0.8 J4	—
1201 to 1350	—	—	—	1.6 J8 or J6+t	1.0 J7	0.8 J7 or J6+t
1351 to 1500	—	—	—	—	1.0 J8 or J6+t	0.8 J8 or J6+t
1501 to 1800	—	—	—	—	1.2 J8 or J6+t	1.0 J9
1801 to 2100	—	—	—	—	1.2 J10	1.2 J11 or J7+t
2101 to 2400	—	—	—	—	J12 or J7+t	1.2 J12 or J7+t
2401 to 3000	—	—	—	—	—	1.2 J8+t

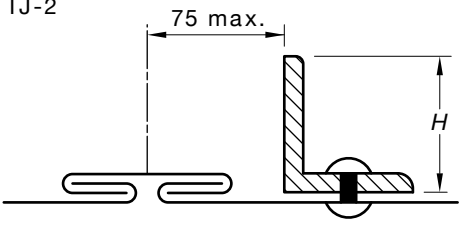
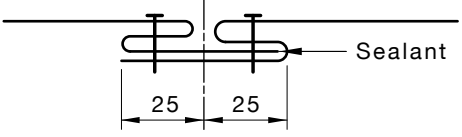
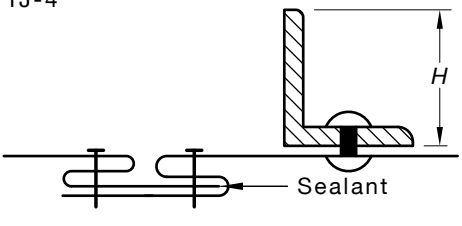
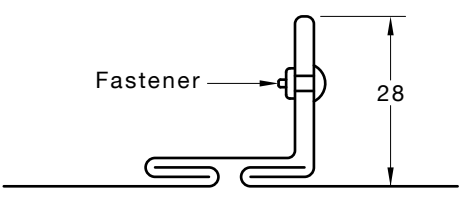
NOTE: 't' denotes tie rod at centre of transverse joint or intermediate reinforcement at a maximum of 1200 mm centres, whichever is the smaller.

TABLE 2.3(G)
METAL RECTANGULAR DUCT REINFORCEMENT—2500 Pa STATIC POSITIVE
OR NEGATIVE PRESSURE

Minimum duct metal thickness/minimum reinforcement rating, mm; Maximum spacing between joints or intermediate reinforcement, mm						
Duct dimensions, mm	3000	2400	1500	1200	750	600
0 to 250	1.0 J1	1.0 J1	0.6 J1	—	—	—
251 to 350	1.2 J2	1.2 J1	0.8 J2	0.8 J2	0.6 J1	—
351 to 450	—	1.6 J3	1.0 J3	0.8 J2	0.6 J2	—
451 to 600	—	—	1.2 J4	1.0 J4	0.6 J3	—
601 to 750	—	—	1.6 J4	1.2 J4	0.6 J3	—
751 to 900	—	—	1.6 J6	1.2 J6	0.8 J5	0.6 J4
901 to 1050	—	—	—	1.6 J8	1.0 J7	0.8 J6
1051 to 1200	—	—	—	—	1.2 J8	0.8 J7
1201 to 1350	—	—	—	—	1.2 J8 or J6+t	1.0 J*
1351 to 1500	—	—	—	—	1.2 J9 or J7+t	1.0 J9 or J6+t
1501 to 1800	—	—	—	—	1.6 J11 or J7+t	1.2 J11 or J7+t
1801 to 2100	—	—	—	—	—	1.6 J8+t
2101 to 2400	—	—	—	—	—	1.6 J8+t
2401 to 3000	—	—	—	—	—	1.6 J8+t

NOTE: 't' denotes tie rod at centre of transverse joint or intermediate reinforcement at a maximum of 1200 mm centres, whichever is the smaller.

TABLE 2.3(H)
RECTANGULAR DUCT TRANSVERSE JOINT TYPES AND RATINGS (J)

Description	Size, mm	Rating	Method
TJ-1  Drive slip (DS)	0.8	J1	TJ-1 drive slip (DS) minimum metal thickness 0.8 mm. Use duct sealant throughout. Not recommended for pressures above 1000 Pa.
TJ-2  Angle-reinforced drive slip (ARDC)	25 × 25 × 3	J4	TJ-2 angle-reinforced drive slip (ARDS), minimum metal thickness 0.8 mm.
	40 × 40 × 3	J6	
	40 × 40 × 5	J7	Use duct sealant throughout.
	50 × 50 × 3	J8	Use fasteners or spot-weld at 150 mm centres to attach reinforcement to duct wall.
	50 × 50 × 5	J9	
	50 × 50 × 6	J10	Not to be used for pressures above 750 Pa.
	65 × 65 × 6	J11	
TJ-3  Streamline joint (STJ)	0.6 + 0.8	J1	TJ-3 stream line joint (STJ).
	1.0	J2	May be used where a smooth external finish is required. Use duct sealant throughout. Use fasteners at 200 mm centres. Not to be used for pressures above 750 Pa.
TJ-4  Angle-reinforced streamline joint (ARSTJ)	25 × 25 × 3	J4	TJ-4 angle-reinforced streamline joint (ARSTJ).
	40 × 40 × 3	J6	
	40 × 40 × 5	J7	Use duct sealant throughout.
	50 × 50 × 3	J8	Use fasteners at 200 mm centres on joint and fasteners, or spot-weld at 150 mm centres to attach reinforcement to duct wall.
	50 × 50 × 5	J9	
TJ-5  Standing drive slip (SDS)	50 × 50 × 6	J10	Not to be used for pressures above 750 Pa. Angle dimensions to AS/NZS 3679.1.
	0.6	J2	TJ-5 standing drive slip (SDS) minimum metal thickness 0.8 mm.
	0.8	J3	Use fasteners at 300 mm centres and 50 mm from corners. Use duct sealant throughout. Not to be used for pressures above 750 Pa.

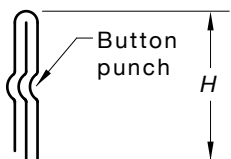
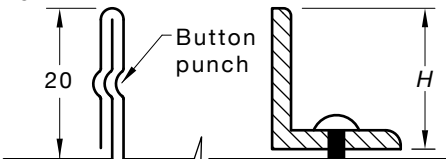
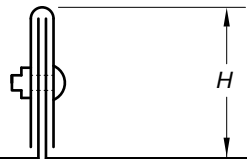
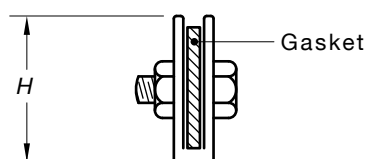
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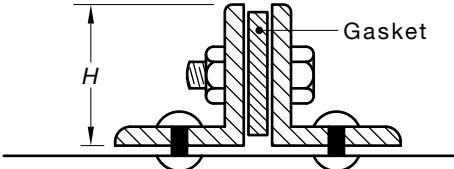
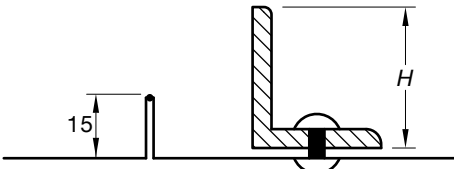
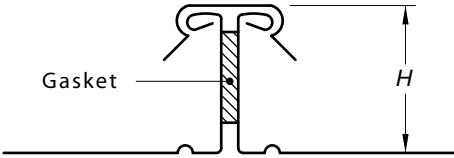
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TABLE 2.3(H) (continued)

Description	Size, mm	Rating	Method
TJ-6  Standing seam (SS)	20 × 0.6	J2	TJ-6 standing seam (SS).
	25 × 0.6	J3	
	25 × 1.0	J4	Use button punch or fastener at 200 mm centres and 50 mm from each corner.
	35 × 1.0	J6	
	35 × 1.0	J6	Use duct sealant throughout.
	35 × 1.2	J7	
TJ-7  Angle-reinforced standing seam (ARSS)	25 × 25 × 3	J5	TJ-7 angle-reinforced standing seam (ARSS).
	40 × 40 × 3	J7	
	50 × 50 × 3	J8	Use button punch or fasteners at 200 mm centres and 50 mm from each corner.
	50 × 50 × 5 + t	J10	Use fasteners or spot-weld to attach reinforcements to duct wall. Use duct sealant throughout. Angle dimensions to AS/NZS 3679.1.
TJ-8  Standing capped flange (SCF)	25 × 0.6	J3	TJ-8 standing capped flange (SCF).
	35 × 0.6	J5	Use fasteners at 200 mm centres and 50 mm from each corner.
	35 × 1.0	J6	Align interior duct surfaces, overlap and seal corners. Use duct sealant throughout. Minimum metal thickness of cap 0.8 mm
TJ-9  Integrated standing flange (SF)	25 × 0.6	J3	TJ-9 integrated standing flange (SF). Use metal corners to complete full flange joint.
	25 × 0.8	J4	
	35 × 0.8	J6	Use 6 mm dia. bolts for pressures up to 750 Pa and 8 mm dia bolts for pressures above 750 Pa at 200 mm centres and 50 mm from each corner.
	35 × 1.2	J7	
	50 × 1.2	J8	
	50 × 1.6	J9	

(continued)

TABLE 2.3(H) (continued)

Description	Size, mm	Rating	Method
 Companion angle flange (AF)	25 × 25 × 3	J5	TJ-10 companion angle flanges (AF) hot-rolled angle flanges, galvanized or primed prior to attaching to duct wall.
	30 × 30 × 3	J7	
	40 × 40 × 3	J8	Use fasteners or spot-weld at 150 mm centres to attach flanges to duct.
	40 × 40 × 5	J9	
	40 × 40 × 6	J10	Use 15 mm min. width gasket between flanges.
	50 × 50 × 5	J11	
	50 × 50 × 6	J12	Use 8 mm dia. bolts for pressures up to 1000 Pa and 10 mm dia. bolts for pressures above 1000 Pa. at 150 mm centres and at each corner. Angle dimensions to AS/NZS 3679.1
 Welded flange (WF)	15 × 0.8	J1	TJ-11 welded flange (WF).
	20 × 0.8	J2	All 15 mm flanges shall be fully welded.
	25 × 0.8	J3	
	25 × 1.2	J4	All flanges 20 mm and above may be riveted, screwed, spot-welded or tack-welded at 100 mm centres
	32 × 1.2	J5	
 Angle-reinforced welded flange (ARWF)	25 × 25 × 3	J6	TJ-12 angle-reinforced welded flange (ARWF).
	40 × 40 × 3	J7	
	40 × 40 × 5	J8	All 15 mm flanges shall be fully welded.
	50 × 50 × 3	J9	All flanges 20 mm and above may be riveted, screwed, spot-welded or tack-welded at 100 mm centres.
	50 × 50 × 5	J10	
	65 × 65 × 5	J12	Use fasteners or spot-weld at 150 mm centres to attach reinforcement to duct wall. Angle dimensions to AS/NZS 3679.1
 Integrated machine-rolled flange (IMRF)	25 × 0.6 duct	J4	TJ-13 integrated machine-rolled flange (IMRF), machine-rolled mating flanges at the end of duct. Use 15 mm min. width gasket.
	35 × 0.6 duct	J6	
	25 × 0.8 duct	J5	
	35 × 0.8 duct	J6	Use special corners and 6 mm dia. corner bolts.
	35 × 1.0 duct	J7	Use joining clips at 150 mm from each end and at 300 mm centres, complying with machine-manufactured EI values.
	35 × 1.2 duct	J8	

(continued)