

LYSAGHT

REFEREE

30TH EDITION

A Handbook of Useful Information



The LYSAGHT logo is rendered in a bold, blue, sans-serif typeface. A white five-pointed star is positioned centrally within the letter 'A'. The entire logo is underlined with a thick blue horizontal bar.

Referee

30TH EDITION

PRODUCED BY:

**BHP****BHP Building Products**

on behalf of BHP Steel –

A business group of The Broken Hill Proprietary Company
Limited and Subsidiary Companies.

As a general reference handbook it is not possible to list contact addresses of all contributors and/or suppliers of products and services.

Information on many of the listed steel products is available from distributors of BHP Steel, located throughout Australia.

Product or contact information is also available from BHP Steel's Customer Support Centre, Port Kembla, using the "BHP Steel Direct" Freecall numbers:

Tel: 1800 800 789

Fax: 1800 800 744

This edition of the Referee Handbook is available on CD ROM.

Call BHP Steel Direct for details

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Produced by John L Methven

F O R E W O R D

The REFEREE first published in 1897 was known as “The Metal Trades Referee and Storekeepers Guide” when a large part of the output of John Lysaght English rolling mills was destined for Australia.

In 1920 as Lysaghts Newcastle plant was nearing completion the 11th EDITION became the LYSAGHT REFEREE to coincide with the first production in Australia of “Galvanized Corrugated Iron” in 1921 a term still affectionately given to the original Red Orb. Since 1988 BHP Steel has been proud to continue the publication of this book which covers a much wider range of products including flat steel sheet, rail track product, building products, structural and hollow sections, coated, painted and roll formed steel, wire and reinforcing products, and steel tubing.

This 30th EDITION has specific emphasis on the relationship of metallic and prepainted steel produced by BHP Coated Steel Australia and the range of LYSAGHT building products produced by BHP Building Products and utilised throughout the building and construction industry.

This publication also marks the production of the 10 millionth tonne of ZINCALUME® steel in Australia by BHP Coated Steel Australia and the revival of the LYSAGHT brand to the BHP Building Products range and thus it will revert to being called THE LYSAGHT REFEREE.

The strength of this publication has been its range of content. It has become a valuable source of much varied information for builders, plumbers, business people, farmers, handy persons, specifiers (viz. architects and engineers) and university and college students.

Some information in this edition has been provided by outside sources and recognised authorities. While great care has been taken to ensure accuracy, no responsibility can be accepted for any errors which may have escaped the attention of the editors.

We hope you will find this edition as useful as generations before you.

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INTRODUCTION TO BHP STEEL

BHP The Company

BHP (Broken Hill Proprietary Company Limited) is an international natural resources company which originated in 1885.

Today, BHP is a public company with more than 311,000 shareholders operating in more than 50 countries.

BHP is divided into four business groups: BHP Steel, BHP Minerals, BHP Petroleum and BHP Services. The latter consists of a number of companies including BHP Transport, BHP Engineering, BHP Insurance and BHP Information Technology.

BHP Steel

BHP Steel is an international manufacturer and distributor of quality steel products producing 9.2 million tonnes of raw steel a year.

Products include a wide range of flat and sheet steel, rail and rail track products, structural and hollow sections, building products, coated, painted and roll-formed steel building and industrial products, wire and reinforcing products and precision steel tubing and pipeline systems.

As a world leader in the development of coated and painted steels for the construction industry, BHP Steel also supports and promotes Australian customers through the “Strengthening Australia” campaign.

How BHP Steel is Organised

BHP Steel operates manufacturing facilities and distribution centres across Australia and around the Pacific Rim.

These businesses include integrated steelworks in Port Kembla (NSW), Whyalla (SA) and Glenbrook (New Zealand), and an electric arc furnace (EAF) steel mill in Sydney (NSW).

BHP Steel is made up of four business units:-

- Flat Products
- Coated Products
- Long Products
- Building & Industrial Products

The following general information outlines BHP Steel businesses, locations and basic product range. Refer to later sections for a detailed outline and technical aspects of products.

BHP Steel Business Units

BHP Flat Products

BHP Flat Products produces a wide range of finished and semi-finished flat steel products from its integrated steelworks for domestic and international customers. Most output is further processed to high value-added products by other BHP Steel businesses.

The BHP Flat Products operations are:-

- Port Kembla Steelworks, New South Wales, Australia
- Packaging Products, New South Wales, Australia
- Thin Strip Casting Plant, New South Wales, Australia
- North Star BHP Steel, Ohio, USA.

BHP Coated Products

BHP Coated Products operations are located across Australia, New Zealand, the USA and throughout Asia. They produce BHP's premium brand pre-painted steel and metallic coated finishes (including COLORBOND® steel and ZINCALUME® steel), and hot and cold rolled sheet and coil.

The BHP Coated Products operations are:-

- Coated Steel Australia
- Coated Steel Asia
- Coated Steel USA
- BHP New Zealand Steel
- Steel Export & BIEC.

BHP Long Products

BHP Long Products produces a wide range of long steel products primarily for the Australian domestic market.

The BHP Long Products operations are:-

- Whyalla Operations, South Australia, Australia
- Rod & Bar Mills
- Sydney Steel Mill, New South Wales, Australia
- Wire Products
- Reinforcing Products.

BHP Building & Industrial Products

BHP Building & Industrial Products operate a diverse range of downstream value-added businesses. With a large steel distribution network, it provides BHP Steel's direct link to consumer markets across Australia and the Pacific rim.

The BHP Building & Industrial Products operations are:-

- Tubemakers Merchandising
- Building Products –
 - Australia
 - Asia
 - Pacific
 - USA
- Structural & Pipeline Products.

HISTORY OF STEEL

Major events in BHP's steelmaking history

- 1848 First iron produced in Australia at an ironworks established at Mittagong.
- 1899 BHP acquires iron ore leases at Iron Knob and Iron Monarch, SA.
- 1900 Australia's first steel produced at Lithgow, NSW.
- 1915 BHP opened the Newcastle iron and steelworks.
- 1921 First corrugated sheet produced at Lysaght, Newcastle.
- 1928 The Hoskins family formed the Australian Iron and Steel Pty Ltd (AIS) and began ironmaking at Port Kembla, NSW.
- 1935 BHP acquires AIS, Port Kembla.
- 1939 War effort – steel used in Australia's first warplane – "Wirraway".
- 1941 A Blast Furnace and Shipyards begin operations in Whyalla, SA.
- 1955 First Continuous Galvanising Line introduced at Lysaght, Port Kembla Works.
- 1962 Basic Oxygen steelmaking introduced at Newcastle, NSW.
- 1965 Opening of steelworks at Whyalla, SA.
- 1966 Prepainted Steel Coil introduced in Australia at Port Kembla Works.
- 1976 First ZINCALUME steel line commissioned at Port Kembla Steelworks.
- 1978 Continuous Slab Caster commissioned at Port Kembla, NSW.

HISTORY OF STEEL

- 1979 BHP fully acquired John Lysaght (Australia) Limited with the purchase of Guest Keen and Nettlefold's Share.
- 1983 Federal Government and BHP Steel announce Steel Plan to revitalise the industry.
- 1986 BHP commits \$1.8 billion over next two years in a massive upgrade of the steelworks as part of the Steel Plan.
- 1987 First continuous bloom caster is commissioned at Newcastle, NSW.
- 1989 New Steel Industry Development Program; acquisition of BHP New Zealand Steel.
- 1990 Opening of Iron Duke iron ore mine, Middleback Ranges, SA.
- 1992 Continuous slab and bloom caster commissioned at Whyalla; BHP Sydney Steel Mill opens; No 6 metallic coating line commissioned at Western Port.
- 1993 \$26 million paintline for making of COLORBOND® steel commissioned in Brisbane.
- 1994 Rolling mill commissioned at Sydney Steel Mill; paintline commissioned in Indonesia; roll formers commissioned in Oregon, USA and Malaysia.
- 1995 Metallic coating facility in California, USA commissioned; rollformer opened in Shanghai and Guangzhou, China.
- 1996 Acquisition of Tubemakers of Australia.

UNDERSTANDING STEEL

What is Steel?

Have you ever tried to imagine your world without steel? It's the metal that provides you with cars, bridges, trains and buses for transport; house frames, roofs and fences for protection; sporting equipment and venues for leisure, and electrical appliances and furniture for comfort and convenience.

Steel is a general term for iron containing small amounts of carbon, manganese and other elements.

Steel is used to make such a wide range of products because it possesses many useful features which can be controlled and slightly changed to suit a particular purpose.

Ironmaking

In traditional blast furnace technology, iron is extracted from iron ore at high temperatures in a reduction process. Coke and fluxes are the other materials required in this process.

Steelmaking

There are two ways of making steel at BHP. The traditional method is called Basic Oxygen Steelmaking; the newer method is called Electric Arc Furnace Steelmaking.

Basic oxygen steelmaking

A Basic Oxygen Steelmaking (BOS) vessel holds about 280 tonnes of steel. Molten iron and scrap are charged into the vessel. Almost pure oxygen is blown into the vessel, causing the temperature to rise and carbon content to be lowered. The resulting product is molten steel.

Electric arc furnace steelmaking

An Electric Arc Furnace (EAF) is used to produce new steel from scrap metal or other iron feed such as HBI (Hot Briquetted Iron). Electrodes produce arcs of electricity to the charge, which melt the iron and reduce it to molten steel.

Casting

Liquid steel is cast continuously into lengths so it can be rolled into a variety of shapes and sizes.

Rolling

Cast steel is a relatively weak mass of coarse, uneven metal crystals, or 'grains'. Rolling causes this coarse grain structure to recrystallize into a much finer grain structure, giving greater toughness, shock resistance and tensile (stress) strength.

Rolling is the main method used to shape steel into different products. There are two types of rolling – hot and cold.

The rolling process (for both hot and cold) consists of passing the steel between two rolls revolving at the same speed but in opposite directions. The gap between the rolls is smaller than the steel being rolled, so that the steel is reduced in thickness and at the same time lengthened.

Coating and Painting

Some cold-rolled products are coated with other metals or paint to protect the steel surface, or to give the steel special characteristics.

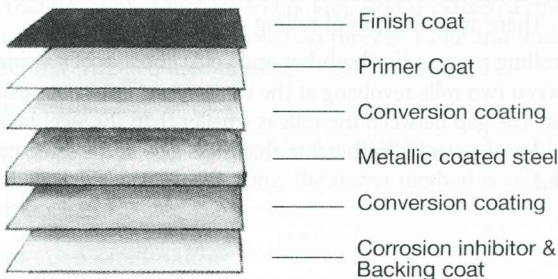
ZINCALUME steel is steel strip with a coating of 45% zinc and 55% aluminium. The coating makes the steel more corrosion resistant.

The process involves cleaning, annealing and then coating the strip. Annealing is a general term which describes processes that clean and soften the steel and prepare it for further machining.

The strip enters a coating bath that contains the heated zinc/aluminium mixture. The strip then passes by control jets that control the amount of metal coating on the steel by blowing any excess off the strip.

COLORBOND prepainted steel is normally metallic coated steel which is painted.

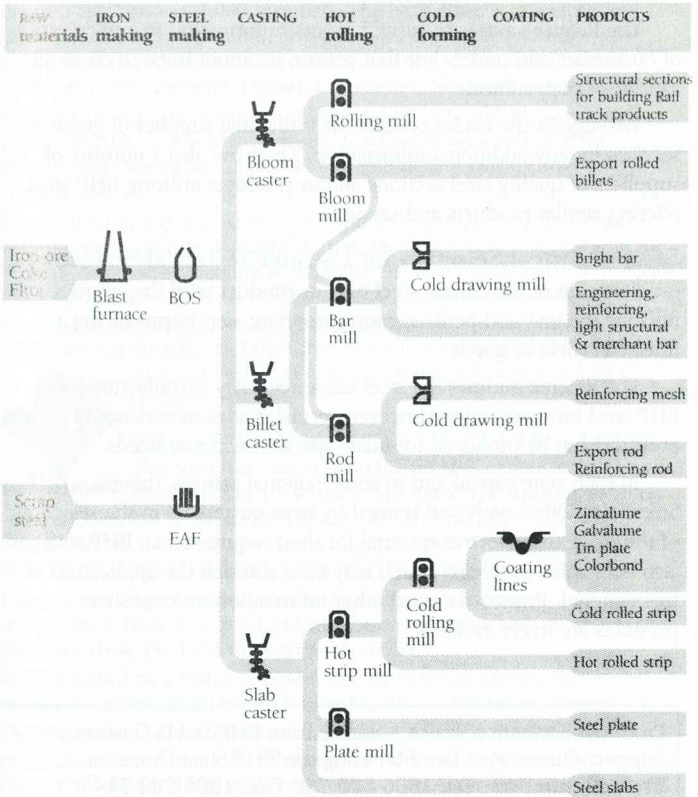
The steel strip is cleaned and a conversion coating applied to ensure good paint adhesion.



BHP Steel publish a number of publications including UNDERSTANDING STEEL. This section is an abridged version of this booklet. For further information please write to:-

BHP STEEL
Public Affairs Department
PO Box 86A Melbourne, VIC 3000.

The pathway from raw material to finished steel product is a complex one. This chart shows the main steps involved in the process.



CUSTOMER SUPPORT

The many contributors to this handbook, including government authorities and associations, offer information and support services. Where possible, we have identified the source.

The Referee's aim is to supply general information to a wide range of businesses and trades. For that reason, it cannot hope to cover all aspects of each subject.

We suggest the reader contact the individual supplier of goods or services for any additional information. There are also a number of suppliers of quality steel sections and/or products utilising BHP Steel offering similar products and services.

Steel – Correct Selection for Use and Technical Services

Selection of the correct steel type or product with the appropriate finish is the first and perhaps most important step in producing a finished article or goods.

The Referee outlines the steel range regularly manufactured by BHP steel business units. However, special grades or varieties of regular products can be produced to satisfy specific customer needs.

In each state capital and in some regional centres, there is a BHP Steel Sales Office with staff trained to assist customers in the selection of the most cost effective material for their requirements. BHP staff can also help solve problems which may arise through the application of this material. Printed data and other information on steel sheet products are freely available.

Product information is also available from BHP Steel's Customer Support Centre, Port Kembla, using the 'BHP Steel Direct'
Freecall numbers: Tel: 1800 800 789 Fax: 1800 800 744



AUSTRALIAN INSTITUTE OF STEEL CONSTRUCTION

AISC is Australia's premier technical information and marketing organisation, representing companies and individuals involved in steel manufacture, fabrication, design and construction. It was established in 1962 and has over 4,000 members. The head office is in Sydney, and there are offices in Melbourne, Brisbane and Perth. State and Regional committees co-ordinate local activities in Sydney, Melbourne, Brisbane, Adelaide, Perth, Canberra, Hobart, Launceston, Newcastle and Wollongong. By developing a close relationship between industry and tertiary education providers, AISC works to increase the practical understanding of the efficient and innovative use of steel for building and engineering construction.

In addition to co-sponsorship of the annual Australian Steel Convention with the Steel Institute of Australia, AISC maintains close contacts with the Welding Technology Institute of Australia, the National Association of Steel-framed Housing, Standards Australia, the Australia Steel Detailing Association, the Institution of Engineers (Australia), the Galvanizers' Association of Australia and the Royal Australian Institute of Architects.

AISC staff serve on various Standards Australia technical committees.



STEEL INSTITUTE

THE STEEL INSTITUTE OF AUSTRALIA INC

The Steel Institute of Australia Inc was established as a trade association in 1970, under the name The Institute of Steel Service Centres of Australia Inc (ISSCA). Its aim was to provide a vehicle through which the many companies engaged in the Steel Service Centre industry in Australia could work towards common goals.

The Institute's members include the Australian manufacturers and converters of basic steel products and the companies which process and/or distribute these products throughout Australia.

It is controlled by a National Board, elected from the Service Centre members, and managed by a full-time Executive Director in Sydney. The Steel Institute of Australia's fundamental role is to promote the products and services of its members, with the end objective of increasing the overall demand for, and consumption of, Australian steel products.

STRENGTHENING AUSTRALIA'S FUTURE

The "Strengthening Australia" campaign is a free marketing support initiative developed by BHP Steel to help steel users market and sell their products.

The campaign's aim is to promote quality Australian-made steel products.

Companies participating in the campaign are given a choice of stickers, tags or labels personalised with their company message. There's also a great range of metal signs for company gates and trucks, so you'll always have the means to promote yourself effectively. Plus there's the credibility and reputation of the BHP name right next to yours. Currently over 8,000 companies are participating in the campaign.

Steel Hotline Magazine is the flagship of the Strengthening Australia campaign. It is a free publication that promotes and encourages excellence in the manufacturing industry. Published throughout the year, it has a national readership of 22,000, including steel users, distributors of BHP Steel, government and business leaders.

For further information contact:-

BHP Steel Direct

FREECALL numbers

Telephone 1800 800 789

Facsimile 1800 800 744



BHP STEEL DIVISIONS AND LOCATIONS

Flat Products Division

The flat products division is headquartered at Port Kembla and produces a range of hot rolled slabs, plates, strip and packaging products – tinplate and strapping.

Facilities include:

- Port Kembla Steelworks, NSW
- North Star BHP Steel Ohio, USA
- Packaging Products, NSW
- Strip Casting, NSW

Division Head Office

Five Islands Road, Port Kembla, NSW 2505

PO Box 1854, Wollongong, NSW 2500

Tel: (61 2) 4275 7522

Fax: (61 2) 4275 7585

The Port Kembla Steelworks in Wollongong (NSW) produces slabs for its plate mill and hot strip mill, feedstock for the hot strip mill at Western Port (Vic), and hot-rolled coils as feedstock for Packaging Products and the Springhill Works (NSW). The Port Kembla Steelworks is a fully integrated iron and steel plant.

Coated Products Division

The Coated Products Division is headquartered at Port Kembla and produces a range of coated sheet and coil products in Australia, New Zealand; and internationally.

The Division is responsible for rolling mills, coating lines and service centres in Australia; an integrated steelmaking facility in New Zealand; coating lines in Asia, Saudi Arabia and US; licensing of steel

coating technology and a number of sales offices throughout the world and BHP Steel's partnership in a flat products steel mill in Ohio, US.

Facilities include:

- Coated Steel Australia and Coated Steel International
- Springhill Works, Port Kembla, NSW
- Western Port Works, Hastings, VIC
- BHP New Zealand Steel, Glenbrook, NZ
- Sales Offices and Service Centres
- Asian Operations
- USA Operations
- Steel Trading (Export) and BIEC.

Division Head Office

Old Port Road, Port Kembla, NSW 2505

PO Box 1854, Wollongong, NSW 2500

Tel: (61 2) 4275 7522

Fax: (61 2) 4275 3146

Springhill Works

Springhill Road, Port Kembla, NSW 2505

Tel: (61 2) 4275 6111

Fax: (61 2) 4275 6258

Western Port Works

Bayview Road, Hastings, VIC. 3915

Tel: (61 3) 5979 6111

Fax: (61 3) 5979 6258

BHP New Zealand Steel Ltd

Mission Bush Road, Glenbrook, South Auckland, New Zealand

Private Bag 92121, Auckland, New Zealand

Tel: (64 9) 375 8999

Fax: (64 9) 375 8959

BHP New Zealand Steel operates an integrated steelworks at Glenbrook, south of Auckland. It specialises in flat and coated products, producing hot-rolled coils, sheet and plate for pipe making, heavy and light engineering and barge construction; cold rolled steel for tubing; hollow sections for agricultural products, commercial construction and reticulation; and coated steels for construction.

Long Products Division

Long Products Division produces a wide range of steel sections mainly for the Australian Domestic Market. Products include – light and heavy angles and channels, merchant bar, hexagons, beams, columns, rails, rods, reinforcing bar and mesh, rural mesh, wire and galvanized wire fencing.

Sales offices throughout Australia, headquarters in Newcastle, NSW.

Facilities include:

- Newcastle Primary Operations
- Rod and Bar Mills
- Sydney Steel Mill, NSW
- Wire Products
- Brisbane Mill
- Whyalla Steel Works, SA

Division Head Office

Ingall Street, Mayfield, NSW 2304
PO Box 196B, Newcastle, NSW 2300
Tel: (61 2) 4940 1444
Fax: (61 2) 4940 1410

Sydney Steel Mill (NSW BHP Steel Pty Ltd)

22 Kellogg Road, Rooty Hill, NSW 2766
Tel: (61 2) 9675 9999
Fax: (61 2) 9675 9900

Whyalla Steelworks

Port Augusta Road, Whyalla, SA 5600

PO Box 21, Whyalla, SA 5600

Tel: (61 8) 8640 4444

Fax: (61 8) 8640 4797

Building and Industrial Products Division

Division Head Office

Industrial Drive Mayfield

NSW 2304

PO Box 156 Newcastle NSW 2300

Tel: (61 2) 4941 1712 Fax: (61 2) 4941 1653

The Building and Industrial Products Division operates most of BHP Steel's downstream manufacturing and distribution activities. Its Divisional head office is in Newcastle, NSW.

Facilities include:-

- Building Products –
 - Australia
 - Pacific
 - Asia
 - USA
- Structural and Pipeline Products
- Tubemakers Merchandising
- Steel and Tube Holdings
- Vinidex

BIPD operates through a number of business units. As the wholly-owned businesses have over two hundred operating locations in Australia, this publication lists only the divisional head offices of Tubemakers Merchandising, BHP Structural and Pipeline Products, and BHP Building Products (Australia, USA, Asia and Pacific).

BHP Building Products (Australia)

Produces and markets a range of roll formed steel building and industrial products throughout Australia. Steel roofing and walling products are probably the most visible, but this business also supplies purlins and girts, structural decking, steel rainwater goods, fencing, expanded metal meshes and gratings and a range of light steel sections as house framing components. The company pioneered the introduction of corrugated steel roofing in Australia and operates extensive product development and engineering facilities. Sales offices are located in all capital cities and many regional towns, and distribution outlets nationwide.

Head Office:

476 Victoria Road, Gladesville, NSW 2111

PO Box 459, Gladesville, NSW 2111

Tel.: (61 2) 9879 9250

Fax: (61 2) 9879 9255

BHP Structural and Pipeline Products

Produces a wide range of steel structural sections combining strength, durability and lightness. The range includes hollow sections and profiles, precision steel tubing, water, oil and gas pipelines, ductile iron pressure pipeline and large diameter steel pipelines for water treatment services. Sales offices are situated throughout Australia, and distributors nationwide.

Head Office:

Industrial Drive, Mayfield, NSW 2304

PO Box 156, Newcastle, NSW 2300

Tel: (61 2) 4941 1711

Fax: (61 2) 4941 1705

Tubemakers Merchandising

Tubemakers Merchandising has an Australia-wide network of metal service centres. With more than 110 merchandising centres, 70-plus franchises, and over 35,000 regular customers, it is the largest metals distribution and processing business in the country, offering value-adding shearing, profiling, sawing, drilling and other processing services, as well as specialist advice. It also distributes lifting products throughout Australia and provides manufacturing and on-site servicing of specialty lifting products.

Head Office:

Cnr Parkview & Blackwall Point Road, Chiswick, NSW 2046

Locked Bag 10, Five Dock, NSW 2046

Tel.: (61 2) 9240 2500

Fax: (61 2) 9240 2555

BHP Building Products (USA)

BHP Steel Building Products USA Ltd

2110 Enterprise Boulevard, West Sacramento

California 95691

Tel: (1 916) 372 0933

Fax: (1 916) 372 5442

BHP Building Products (Asia)

c/o BHP Steel Building Products (Malaysia) Sdn Bhd

16/9 Jalan Gudang Shah Alam Industrial Estate

Selangor, West Malaysia

Tel: (60 3) 559 2000

Fax: (60 3) 550 5428

BHP Building Products (Pacific)

15-17 Kings Crescent, Lower Hutt, Wellington, New Zealand

Tel: (64 4) 570 5000

Fax: (64 4) 569 4218

Note: It is not practical to list all the BHP Steel Divisional Sales Offices in this Handbook.

Information relating to many of the listed products is available from distributors of BHP Steel, located in major centres throughout Australia. Telephone and facsimile contact numbers for BHP Steel Sales Offices are listed in the Telstra White Pages for capital cities, the ACT, Newcastle, Port Augusta and Wollongong under BHP (The Broken Hill Proprietary Company Limited).

Product information is also available from BHP Steel's Customer Support Centre, Port Kembla, using the 'BHP Steel Direct' Freecall numbers:

Tel: 1800 800 789

Fax: 1800 800 744

HOT-ROLLED STEEL PRODUCTS

Plate

BHP Steel offers a wide variety of flat products and customer services from its Port Kembla plant. Plates are regularly produced to grades and thicknesses listed below. For the availability of other grades, sizes and specific customer requirements, please contact your nearest BHP Steel Sales Office.

Additional information may be obtained from the BHP Flat Plate and Strip Product Manual, or through your nearest BHP Integrated Steel Division Sales Office or Distributor.

Product definitions

Plate: Plate is a product rolled on a platemill and structural grades are supplied to AS 3678 standard.

Production Centre: Port Kembla Plate Mill

Section Availability: 1200-3300 mm width
5-100 mm thickness
4-18 m length

Coil Plate: Coil plate is a product rolled on a continuous hot strip mill and structural grades are supplied to AS 1594 standard.

Production Centres: Port Kembla Hot Strip Mill
Western Port Hot Strip Mill

Section Availability: 900-1800 mm width
3-12 mm thickness
2.4-9.0 m length.

Prime plate

Prime Plate is on-line abrasively cleaned to a Class 2.5 finish in accordance with AS 1627 Parts 4 and 9, then (optionally) coated with a pre-construction primer paint. All plate grades are available as Prime Plate.

- Prime Plate to the following specifications is also available on enquiry:
- Blast Class 3.
 - One side priming, both sides blasted.

Heavy Plate and Extra Heavy Plate

Heavy plate and Extra-Heavy plate is principally used in the construction and heavy engineering industries in a variety of end-uses.

Product definitions

Heavy plate (110-150mm)

Heavy plate is a product in thickness 110 to 150mm. Heavy plates are available in standard sizes in grade AS 3678-250.

Extra heavy plate (160-250mm)

Extra-Heavy plate is a product in thickness 160-250mm. Extra-Heavy plate is available in standard sizes in grade AS 3678/XK1016. Grade XK1016 is a chemical analysis grade, with mechanical testing for customer information available on request.

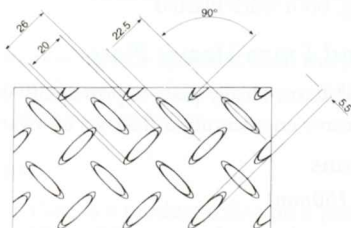
Availability

Standard sizes in Heavy plate and Extra-Heavy plate will ensure enhanced availability and delivery. Non-standard sizes may be available as detailed in BHP Size Schedule 3, which can be obtained at your nearest BHP Steel Sales Office.

Floor Plate

Floor plate is characterised by a raised angular pattern (see pattern diagram) rolled on to one surface. The pattern aids cleaning and draining while retaining non-slip characteristics. The nominal thickness of floor plates is exclusive of the raised pattern.

Floor plates are normally supplied in rectangular flat plate form but, by negotiation, may be supplied in coiled form up to 8mm thick.



Steel grades

The following steel grades are classed as regular grades for floor plate.

	Thickness Range (mm)
AS 3678-250 Floor plate	6 - 12
AS 1594/HU250 Coil floor plate	3 - 8

Floor plates to be used as stress carrying members are ordered to AS 3678 - 250 (Floor plate is suitable for cold bending. The recommended minimum inside radii are similar to those recommended for AS 3678-250 or AS 1594/HU250 plates. Where the raised pattern is on the outside of the bend, more liberal radii should be used.)

For standard floor plate sizes and or non-preferred dimensions within product definitions listed, contact your nearest BHP Sales Office or distributor.

Product definitions

1. Floor Plate:

Production Centre:	Port Kembla Plate Mill
Section Availability:	1200-2400mm width 6 - 12mm thickness 4 - 18m lengths

2. Coil Floor Plate

4-12 m lengths	
Production Centre:	Port Kembla Hot Strip Mill
Section Availability:	900 - 1500 mm width 3 - 8mm thickness 2.4 - 12m lengths

3. Floor plate in coils:

Production Centre:	Port Kembla Hot Strip Mill
Section availability:	900 - 1500mm width 3 - 8mm thickness

Mass Calculations

Plate Mass Calculation:

Plate Mass (kg) = Plate mass per square metre (kg/m²) x plate surface area (width x length m²)

e.g. 3000 x 10 x 9 Plate

$$\text{Mass} = 78.5 \text{ kg/m}^2 \times 27\text{m}^2$$

$$\text{Mass} = 2119.5 \text{ kg (2.12 tonne)}$$

Floor Plate Mass Calculation:

Floor Plate Mass (kg) = Floor plate mass per square metre (kg/m²) x plate surface area (width x length m²)

e.g. 1800 x 10 x 6 Floor Plate

$$\text{Mass} = 80.50 \text{ kg/m}^2 \times 10.82\text{m}^2$$

$$\text{Mass} = 869.4 \text{ kg (0.87 tonne)}$$

When calculating the theoretical mass of floor plate, add 2.0 kg/m² to the mass of plate of the same dimensions.

Plate and floor plate mass per square metre

Thickness mm	Plate Mass kg/m ²	Floor Plate Mass* kg/m ²
3	23.55	25.55
4	31.40	33.40
5	39.25	41.25
6	47.10	49.10
8	62.80	64.80
10	78.50	80.50
12	94.20	96.20
16	125.60	—
20	157.00	—
25	196.25	—
28	219.80	—
32	251.20	—
36	282.60	—
40	314.00	—
45	353.25	—
50	392.50	—
55	431.75	—
60	471.00	—
70	549.50	—
80	628.00	—
90	706.50	—
100	785.00	—
110	863.50	—
120	942.00	—
140	1099.00	—
150	1177.00	—

*Floor Plate Mass per square metre includes 2kg/m² for pattern.

Plate Preferred and Non-Preferred Dimensions

Plate may be ordered in BHP Steel “preferred” or “non-preferred” dimensions or combinations of preferred and non-preferred dimensions.

Not all combinations of width, thickness and length can be supplied because of various production constraints.

The preferred and non-preferred dimensions available in the regular grades are nominated below. For size availability of regular grades, please refer to the “BHP Plate Size Schedules” which can be obtained at your nearest BHP Steel Sales Office or distributor.

Preferred dimensions

PLATE

Width (mm)

1200-3300 in 100 mm increments.

e.g. 1200, 1300, . . . 3200, 3300.

Thickness (mm)

5, 6, 8, 10, 12, 16, 20, 25, 28, 32, 36, 40, 45, 50, 55, 60, 70,
80, 90, 100.

Length (m)

4-18 metre lengths in 0.2 m increments.

COIL PLATE

Width (mm)

900, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800.

Thickness (mm) 3, 4, 6, 8, 10, 12.

Length (m)

2.4, 3.0, 3.6, 4.8, 6.0, 7.2, 9.0

Non-preferred dimensions

PLATE WIDTH (mm)

Width (mm)

Widths other than preferred, specified to the nearest 10mm.

Thickness (mm)

Over 5 to under 25: thicknesses other than preferred, specified to the nearest 0.05 mm; e.g. 6.35 mm, 12.70 mm.

Over 25 to under 60: 26, 27, 29, 30, 31, 33, 34, 35, 37, 38, 39, 41, 43, 44, 46, 47, 48, 49, 51, 52, 53, 54, 56, 57, 58, 59.

Over 60 to under 150: 65, 75, 85, 105, 115, 130.

Length (m)

3 to under 18 m: lengths other than preferred, specified to the nearest 0.01 m.

COIL PLATE

Width (mm)

Widths other than preferred, specified to the nearest 10mm.

Thickness (mm)

Over 3 to under 12 mm: thickness other than preferred specified to the nearest 0.05 mm.

Length (m)

2.4 to under 12 m: lengths other than preferred specified to the nearest 0.01 m.

0.9 to under 2.4 m: available by enquiry.

HOT-ROLLED STRIP AND SHEET

Hot-rolled strip is produced at both Port Kembla and Western Port. Grade specifications and dimensions available depend on the required properties and conditions of supply. The dimensional range available is according to the following product definitions:

Product definitions

Hot rolled strip	Thickness: 3.3-12.7 mm	Width: 910-1830 mm
Skin-passed strip	Thickness: 3.3-6.0 mm	Width : Max. 1500 mm
Hot rolled strip	Thickness: 1.6-3.2 mm	Width: Max. 1830 mm
	Thickness: 3.3-8.0 mm	Width: Max. 900 mm
Pickled strip	Thickness: 1.6-6.35 mm	Width: Max.. 1830 mm
Sheet	Thickness: 1.6-3.2 mm	Width: Max. 1830mm
Skin-Passed, Strip & Sheet	Thickness: 1.6-3.2 mm	Width: Max. 1830mm

Product availability

The availability of regular grades and thicknesses are listed in the table. For the availability of other grades sizes and specific customer requirements, please contact your nearest BHP Steel Sales Office.

Steel grades

All hot-rolled strip and sheet is produced from continuously cast slabs which are generally fully killed, aluminium treated steels. Most steel grades fall into three broad groups, namely: **Formable Steels**, **Structural Steels** and **Analysis Steels**.

Hot-rolled steel sheet is produced from selected steel slab by the continuous rolling process and supplied in accordance with AS 1594. Where no appropriate Australian Standard exists, steel is produced in accordance with the principles embodied in the standards.

Because of the oxidation which occurs at hot rolling temperatures, these products, unless pickled, characteristically carry surface scale. hot-rolled products are not used where high quality surface finish, as produced on cold rolled product, is a prime requirement.

Hot-rolled sheet and strip are supplied in the as-rolled condition or, depending on the quality and customer specified requirements, may be pickled and oiled and/or skin-passed or supplied to special dimensional and flatness tolerances. Dimensional tolerances are in accordance with AS 1365.

Designations

In AS 1594, hot-rolled steel is signified by the first character in the designation, H. The second character (A,K or U) indicates the steel type used in the product.

A = Aluminium killed

K = Silicon/Aluminium killed

U = Unspecified steel type

Product availability – hot-rolled strip to AS 1594

PRODUCT	Thickness Range (mm)	Supply Condition Options	Thickness Range (mm)	Supply Conditions Options
Formable & Extra Formable Steels				
HU1	3.3-12.7	Untrimmed, as-rolled	1.6-8.0 ⁽⁶⁾	ME, S/trimmed, P, skin-passed
HA3-P	—		1.6-6.0	ME, S/trimmed, skin-passed
HA4N-P	—		1.6-6.0	ME, S/trimmed, skin-passed
XF 300-P	—		1.6-6.0 ⁽⁶⁾	ME, S/trimmed, skin-passed
XF 400-P	—		1.6-6.0 ⁽⁶⁾	ME, S/trimmed, skin-passed
XF 500-P	—		2.5-6.0	ME, S/trimmed, skin-passed
Structural Steels				
HA200	3.3-8.0	Untrimmed, as-rolled	1.6-8.0 ⁽⁶⁾	ME, S/trimmed, P, skin-passed
HA250	3.3-8.0		Untrimmed, as-rolled	ME, S/trimmed, P, skin-passed
HU250	10.0-12.0		Untrimmed, as-rolled	ME, S/trimmed, P, skin-passed
HU300	3.3-8.0		Untrimmed, as-rolled	ME, S/trimmed, P, skin-passed
HU300/1	—	Untrimmed, as-rolled	1.6-8.0 ⁽⁶⁾	ME, S/trimmed, P, skin-passed
HA350	4, 5, 6		1.6-8.0 ⁽⁶⁾	ME, S/trimmed, P, skin-passed
HW350	—		2.5-3.2	ME, S/trimmed, P, skin-passed
Analysis Steels				
A1006	3.3-12.7	Untrimmed, as-rolled	1.6-8.0 ⁽⁶⁾	ME, S/trimmed, P, skin-passed
HA1006				
A1010	3.3-12.7	Untrimmed, as-rolled	1.6-8.0 ⁽⁶⁾	ME, S/trimmed, P, skin-passed
HA1010				
A1016	3.3-12.7	Untrimmed, as-rolled	2.2-8.0 ⁽⁶⁾	ME, S/trimmed, P, skin-passed
HK1073*				

See notes over page.

Notes:

1. Hot-rolled sheet is cut-to-length, hot-rolled strip. However, hot rolled sheet is normally only supplied in the skin-passed condition to achieve acceptable flatness in the normal thickness range 1.6 to 3.2mm, and normal length range of 760 mm to 4880mm.
2. The temperature at which hot rolling occurs causes oxidation so that "as-rolled" strip is characterised by a surface film of hot mill scale. Pickling "P" is available as an optional extra to remove hot-mill scale. Pickled strip is supplied in an oiled "O" condition to help preserve the cleaner surface.
3. Untrimmed or mill edge "ME" strip is produced when steel is hot rolled between horizontal rolls on hot strip mills. Consequently, untrimmed/mill edge strip is supplied to a relatively broad width tolerance. Where tighter width tolerances are required, the as-rolled edge may be side-trimmed "S/trimmed" or slit. Mill edge strip is normally available in widths 650 mm and greater. Because of improved control of strip processing whereby width coverage of mill edge strip over the nominal is much tighter, customers should be aware of this when specifying widths of their requirements.
4. Skin-passing is a light cold rolling which suppresses the appearance of stretcher strain and coil break during uncoiling and subsequent processing, and also improves flatness and surface texture.
5. Width, length and flatness tolerances are to Australian Standard AS 1365.
6. Pickled product available in thickness up to 6.0 mm only;
Skin-passed product available in thickness up to 3.2 mm only.

Four basic categories or grades of steel may be specified:

- Formable (ductile) grades
- Structural grades
- Composition grades
- Hardness grades

Formable grades are identified by the third character (1,2,3 or 4) to indicate progressively better formability:

- 1 = Commercial forming
- 2 = Commercial drawing
- 3 = Deep drawing
- XF = Extra Formable

For structural and extra formable products, a three-digit number is used to represent the minimum yield strength in megapascals.

Other characters are added to the designation if required, for example: S = Skin-passed, P = Pickled.

For composition grades, a four-digit number indicates the chemical composition specification as designated in AS 1594.

Typical Hot-Rolled Steel Products

Details of the full range of hot-rolled steel products are obtainable from BHP Steel Sales Offices. Assistance with the selection and specification of steels is also freely available.

Formable (Ductile) Grades

HUI5 – a hot-rolled non-drawing commercial forming grade, skin-passed to ensure good shape and freedom from coil break. Formability is sufficient for simple bending operations.

In standard thicknesses and sizes, HUI5 is normally traded as merchant stock for applications requiring a flat sheet capable of bending and welding-but not requiring the high surface finish of a cold rolled product.

Typical examples:

- General fabrication
- Structural members
- Shelving
- Tanks

HA3-P a hot-rolled pickled and oiled deep drawing grade suitable for pressings of moderate severity where surface finish is not of prime importance. HA3-P is recommended and typically used for:

- Sealed unit housings
- Hydraulic jacks
- Auto brake components
- Clutch parts

Compressors

Extra Formable – The extraform series of steels are used for applications requiring minimum yield strengths in the range 300-500 MPa, combined with a greater degree of formability than is achievable with structural steels.

A typical example is Xtraform 400, used for automotive components and gas cylinders where a combination of high strength, good formability and excellent weldability are required.

Structural grades

These are steels supplied for applications where minimum design strengths are required, but where surface standard is not of prime importance. Minimum yield strengths in the range 240 to 340 MPa are available, all with excellent weldability. HA340 is a typical example.

HA350S – a hot-rolled structural grade, with a guaranteed yield strength of 350 MPa, used where surface is not of prime importance. HA350S

General guide to comparative features – hot-rolled steel

Product	HU1S	HA3-P	XF400	HA200	HK1073
Form	strip	strip, sheet	strip, sheet	strip, sheet	strip sheet
Finish	skin-passed, not oiled	pickled, oiled	as rolled	as rolled	as rolled
Bending	very good	excellent	excellent	good	limited*
Roll-forming	very good	excellent	excellent	good	—
Pressing	good	very good	good	moderate	—
Drawing	good	very good	good	moderate	—
Welding	excellent	excellent	excellent	excellent	limited

Dimensions of Hot-Rolled Flat Steel Products

There is a wide range of thickness/width combinations available in all rolled strip and sheet. Details are available from BHP Steel Sales Offices. As a guide, the following table indicates normal thicknesses of some products.

Product	Thickness range, mm
Formable	
HU1S	1.6-3.2
HA3-P	1.6-6.0
Structural	
HA350	1.6-8.0
Composition	
HK1073	2.5-8.0
Extra Formable	
XF400	1.6-6.5

COLD-ROLLED STEEL PRODUCTS

BHP Steel produces a variety of cold-rolled steel sheet and strip to AS 1595 specification. These steels are available in strip or sheet form in a range of surface finishes and surface qualities, with formability and/or hardness requirements for most end applications.

Dimensional tolerances are in accordance with AS 1365.

Designations

In AS 1595, **cold-rolled** steel is signified by the first character in the designation.

Basic types of cold-rolled steel are:

Formable (ductile), Hardness, Structural (strength) and Composition

In addition, the quality designation indicates:

Surface finish, and Surface quality. Formable (Ductile) Grades.

The second character (**A, U, V, K, M or W**) indicates steel type:

A = Aluminium killed

K = Silicon/aluminium killed

U = Unspecified steel type

M = Modified with micro-alloy
additions

V = Vitreous enamelling steel

W = Weathering steel

The third character (**1, 2, 3 or 4**) indicates degree of formability:

1 = Commercial forming

3 = Deep drawing

2 = Commercial drawing

4 = Extra deep drawing

A fourth character (**S or A**) is added to designate performance characteristics, and a fifth character (**N**) if non-ageing grade steel is necessary.

S = Skin-passed

A = Annealed last

N = Non-ageing (stabilised)

Hardness Grades the second and third characters are a two-digit number representing the minimum Rockwell hardness (scale B).

The fourth character is the letter T to indicate that the hardness has been achieved by temper rolling.

Surface Quality designated by a letter (G, E, F) joined to the quality designation by a dash.

G = General purpose

E = Exposed

F = Fully inspected

Typical Cold-Rolled Steel Qualities

Formable (Ductile) grades

For applications requiring formability, a range of steels is available with ductilities varying from commercial forming through to extra deep drawing. Non-ageing steel types are also available.

Details of the full range of BHP Cold Rolled Steel qualities can be obtained from BHP Steel Sales Offices. Assistance with the selection and specification of steels is also freely available.

Typical BHP products include:

CA2S-E – a skin-passed commercial drawing steel capable of moderate forming and pressing and with a surface suitable for exposed panels. This is a very versatile product.

CA3SN-E – a skin-passed deep drawing steel guaranteed non-ageing and free from stretcher strain with a surface suitable for exposed components.

CA5SN-E – a skin-passed critical drawing steel suitable for severely drawn components in exposed applications with a minimum of rework. This product is guaranteed free of ageing and stretcher straining.

Hardness grades

These are produced for applications where minimum hardness is required and where ductility and surface finish are not of prime importance.

Structural grades

A range of structural grade steels is produced mainly for applications where design requirements specify minimum strength. Steels are available with minimum yield strengths varying from 350 to 600 MPa. These steels are outside the scope of AS 1595 but designation and supply follow the principles embodied in Australian standards.

Composition/Carbon grades

These are plain carbon steels often used in applications where heat treatment is a necessary part of the manufacturing process. The chemical composition is guaranteed and indicated by a four digit carbon content. The first two numbers in BHP composition grades are "10" for plain, unalloyed, carbon steels.

General guide to comparative features - cold rolled steel

Quality	CA2S-E	CA3SN-E	CA5SN-E
Form	Strip, sheet	Strip, sheet	Strip, sheet
Surface quality	Exposed Panel Oiled	Exposed Panel Oiled	Exposed Panel Oiled
Bending	Excellent	Excellent	Excellent
Roll-forming	Excellent	Excellent	Excellent
Pressing	Good	Excellent	Excellent
Drawing	Good	Very good	Excellent
Welding	Excellent	Excellent	Excellent

Dimensions of Cold-Rolled Flat Steel Products

Details of the wide range of thickness/width/length combinations possible are available on request. The following table gives the normal thickness ranges of the formable products listed.

Product	Thickness range, mm
CA2S-E	0.40-3.2
CA3SN-E	0.60-3.2
CA5SN-E	0.60-3.2

LY-CORE ELECTRICAL STEEL QUALITIES

BHP Steel produces a range of fully-processed, non-oriented electrical steels with magnetic properties covering the requirements of the electrical manufacturing industry. Industry products include motors, alternators, transformers and fluorescent lighting ballasts.

These steel qualities are identified by the name LY-CORE, followed by a number which is 100 times the guaranteed maximum core loss in watts per kilogram for 0.50 mm thick sheet at an induction of 1.0 tesla and a frequency of 50 hertz, viz Ly-Core 140, 150, 230 and 150.

Laminations

Sankey provides a range of standard and custom laminations for motors and transformers. Laminations are supplied either as stamped Ly-core grades, or post annealed Sankore grades. Sankey also supplies laminations cut from grain oriented electrical steel and nickel-iron alloys.

Details are available from Sankey (Aust) Pty Ltd

Tel (61 2) 4967 1766

Fax (61 2) 4967 2367.

T I N P L A T E

Tinplate consists of low carbon steel sheet/coil with a thin electro deposited coating of commercially pure tin on both top and bottom surfaces.

Used in the manufacturing of cans and other containers, closures and fabricated articles for household and industrial uses, tinplate is produced in a variety of dimensions, grades (tempers) and tin coating masses to meet the requirements of the consumer.

The characteristic qualities of tinplate are strength, lightness, pleasing appearance, ease of fabrication and recyclability.

BHP Tin Mill Products is accredited to the general quality systems standard: ISO 9002: 1987/NZS 9002:1990 / AS 3902-1987 and producers tinplate to meet the AS 1517 Australian Standard.

Thickness

The normal thickness range available in Single Reduced grades is from 0.19 to 0.60mm, and in Double Reduced grades from 0.16 to 0.22mm.

Thickness (mm) in common usage:		
0.16	0.24	0.35
0.17	0.25	0.36
0.18	0.26	0.38
0.19	0.27	0.43
0.20	0.28	0.50
0.21	0.30	0.55
0.22	0.31	0.60
0.23	0.33	

Width availability – full width coil and sheet

Thickness mm	Available Widths mm		
	Double Reduced	Single Reduced	
		CA	BA
0.16	700 – 870	–	–
0.17 – 0.18	700 – 910	–	–
0.19	700 – 910	610 – 860	–
0.20	700 – 910	610 – 870	610 – 870
0.21	700 – 910	610 – 910	610 – 920
0.22	700 – 910	610 – 920	610 – 970
0.23	–	610 – 920	610 – 970
0.24 – 0.26	–	610 – 930	610 – 970
0.27 – 0.28	–	610 – 950	610 – 970
0.30 – 0.60	–	610 – 950	610 – 985

Length availability – sheet 460 – 1020mm

Slit coil availability 38 – 483 mm

Note: Sizes outside these ranges may be available, subject to enquiry

Temper

a) Single reduced

Temper Designation	Rockwell 30 – T Hardness Range Aim	Plate Characteristics	Examples of Use
Batch Anneal			
T1	52 max.	Soft for drawing	Drawn cans and component
T2	48 – 56	Moderate drawing general purpose	Simple drawn components, rings and closures:
T3	54 – 61	General purpose and shallow drawing	Can ends and bodies, simple stampings
T4	57 – 65	General purpose where increased stiffness desired	Can ends and bodies
Continuous Anneal			
T4CA	57 – 65	Moderate forming Fair degree of stiffness	Closures, can ends and bodies
T5CA	61 – 70	Increased stiffness to resist buckling	Can ends and bodies
NT5CA	63 – 71	Greater stiffness	Beer can ends, Aerosol ends

(b) Double reduced

Designation	Rockwell 30 – T Hardness Range Aim	Longitudinal Tensile Proof Stress Aim MPa	Examples of Use
DR8	70 – 76	480 – 620	Can bodies, ends and drawn cans.

Tin Coating

Coating Mass g/m ²		
Designation	Nominal	Minimum average
Equally Coated		
LTS1	1.1/1.1	1.0/1.0
E02	1.1/1.1	0.9/0.9
E05	2.8/2.8	2.5/2.5
E07	3.9/3.9	3.6/3.6
E10	5.6/5.6	5.2/5.2
E15	8.4/8.4	7.8/7.8
E20	11.2/11.2	10.1/10.1
E27	15.1/15.1	13.4/13.4
Differentially Coated		
D05/02	2.8/1.1	2.5/0.9
D10/05	5.6/2.8	5.2/2.5
D15/05	8.4/2.8	7.8/2.5
D15/10	8.4/5.6	7.8/5.2
D20/05	11.2/2.8	10.1/2.5
D20/10	11.2/5.6	10.1/5.2
D27/10	15.1/5.6	13.4/5.2

Technical Service

BHP has laboratory facilities and specialists with experience in all aspects of tinplate manufacture, food technology and can-making technology. These are freely available to assist tinplate users in the resolution of any technical enquires.

Note: It is not practical to list all the BHP Steel Divisional Sales Offices in this Handbook.

Information relating to many of the listed products is available from distributors of BHP Steel, located in major centres throughout Australia. Telephone and facsimile contact numbers for BHP Steel Sales Offices are listed in the Telstra White Pages for capital cities, the ACT, Newcastle, Port Augusta and Wollongong under BHP (The Broken Hill Proprietary Company Limited).

Product information is also available from BHP Steel's Customer Support Centre, Port Kembla, using the 'BHP Steel Direct' Freecall numbers:

Tel: 1800 800 789

Fax: 1800 800 744

METALLIC-COATED STEEL PRODUCTS

Coatings on Steel Sheet

Coatings have been successfully applied to steel sheet for well over a century, the main purpose being to protect the steel against its natural tendency to form iron oxide. Sometimes coatings serve to provide decoration, but frequently both protection and decoration are required.

Steel coating technology has progressed to keep pace with, or ahead of, changing atmospheric environments in cities, industrial areas, etc., particularly where claddings for buildings are concerned.

Selection of the appropriate coated steel to suit conditions is important. For example, coating needs for rural or non-aggressive inland locations differ from those required for marine and industrial environments. Some useful information is included under the heading "Atmospheric Exposure Conditions."

In general terms, the metallic-coated steel products produced on the continuous coil coating lines by BHP Coated Steel Division are:-

- Hot-dip zinc-coated and zinc/aluminium alloy-coated (AS 1397)
- Hot-dip zinc-iron alloy coated (AS 1397)

Hot-dip zinc-coated products include GALVABOND (ductile-coated products), ZINCFORM (structural) and ZINC-HI-TEN (high strength) steels in various coating classes and finishes. ZINCANNEAL steel, a ductile product, has a surface modified in production by a post galvanizing heat treatment.

Hot-dip zinc/aluminium alloy-coated sheet is ZINCALUME steel in structural and high strength grades in two coating classes.

General Description

The metallic-coated products of BHP Coated Steel Division are generally described by a registered trade mark followed by a designation of the steel base and coating class, as outlined in Australian Standard AS 1397.

Continuously hot-dipped metallic-coated steels

As the surface of steel products gradually reverts to its most stable form (that is, iron oxide,) it is necessary to isolate the surface from atmospheric conditions to prevent the unsightly oxide forming. This can be achieved by covering the surface with metals or organic materials, such as paint or PVC laminate. The latter materials and some metals merely provide a blanket covering to protect the steel from the atmosphere. This is successful provided the complete coverage remains intact. Some metals, such as zinc, give an added feature of sacrificial protection at areas where the steel base is exposed, such as cut edges, holes and scratches. An zinc/aluminium alloy-coating combines the best features of both aluminium and zinc coatings. Metallic coating with zinc or zinc/aluminium alloy by the hot-dip method is a universally proven and accepted system. The continuous hot-dip metallic coating lines operated by BHP Coated Steel Division produce a range of zinc-coated and zinc/aluminium-coated steel sheet and strip products to meet the requirements of manufacturers in Australia.

The degree of corrosion protection afforded by each coating type and class depends on the many macro and micro environments in which it performs and therefore cannot be simply quantified. However, it can be generally assumed that for a particular coating class the life of the sheet would be in direct proportion to the coating mass on the sheet. For normal exterior protection, the life of zinc/aluminium coatings is far superior to the life of an equivalent thickness zinc coating.

Zinc coatings are superior where products manufactured from them come into contact with un-cured concrete, and are also superior for sheds used in intensive animal farming.

In addition, some manufacturers prefer the increased ductility of zinc coatings when forming metallic-coated steel sheet into articles with very tight bends.

ZINCALUME steel and GALVALUME® steel are the brand names of BHP Coated Steel Products Division's alloy-coated steel sheet. It is more readily painted than zinc surfaces, for which added precautions are necessary in pretreatment and priming to ensure adequate paint adhesion.

ZINCALUME zinc/aluminium alloy-coated steel is now supplied standard with a new, specially-formulated water-based clear acrylic resin film, factory roller-coated and oven cured over the conventional passivation layer. The resin film, in combination with the passivation layer, has excellent adhesion to the substrate, very good impact resistance and flexibility, excellent marking resilience, and the resin film acts as a lubricant during forming operations. GALVALUME zinc/aluminium alloy-coated steel is essentially the same product as ZINCALUME steel, except it is not supplied with a resin coating.

General Information

Designation System – Base Steel

The steel base grades of BHP continuously heat-treated, hot-dipped qualities are designated with the letter “G” followed by characters which indicate formability or strength and condition. Refer Table 1.

Table 1 – Designation System for Base Steel Metallic Coated

Groups	Character Position			
	1	2	3	4
	Product Type	Degree of Formability	Condition	Surface Quality
Formable (Ductile)	G – Continuously heat-treated and hot-dip coated	1 – Profiling 2 – Commercial forming 3 – Drawing	S-Skin-passed N-Non-ageing X-Special properties	F – Fully inspected
Example	G	2	S	
Structural (Strength)	Product Type	Strength (Minimum Yield Strength - MPa)		
		Numeral	Numeral	Numeral
	G – Continuously heat-treated and hot-dip coated			
Example	G	2	5	0

Designation System – Coatings

Metallic coatings on steel sheet and strip are divided into three different types. Refer Table 2.

Table 2 – Metallic Coating Types and Designations

Coating Type	Coating Designation
Hot-dipped zinc (Zn)	Z
Hot-dipped zinc/aluminium (Zn/Al)	ZA
Hot-dipped zinc/iron (Zn/Fe)	ZF, ZS

Coating Mass

The ability of a metallic-coated sheet and strip product to withstand corrosion in a particular environment is a function of the amount (and type) of coating on the surface of the steel base substrate. This is quantified as the “coating mass” and is the combined mass of coating on both sides of the steel base expressed in grams per square metre (g/m^2).

Coating Class

Coating Class is designated by the specified coating type and the minimum mass of coating on both sides of the sheet measured by the triple spot test, as detailed in Australian Standard AS 1397, eg AZ150, zinc/aluminium coating with a minimum coating of 150 g/m^2 .

Coating Adhesion

The ability of metallic coating to withstand deformation without peeling from the sheet substrate varies with coating type and coating mass. Table 3 lists the guaranteed performance of the various metallic coatings and base combinations.

Table 3 – Coating Adhesion (180° Bend Test)

Base Grade	Diameter of bend in terms of thickness (t) of product							
	Coating Class							
	Z100	Z200	Z275	Z350	Z450	Z600	AZ150	AZ200
G3	Flat	Flat	Flat	—	t	2t	—	—
G2	Flat	Flat	Flat	—	t	2t	—	—
G2N	—	—	—	—	—	—	Flat	t
G250	Flat	Flat	Flat	—	t	2t	t	t
G300	Flat	Flat	t	t	t	2t	t	t
G350	Flat	Flat	t	t	t	2t	—	—
G450	Flat	t	2t	2t	2t	3t	—	—
G500	Coating will withstand base forming limits						—	—
G550							—	—

Note: These tables are an explanation of the DESIGNATED SYSTEM ONLY. It does not imply that all combinations are available.

Formable Steel Grades

GALVABOND® G2, G3N (AS 1397)

GALVABOND steel is a general purpose zinc-coated flat sheet and is the most widely used of zinc-coated products. It is suitable for a broad range of applications demanding a high standard of formability, coating adhesion and resistance to corrosion. Several optional coating classes and finishes and two steel base grades are available to suit specific applications.

GALVABOND steel base grade G2 with regular coating class Z275 will permit severe forming (including lock-forming) and many drawing operations. For the more critical drawing or spinning operations, base grade G3N with coating class Z200 (for internal applications) is manufactured.

Coatings heavier than coating class Z275, while giving excellent protection against corrosive conditions, are not guaranteed for close forming.

The coating, with its characteristic spangled pattern, has excellent adherence and will permit a wide range of forming operations without peeling or flaking. Soldering and welding, if carried out according to recommended practices, present no difficulties.

To achieve satisfactory paint adhesion, pretreatment or priming is required. Recommendations are given under Painting (see index) and in the Technical Information booklet "Painting", available from any BHP Steel Sales Office. Where higher standards of paint finish are required, alternative products are available.

Typical Applications

GALVABOND steel is recommended for:–

- Meter boxes
- Motor housings
- Ducting
- Cable Trays
- Expanded metal
- Containers
- Garage doors
- Garbage cans
- Poultry feeding equipment

ZINCANNEAL® G2, G3 (AS 1397)

. Modification by a post galvanizing heat treatment, which converts the coating into a zinc/iron alloy, gives ZINCANNEAL steel its distinctive smooth grey surface with a complete absence of spangle appearance. The coating, which possesses good adherence to the steel base, provides a corrosion-resistant surface for painting directly with high quality finishes without any additional surface treatment such as priming, (except for severe external conditions where etch priming is recommended for optimum performance). ZINCANNEAL steel **must** be painted for external applications.

The mechanical properties of the base are such that ZINCANNEAL steel permits many bending and forming operations, but as the zinc/iron alloy coating has only limited ductility, powdering may occur if the deformation becomes excessive.

ZINCANNEAL steel present no difficulties in welding. It can be readily soldered, but attention must be paid to the use of recommended fluxing techniques.

Typical Applications

ZINCANNEAL steel is recommended for:–

- Signs
- Number plates
- Door frames
- Commercial refrigerators and freezers
- Van and bus doors
- Louvres

ZINCSEAL® G2

ZINCSEAL steel is produced in a similar manner to ZINCANNEAL steel. It is a low coating mass zinc/iron alloy-coated commercial forming steel suitable for bending and moderate forming, with a skin-passed extra smooth high quality surface finish suitable for high quality paint finishes. Most suitable for office furniture, light fittings and general fabrication.

ZINCMATTE® G3 (AS 1397)

ZINCMATTE steel is a hot-dipped zinc-coated drawing steel with a minimised spangle, extra smooth surface suitable for exposed applications. It can be drawn and pressed and is suitable for high gloss paint finishes.

Structural Steel Grades

ZINCFORM® G250, G300 (AS 1397)

ZINCFORM steel is produced to meet the minimum strength requirements of AS 1397 base grades G250 and G300. It has been specially developed for structural applications, particularly roll-formed sections, and is available in a variety of coating classes to suit particular end uses. ZINCFORM steel is not suitable for applications where fluting is critical (eg. Rima machines) or for severe drawing, pressing or lock-forming.

ZINCFORM steel has a bright, relatively smooth appearance with a full spangle surface pattern. It has very good corrosion resistance and may be readily soldered, welded or painted. Pretreatment or priming is necessary to promote paint adhesion.

Typical Applications

ZINCFORM steel is recommended for:

- **Z200** (internal applications only)
 - building sections, studs, plates, wall frames, purlins, ceiling hangers, fittings, general roll-formed sections
- **Z275** – general roll-forming, purlins
- **Z450** – rain-water goods and accessories
- **Z600** – corrugated tank walls, general items exposed to severe corrosion

ZINC-HI-TEN® G450, G500, G550 (AS 1397)

ZINC-HI-TEN steel is a flat zinc-coated product produced to meet the minimum strength requirements of AS 1397 base grades G450, G500 and G550, and a specific market demand for high strength zinc-coated steel sheet with very good corrosion resistance. Careful design will often make it possible to achieve savings in costs by allowing the substitution of thinner ZINC-HI-TEN steel sheet for thicker sheet otherwise required in other qualities. In some cases, modifications to the profile may be necessary to compensate for any loss of rigidity under load resulting from this reduction in sheet thickness.

Although not intended for the same wide range of applications as GALVABOND steel, ZINC-HI-TEN steel has been used successfully in many roll-forming and bending operations.

ZINC-HI-TEN steel is readily formable on a brake press or other equipment in common use for cold forming operations. Only slightly higher forming pressures are required to produce a permanent set, since the lighter ZINC-HI-TEN steel is usually used without any loss of structural strength. The technique of forming ZINC-HI-TEN consists mainly in making provision for more liberal radii of bends, for slightly increased die clearances and for more springback.

ZINC-HI-TEN steel may be soldered, welded and painted, provided recommended procedures are followed. In welding, allowances should be made for the loss of strength in the area of the weld where the mechanical properties will revert to those of ZINCFORM steel. Priming or pretreatment is necessary before painting to achieve satisfactory adhesion.

Typical Applications

ZINC-HI-TEN steel is recommended for:–

Coating Class

- **Z200** – internal structural sections, structural decking, concrete formwork
- **Z275** – fence droppers, tubing
- **Z600** – general items exposed to severe corrosion conditions

GALVASPAN® G450, G500, G550 (AS 1397)

GALVASPAN steel is a hot-dipped, zinc coated structural steel with a spangled surface. Suitable for roll-formed sections for internal structural applications in benign environments.

Typical Applications

- **Z350** – purlins and girts

ZINCALUME® G300 (AS 1397)

ZINCALUME steel provides significantly improved corrosion resistance. It is produced to meet the minimum strength requirements of AS 1397 base grade G300 and is suitable for roll-forming and bending.

All materials (except lead) that can be used in contact with traditional zinc-coated steel can be used in contact with ZINCALUME steel in the field. Economical joining and sealing systems using silicone rubber sealants are described under Sealants. **Do not use lead.**

Typical Applications

ZINCALUME G300 is recommended for:–

Coating Class

- **AZ150** – general roll-forming, garage doors, roof decking, gutters and downpipes, ridge capping and valleys, rain water goods and accessories, vertical walling, fencing systems, house frames, refrigerator and stove rear panels, air conditioning panels (NOT DUCTWORK)
- **AZ200** – near marine and industrial conditions

Note: Grade 250 is also available; good ductility makes it suitable for tubing, mufflers, signs and roll-formed structural sections.

ZINCALUME® G550 (AS 1397)

ZINCALUME steel provides significantly improved corrosion resistance. It is produced to meet the minimum strength requirements of AS 1397 base grade G550.

The same general comments apply to ZINCALUME steels as for ZINC-HI-TEN steel equivalent products. Two notable differences are

- priming or pretreatment are usually not necessary before painting
- ZINCALUME steel **does** not readily solder – use sealants instead.

All materials (except lead) that can be used in contact with traditional zinc-coated steel can be used in contact with ZINCALUME steel. *Do not use lead.*

Typical Applications

ZINCALUME steel is recommended for:–

Coating Class

- **AZ150** – roll-formed decking and walling
- **AZ200** – for severe corrosion conditions

GALVALUME® G2N, G250, G300, G550 (AS 1397)

GALVALUME hot-dipped zinc/aluminium alloy-coated steel with a spangled surface is suitable for a wide range of products, depending on the mechanical properties and coating class used (which will effect fabricating performance).

Unlike ZINCALUME steel, GALVALUME steel is not supplied with a resin coating.

Typical Applications are:–

- G2N – roofing tiles, auto components, solar heaters
- G250 – tubing, mufflers, signs, structural sections
- G300 – mufflers, cladding and general manufacturers articles
- G550 – roll-formed decking and walling

Dimensions of Hot-Dip Zinc-Coated and Zinc/Aluminium Alloy-Coated Flat Steel Sheet – Typical only

Most products are available as both sheet and strip. Typical dimensions are shown for regularly produced product but other thickness/width/length combinations are available subject to enquiry.

Maximum sheet length 4880m.

Grade	Zinc-Coated		Zinc/Aluminium-Coated	
	Typical thickness mm	Maximum width mm	Typical thickness mm	Maximum width mm
Formable				
Commercial	0.30 - 3.2	1830	–	–
Deep drawing	0.40 - 3.2	1525	–	–
Structural				
G250	1.0 - 3.2	1350		
G300	0.30 - 3.2	1525	0.30 - 1.2	1245
G450	1.5 - 3.2	1350	–	–
G500	1.1 - 1.4	1350	–	–
G550	0.35 - 1.0	1300	0.30 - 0.80	1245

BHP COLORBOND PREPAINTED STEEL

COLORBOND prepainted steel can be fabricated into an end product without further treatment. Produced on high speed continuous strip coating lines, COLORBOND steel is available with a base of cold-rolled uncoated, zinc-coated or zinc/aluminium alloy-coated steel.

COLORBOND prepainted steel for interior/exterior building applications conforms to the requirements of AS 2728.

A range of colours, coating types and gloss levels has been developed for a wide variety of applications, both exterior and interior. These products are available either single sided or double sided, in the same or different colours.

By selecting the correct COLORBOND steel product, standard fabrication techniques such as deep drawing, roll-forming, lock-seaming, stamping, spinning and brake press forming are possible without damage or deterioration to the coating. In some fabrication techniques the paint coating acts as a lubricant and can measurably increase tool life.

COLORBOND steel is available in widths from 25mm to 1575mm and in preferred thicknesses from 0.30mm to 1.6mm, depending on steel substrate. Other thicknesses may be available on application.

The paint finish coating on COLORBOND steel for both interior and exterior use is applied over a corrosion-inhibitive primer, unless otherwise specified.

If it is intended to use COLORBOND steel in exterior applications within 1km of a salt marine location, or in severe industrial or unusually corrosive environments, please contact the nearest BHP Steel Sales Office for specialised advice.

Working with COLORBOND prepainted steel

Manufacturers planning to use COLORBOND prepainted steel are advised to contact BHP Steel Sales Offices for specialised advice. Benefits can accrue when new or modified production lines are planned to fully exploit the advantages of using COLORBOND steel. For example, it may simplify operations if the prime surface faces downwards, or if a bending operation is performed in an unconventional manner. In-line integral fastening or adhesive may reduce the quantity of mechanical fasteners otherwise required.

BHP specialists have a lot of local and overseas experience in production innovation and welcome any opportunity to assist in early design stages. A fully equipped Product Application Laboratory (PAL) is located at the BHP Steel Research Laboratories, Port Kembla. Prototypes of customers' new applications can be developed to demonstrate the most cost-effective material and manufacturing technique.

Typical applications

COLORBOND steel is manufactured to suit a range of end uses from severe exterior applications to interior fittings and fixtures. The following briefly outlines the COLORBOND steel types available and their applications.

COLORBOND XRW – Exterior Roofing and Walling – designed for a range of roofing and walling applications, rainwater goods, garage doors and accessories.

COLORBOND XPD – Exterior Premium Durability – for roofing, walling and architectural panel applications requiring the ultimate in long term colour and gloss durability.

COLORBOND XSE – Exterior Severe Environments – combines the long term durability of COLORBOND XPD with exceptional corrosion resistance for marine and industrial environments.

COLORBOND XFP – Exterior Fencing Panels – designed to provide a high level of durability in fencing applications.

COLORBOND CRP – Coolrooms – product designed for the manufacture of sandwich panels for the coolroom industry.

COLORBOND XMA – Exterior Manufactured Articles – designed for use in hot water service jackets, air conditioner cabinets, garden sheds and other applications requiring good exterior performance.

COLORBOND HGA – High Gloss Appliance – a durable and mar resistant product for the manufacture of appliances (viz refrigerators, freezers, dryers, dishwasher cabinets, light fittings).

COLORBOND IFS – interior furniture and shelving.

COLORBOND SWP – Sign Writing Panels – a product specifically developed for overpainting by the sign writing industry.

COLORBOND GMA – General Manufactured Articles – a range of products individually formulated to meet the requirements of a range of manufactured articles for interior use. Please consult your BHP Steel Sales Office for specialised advice.

COLORBOND POM – Primed only material – is designed to be painted after fabrication. This product provides a readily paintable surface with good formability, and good adhesion to post-painted topcoats at relatively low cost.

Ensure when you purchase or specify COLORBOND prepainted steel, the product is genuine BHP Steel. Look for the BHP brand.

AQUAPLATE® Steel

AQUAPLATE steel is AS 1397 G300 Z450 galvanised (Colorbond Z275) steel sheet laminated with AS 2070 food grade polymer film. This steel/film laminate has been developed to make durable tanks for the storage of potable waters from rain, river, dam, spa or bore.

AQUAPLATE – W (film on one side) is for tank walls and is available as flat strip sheet, or as 8 or 10.5 x 76mm corrugated sheet in custom cut lengths. A Colorbond XMA paint finish is also available for the tank wall outer surface (refer to Technical Bulletin No. 12).

AQUAPLATE – B (film on two sides) is for tank bottoms and is available 1200mm wide as flat strip or sheet. The additional film surface is to protect the tank base from tank support materials.

Refer to Section – Water Tanks AQUAPLATE Polymer Coated Steel.

AREA PER TONNE OF SHEET PRODUCT

Calculated area per tonne of product (square metres per tonne)
Uncoated & Coated Sheet & Strip

Specified thickness of base steel mm	Uncoated Steel	METALLIC COATED						
		Z100 ZF100	Z200	Z275	Z450	Z600	AZ50	AZ150
0.30	424.6	402.4	388.3	378.1	354.0	332.8	412.4	396.0
0.35	363.9	347.5	336.9	329.2	310.8	294.3	354.9	342.7
0.40	318.5	305.8	297.6	291.5	277.0	263.9	311.5	302.1
0.42	303.3	291.8	284.3	278.8	265.5	253.4	297.0	288.4
0.48	265.4	256.5	250.8	246.4	236.0	226.3	260.6	253.9
0.50	254.8	246.6	241.3	237.2	227.5	218.6	250.3	244.2
0.55	231.6	224.8	220.4	217.0	208.9	201.3	227.9	222.8
0.60	212.3	206.6	202.8	200.0	193.1	186.6	209.2	204.9
0.65	196.0	191.1	187.9	185.5	1709.5	173.9	193.3	189.7
0.70	182.0	177.8	175.0	172.9	167.6	162.7	179.7	176.5
0.75	169.8	166.2	163.7	161.9	157.3	153.0	167.8	165.1
0.80	159.2	156.0	153.8	152.2	148.1	144.3	157.5	155.0
0.85	149.9	147.0	145.1	143.6	140.0	136.6	148.3	146.2
0.90	141.5	139.0	137.3	136.0	132.7	129.6	140.2	138.2
0.95	134.1	131.8	130.2	129.1	126.1	123.3	132.8	131.1
1.00	127.4	125.3	123.9	122.9	120.2	117.6	126.3	124.7
1.15	110.8	109.2	108.1	107.3	105.3	103.3	109.9	108.7
1.20	106.2	104.7	103.7	103.0	101.0	99.3	105.4	104.3
1.40	91.0	89.9	89.2	88.7	87.3	85.9	90.4	89.6
1.50	84.9	84.0	83.4	82.9	81.7	80.5	84.4	83.7
1.60	79.6	78.8	78.2	77.8	76.7	75.7	79.2	78.6
1.80	70.8	70.1	69.7	69.3	68.5	67.7	70.4	69.9
1.90	67.0	66.5	66.1	65.8	65.0	64.2	66.7	66.3
2.00	63.7	63.2	62.8	62.5	61.8	61.2	63.4	63.0
2.20	57.9	57.5	57.2	56.9	56.4	55.7	57.7	57.3
2.50	51.0	50.6	50.4	50.2	49.8	49.2	50.8	50.5
3.00	42.5	42.2	42.1	41.9	41.6	41.3	42.3	42.2
3.20	39.8	39.6	39.5	39.4	39.1	38.8	39.7	39.5

**BHP****BHP Building Products****LYSAGHT**

Manufacturers of the following LYSAGHT range of Building and Industrial Products, covered in this section:—

- CUSTOM ORB
- CUSTOM BLUE ORB
- WALLCLAD
- TRIMDEK HI-TEN
- TRIMWALL
- SPANDEK HI-TEN
- INTEGRITY 820
- INTEGRITY 890
- KLIP-LOK 406 AND 700
- FLATDEK
- BROWNBUILT 305
- PANELRIB
- EASY-CLAD HI-TEN
- MINI ORB

(CONT.)

(CONT.)

Manufacturers of the following LYSAGHT range of Building and Industrial Products, covered in this section:—

- MULTICLAD
- MULTILINE 600 + 900
- GUTTER RANGE
- FASCIA
- DOWNPIPE AND ACCESSORIES
- STANDARD FLASHINGS/CAPPINGS
- PURLIN AND GIRT SYSTEM
- LIGHT STEEL SECTIONS
- FIRMLOK BEAMS
- SPANFLOOR FLOORING
- UNI-PIER
- STEEL FENCING
- COLD FORMED CHANNELS AND ANGLES
- EXPANDED METAL MESHES
- STRUCTURAL DECKING
- SHEET PILING
- INTERLOK STEEL GRATING
- ROOF WALKWAY SYSTEM

CLADDINGS AND ACCESSORIES

ZINCALUME and COLORBOND Steel Roof and Wall Claddings

ZINCALUME zinc/aluminium alloy-coated steel roof and wall cladding, either with its now familiar silvery-matt finish or as COLORBOND prepainted steel, has largely replaced galvanized steel in the Australian building industry. The familiarity of steel roofing should not, however, obscure the even greater advantages derived from recent technical developments.

New profiles

Many modern profiles have been added to the range. Even the traditional corrugated sheet has been modernised. Wider, long-length sheets make a significant contribution to cost savings by reducing installation time. Some large building projects may need a cladding sheet specially designed to meet specific structural or other requirements. Given sufficient volume, sheets can be developed and produced by BHP Building Products.

Long lengths

The LYSAGHT range of roofing and walling profiles are manufactured in long lengths so that one roof sheet will cover from ridge to gutter. The advantage of long length sheets are neater appearance, reduced handling and installation costs, wider spacing for supports and the elimination of end laps and their attendant (mainly historical) corrosion problems.

Improved weather and corrosion resistance

LYSAGHT ZINCALUME steel roofing and walling gives improved corrosion resistance compared with traditional galvanized steel of similar coating thickness in similar environments. Anti-capillary side laps and new fastenings have been designed to ensure weather-tightness. In some profiles, fastenings are attached below or behind the cladding, avoiding the need for piercing. This is known as concealed fastening.

Colour

COLORBOND steel has an organic coating applied under controlled factory conditions. There are 18 standard colours in the COLORBOND XRW steel range, plus a number of non-standard special colours. Colour matched accessories and fastenings are also available. Check your local BHP Building Products Centre or distributor for availability.

Strength

Of the many roofing and walling materials now available, high tensile sheet steel remains the strongest.

Thermal Insulation

Lined dwellings

The Commonwealth Experimental Building Station has carried out very extensive studies on the thermal behaviour of buildings, and has found that the major factor controlling internal room temperatures is the heat capacity or mass of the building. The material used for roof sheeting has little or no effect on room temperature or personal comfort in a lined building. The full findings are published in CEBS Technical Study No 34 "The Thermal Behaviour of Dwellings", from which the following passage is quoted: 'It was popularly believed that a

galvanized iron roof caused a house to be hotter than it would be if sheeted with asbestos or roofed with clay tiles. This view is not supported by the results obtained.'

Unlined single membrane buildings

A bright polished metal surface has relatively low thermal emissivity, which reduces radiation intensity to a low value. At the same time, improved light reflectivity and distribution is a considerable advantage with a single membrane roof without ceiling.

Roofing performance (standards)

BHP Building Products roofing and installation procedures comply with the requirements of AS 1562.1 – 1992, "Design and Installation of Sheet roof and wall cladding". The requirements of this standard include stringent proof tests to measure the ability of the roofing medium to withstand simulated wind uplift loads and superimposed concentrated loads.

Fastening Should Always be in Accordance with the Manufacturer's Published Recommendations.

Service

Most LYSAGHT profiles are now manufactured in every Australian capital city, and a number of regional centres. Products are available through BHP Building Products roof and wall cladding distributors, either in stock sizes or factory cut to a customer's own needs. A range of accessories and fasteners is also available. BHP Building Products State and Regional offices can supply detailed technical literature for specific products, and expert technical advice on particular problems.

ZINCALUME STEEL ROOFING AND WALLING SELECTION GUIDE

New Homes

One of the most exciting design innovations in home building in of recent years has been the increased use of very low-pitched or flat roofs. It is in this area that steel's flexibility has proved a significant factor. This flexibility allows steel to be used successfully at lower pitches than most other roofing products. In designs where a nearly flat roof is required, KLIP-LOK® 406 or KLIP-LOK® 700 decking are the obvious choices, since they allow pitches as low as 1°. Where the pitch is not as critical, other LYSAGHT profiles, such as CUSTOM ORB®, TRIMDEK HI-TEN® or SPANDEK HI-TEN®, may be used. In home construction, the use of low-pitched roofing gives the dual advantage of design freedom and cost saving in structural framing.

Home Extensions

With steel sheet roofing, it is usually possible to add extensions beneath the existing roof eaves and still maintain sufficient ceiling height to meet building regulations. By avoiding the necessity to interfere with the existing roof structure and drainage, major cost savings are possible. Where the roof slope must be kept to a minimum, KLIP-LOK 406 or KLIP-LOK 700 deckings are the most suitable profiles. Where there is sufficient height to permit a slightly steeper roof fall, CUSTOM ORB, SPANDEK HI-TEN, TRIMDEK HI-TEN, INTEGRITY® 820 and INTEGRITY® 890 make excellent choices.

Carports, garages, roofed outdoor areas

Where a flat roof is desired, use KLIP-LOK 406 or KLIP-LOK 700, BROWNBUILT® 305 or FLATDEK™ if long spans are necessary. Use CUSTOM ORB, SPANDEK HI-TEN, TRIMDEK HI-TEN or INTEGRITY® 820 or 890 where slightly more roof fall is possible. All these products have an underside which can be left exposed, avoiding the additional cost of ceiling linings.

Fences, privacy screens

NEETASCREEN® and NEETASCREEN PLUS® are complete, coloured steel fencing systems comprising COLORBOND steel infill panels with matching or contrasting COLORBOND steel posts and rails. The advantage of the NEETASCREEN system is that the fence looks the same from both sides. LYSAGHT MINISCREEN® and MINISCREEN PLUS® has virtually all the features of NEETASCREEN but by utilising Lysaght MINI ORB® it offers a more decorative and heritage style with a number of design options. Matching gates are optional. NEETASCREEN and MINISCREEN fences can be do-it-yourself or contract installed. LYSAGHT also supplies a range of wire formed and welded fencing – all Hot-Dipped Galvanized.

Colour

The regular finish for all LYSAGHT roofing and walling profiles is hot dipped ZINCALUME steel. But with colour such an important consideration in so many applications, most LYSAGHT roofing and walling profiles are also available in COLORBOND steel.

The paint system used for COLORBOND steel in exterior applications is specially formulated to resist exposure to the elements. The choice of profiles available in COLORBOND steel is matched by an attractive range of colours. A range of colour and material matching accessories is also available. The use of colour is a central element of many modern designs. With that in mind, the range and variety of COLORBOND steel profiles and accessories provides even greater design scope.

Farm buildings

LYSAGHT CUSTOM ORB, TRIMDEK HI-TEN and SPANDEK HI-TEN are recommended materials for the roofing and walling of sheds, barns and other farm buildings. Wall-Clad and Trim-Wall are cost effective alternatives for wall cladding only.

Shop roofs

All LYSAGHT decking profiles are suitable for the roofing of shopping blocks. The final choice of profile will be influenced largely by the design. Generally, KLIP-LOK 406, KLIP-LOK 700, INTEGRITY 820 and 890 deckings are used for modern low-pitched constructions. SPANDEK HI-TEN, TRIMDEK HI-TEN or even CUSTOM ORB provide an attractive ribbed appearance.

Shop facades

There are a number of LYSAGHT profiles which can be used to achieve a variety of shop facade designs. EASY-CLAD HI-TEN® cladding system can be used for a clean, sheet appearance. Alternatively, MINI ORB®, PANELRIB, MULTICLAD®, TRIMDEK HI-TEN or SPANDEK HI-TEN provide an attractive ribbed appearance.

Shop awning soffits

LYSAGHT PANELRIB, MULTICLAD and MINI ORB, or any of the roof deckings, may be used for awning soffits. Available as ZINCALUME steel or COLORBOND steel, long length sheets virtually end the necessity for end lapping. The various types of claddings also include the EASY-CLAD HI-TEN cladding system. The range takes in panels in differing tray modules.

Factories, warehouses

Strength and economy make TRIMDEK HI-TEN, SPANDEK HI-TEN, INTEGRITY 820 and 890 the most commonly used profiles for the roofing and walling of factories and similar buildings. Long lengths enable cladding to be carried out in a single run without end laps, resulting in savings in cladding time and a more pleasing finish. Virtually all of the LYSAGHT profiles are suitable for walling applications. The choice will depend on the type of building and aesthetic considerations.

For prestige buildings, or for feature areas, use KLIP-LOK 406 or KLIP-LOK 700 or BROWNBUILT 305 decking. All feature secret fixing, whereby the fastening clips are hidden from view. Where appearance is a factor, LYSAGHT prepainted profiles are an excellent choice. The range of colours and distinctive enough to available ensures that no part of a factory area need look dreary merely because it is functional.

Buildings such as schools, hospitals, sporting centres, clubs and churches are usually architect-designed and the choice of roofing will usually be made on the basis of individual design considerations.

Bull-nosing and curving

Many modern buildings incorporate bull-nosed or concave curved features. These are achieved using the CUSTOM BLUE ORB[®] profile in either ZINCALUME steel or COLORBOND prepainted steel.

Application of LYSAGHT cladding profiles

Profile	Roofing	Walling	Fencing and Privacy Screens	Fascias Soffits Awnings
CUSTOM ORB	●	●	●	●
TRIMDEK HI-TEN	●	●	●	●
SPANDEK HI-TEN	●	●	●	●
KLIP-LOK 406 and 700	●	●	—	●
INTEGRITY 820 and 890	●	●	—	●
BROWNBUILT 305	●	●	●	●
FLATDEK	●	●	●	●
PANELRIB	—	●	●	●
MINI ORB	—	●	●	●
MULTICLAD	—	●	●	●
MULTILINE 900	—	●	●	●
MULTILINE 600	—	●	●	●
WALLCLAD	—	●	●	●
TRIMWALL	—	●	●	●
EASY-CLAD HI-TEN	—	●	—	●

● Suitable for indicated applications

BHP Roof and Wall Sheeting Optional Finishes

LYSAGHT roofing and walling sheets are roll-formed from either plain or organic pre-finished ZINCALUME zinc/aluminium alloy-coated steel manufactured to AS 1397 specification. Plain ZINCALUME steel has a characteristic silver grey spangle finish.

All the profiles are available as COLORBOND prepainted steel in a wide range of colours. For a more detailed description of these steels, refer to the index under the appropriate product name.

The following pages briefly describe each of the LYSAGHT roofing and walling profiles. The steel used is expressed by Australian Standard number, steel base minimum yield stress in megapascals, followed by the metallic coating class. Thus AS 1397 G550 AZ150 means steel conforming to Australian Standard 1397, with steel base minimum yield stress 550 MPa, zinc/aluminium alloy coating 150 g/m² minimum coating mass determined by a prescribed triple spot test.

The coating classes nominated relate to both ZINCALUME steel and the ZINCALUME steel base of COLORBOND steel.

ROOFING AND WALLING SELECTION TABLES

Product Range Data

The LYSAGHT range of steel roofing and walling includes the profiles listed in the tables on pages 78 – 81.

Most are available in two materials:–

- ZINCALUME: Zinc/aluminium alloy-coated steel
- COLORBOND: Prepainted silicone modified polyester

Check with your BHP Building Products office regarding local availability of profiles and colours.

This table lists general information to enable profile selection. Please refer to individual product literature for detailed specification and also to the ZINCALUME steel and COLORBOND prepainted steel literature for specific information on these materials.

Roofing and Walling Selection Tables – Table 1.

LYSAGHT Roofing and Walling Profiles	Maximum recommended spacing of supports for normal conditions mm												
	BMT mm	Mass kg/m ²	Width of Coverage mm	Depth of Rib mm	Minimum Recommended Roof Pitch mm	WALLS							
						ROOFS			WALLS				
	0.42	4.3	762	16	5° (1 in 12)	Single	End	Internal	Unstiffened Overhang	Stiffened Overhang	Single	End	Internal
	0.48	4.9	762	16		700	900	1200	200	300	1700	2300	2700
	0.60	6.1	762	17	5° (1 in 12)	Single	End	Internal	Unstiffened Overhang	Stiffened Overhang	Single	End	Internal
	0.80	8.0	762	17		1600	1600	1800	200	300	1900	2800	3000
	0.42	4.3	762	29	2° (1 in 30)	Single	End	Internal	Unstiffened Overhang	Stiffened Overhang	Single	End	Internal
	0.48	4.9	762	29		1100	1300	1900	150	300	2400	2900	3000
	0.42	4.7	700	24	3° (1 in 20)	Single	End	Internal	Unstiffened Overhang	Stiffened Overhang	Single	End	Internal
	0.48	5.3	700	24		1300	1800	2400	300	600	2400	1800	2300

Note: 1. All roofing and walling profiles listed in Table 1 are supplied in plain ZINCALUME steel conforming to Australian Standard AS 1397-AZ150 (Except Custom Blue Orb, AZ200) or COLORBOND steel conforming to AS 1397-AZ150 and AS 2728.

2. At 1° in 50 (1°) slope all roof supports must be in the one plane as slight variations can result in a zero or negative fall. This may even occur after completion of the building as a result of timber warping or shrinkage or from settlement. Where possible, it is wise to design for a minimum 1 in 30 (2°) slope to ensure a positive fall and avoid any danger of "ponding," which can lead to a reduced service life, particularly in coastal areas.

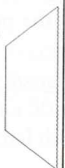
Continued... LYSAGHT Roofing and Walling Profiles	BMT mm	Mass kg/m ²	Width of Coverage mm	Depth of Rib mm	Minimum recommended roof pitch mm	Maximum recommended spacing of supports for normal conditions mm								
						ROOFS						WALLS		
						Single	End	Internal	Unstiffened Overhang	Stiffened Overhang	Single	End	Internal	
KLIP-LOK 406 	0.42	4.9	406	41	2°(1 in 30)	1500	1700	2100	200	600	1600	1600	1600	
	0.48	5.6	406	41	1°(1 in 50)	1800	2400	3000	200	600	2200	2200	2200	
	0.60	6.9	406	41	1°(1 in 50)	2300	2700	3600	300	900	2500	2500	3100	
KLIP-LOK 700 (Made in Qld only) 	0.42	4.6	700	41	2°(1 in 30)	1600	1700	2100	150	500	-	-	-	
	0.48	5.3	700	41	1°(1 in 50)	2000	2550	3000	150	500	1800	1800	1900	
	0.60	6.6	700	41	1°(1 in 50)	2600	2900	3600	200	750	2700	2900	2900	
INTEGRITY 820 (Made in NSW only) 	0.42	4.7	820	48	2°(1 in 30)	2100	2300	2800	150	300	1500	1700	2800	
	0.48	5.3	820	48	2°(1 in 30)	2500	2550	3050	200	350	2100	2100	3000	
INTEGRITY 890 (Made in NSW only) 	0.42	4.2	890	40	2°(1 in 30)	1100	1500	2100	150	300	1300	1900	2800	
	0.48	4.8	890	40	2°(1 in 30)	1500	1700	2300	200	350	1800	1900	2900	
BROWNBUILT 305 (Made in NSW only) 	0.55	7.80	305	48	1°(1 in 50)	-	1300	1500	-	-	-	-	2350	
	0.70	9.81	305	48	1°(1 in 50)	-	2000	2500	-	-	-	-	2700	
FLATDEK (Made in NSW only) 	0.42	1.56	250	45	2°(1 in 30)	3600	4000	4000	NA	NA	-	-	-	
						(Refer to brochure)								

(Refer to brochure)

Table 2.

LYSAGHT Walling only Profiles	BMT mm	Mass kg/m ²	Width of coverage mm	Depth of rib mm	Maximum recommended spacing of wall supports for normal conditions mm		
					Single	End	Internal
WALLCLAD 	0.35	3.6	762	16	1800	1700	2200
TRIMWALL 	0.35	3.6	762	29	1600	2100	2300
EASY-CLAD HI-TEN 4P 300 (Made in NSW only) 	0.42	4.5	300	12	—	1150	1150
EASY-CLAD HI-TEN 2PF 300 (Made in NSW only) 	0.42	4.5	300	19	—	900	900
PANELRIB 	0.35 0.42	3.3 3.9	850 850	4 4	1000 1100	1100 1200	1200 1200

Table 2.

Continued... Walling only Profiles	BMT mm	Mass kg/m ²	Width of Coverage mm	Depth of Rib mm	Maximum recommended spacing of wall supports for normal conditions Internal spans mm		
					Single	End	Internal
MINI ORB (Made in NSW only) 	0.35	3.40	820	6			1200
	0.42	4.04	820	6			1300
	0.48	4.51	820	6	-	-	1500
	0.60	5.25	795	6			1500
MULTICLAD (Made in NSW only) 	0.35	3.25	840	12	1100	1300	1700
	0.42	3.85	-	-	1400	1800	1800
MULTILINE 900 (Made in Qld only) 	0.35	3.10	890	12	-	800	900
	0.42	3.66	890	12	-	800	900
MULTILINE 600 (Made in Qld only) 	0.35	3.10	593	12	-	800	850
Note: All Walling profiles listed in Table 2 are supplied in plain ZINCALUME steel conforming to Australian/Standard AS 1397 - AZ150 or COLORBOND steel conforming to AS 1397-AZ150 and AS 2728.							

Custom Orb

Zincalume Custom Blue Orb

Wallclad

Custom Blue Orb



LYSAGHT CUSTOM ORB, ZINCALUME CUSTOM BLUE ORB and WALLCLAD sheets are ZINCALUME zinc/aluminium alloy-coated steel roll-formed to the familiar conventional 76mm pitch corrugated profile. CUSTOM BLUE ORB has the same corrugated profile but with a zinc coating.

Each of these building products is produced according to its steel base/coating combination to suit particular requirements.

- **Custom Orb** – Steel roofing and walling
- **Zincalume Custom Blue Orb** – Steel curving quality roofing and walling sheet for bull-nosing
- **Wallclad** – Steel walling only

These sheets have one edge specially contoured to break contact between the sheets in the lap to prevent the possibility of capillary action drawing moisture into the lap.

LYSAGHT CUSTOM ORB

CUSTOM ORB is a corrugated ZINCALUME steel sheet combining high strength, light weight and zinc/aluminium coating for corrosion resistance. It is intended for roof and wall cladding requiring high resistance to deformation, and relatively wide spacing of support centres. CUSTOM ORB conforms to AS 1445 G550 AZ150: 10¹/₂ x 76mm corrugations; 762mm cover width with 1¹/₂ corrugations side lap, steel base thickness 0.42mm or 0.48mm.

CUSTOM ORB steel is not suitable for curving. ZINCALUME CUSTOM BLUE ORB steel is a companion sheet which may be used where curving and bull-nosing are required.

CUSTOM ORB is available in stock lengths up to 9000mm, or factory cut to lengths in 10mm increments. Longer lengths can be supplied provided transport and on-site handling can be arranged.

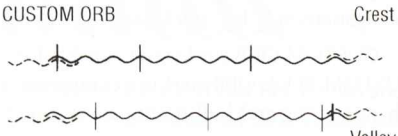
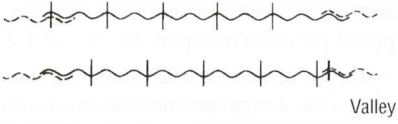
The profile design, width and long sheet length of CUSTOM ORB steel provide design and installation advantages including:

- Custom cut lengths to avoid waste
 - Wide support spacings – internal spans up to 1200mm for roofing and up to 2700mm for walling in normal weather conditions
 - One sheet from roof ridge to gutter – no end laps
 - Minimum roof slope of 5° (1 in 12) on roofs without end laps
 - Consecutive side lapping and laying without the need to turn over alternate sheets
 - Weather-resistant 1¹/₂ corrugations side laps
- Maximum eave overhangs of 200mm unstiffened, or 300mm when stiffened with a 50 x 1.2mm angle or equivalent, depending on material thickness

CUSTOM ORB is also available in COLORBOND prepainted steel.

Installation data

Location of crest or valley fastenings for intermediate and end fastening for normal weather conditions.

Support Location	Fasteners per Sheet	Location of crest Fasteners for Roofs and Walls and Valley Fasteners for Walls
INTERNAL SUPPORTS	3	 <p>Crest</p> <p>Valley</p>
END AND LAP SUPPORTS	5	 <p>Crest</p> <p>Valley</p>

LYSAGHT ZINCALUME CUSTOM BLUE ORB

ZINCALUME CUSTOM BLUE ORB® steel is essentially the same as CUSTOM ORB, but formed from a thicker ductile steel so it is **suitable for curving**. It is used in roofing and walling applications where **bull-nosing** or **concave curving** is required, and for **tank-making**.

ZINCALUME CUSTOM BLUE ORB conforms to specification AS 1445 G300 AZ 200, 10½ x 76mm corrugations; 762mm cover width with 1½ corrugations side lap. Two thicknesses are available:—

Steel base thickness

0.60mm and 0.80mm

The long lengths available allow sheets to be curved into a full circle for tank-making, particularly where a curving machine with vertical rollers is used.

Lengths available and installation details are as for CUSTOM ORB, except that in addition, the 0.80mm BMT sheet maximum support spacings in normal areas are 2600mm for roof intermediate spans and 3000mm for wall spans.

ZINCALUME CUSTOM BLUE ORB sheet can be supplied as ZINCALUME steel or COLORBOND prepainted steel.

LYSAGHT WALLCLAD

WALLCLAD® steel is an economy corrugated walling sheet produced from ZINCALUME steel with the same traditional profile as CUSTOM ORB. WALLCLAD steel conforms to AS 1397 G550 AZ150; 10¹/₂ x 76mm corrugations; 762mm cover width with 1¹/₂ corrugations side lap; steel base thickness 0.35mm.

Lengths available and walling installation details are as for CUSTOM ORB, except that maximum wall support spacing in normal areas for two or more spans is 2200mm.

LYSAGHT CUSTOM BLUE ORB

CUSTOM BLUE ORB is a curving quality corrugated steel sheet produced with a heavy zinc coating to AS 1445-G300-Z600; steel base thickness 0.60mm. Two widths are available:

- 10¹/₂ x 76mm corrugations
- 8 x 76mm corrugations

Long lengths allow sheets to be curved into a full circle, particularly where a machine with vertical rollers is used.

CUSTOM BLUE ORB sheet is available in stock lengths up to 9000mm or factory cut to lengths in 10mm increments. Lengths over 9000mm can be supplied provided transport and on-site handling can be arranged.

LYSAGHT TRIMDEK HI-TEN



762mm Cover

TRIMDEK HI-TEN® is a high-tensile, light-weight ZINCALUME steel roofing and walling sheet roll-formed to a modern shape.

Material conforms to AS 1397 G550 AZ150; 762mm cover width; steel base thickness 0.42mm or 0.48mm.

TRIMDEK HI-TEN is also available in COLORBOND prepainted steel.

It is available in factory cut lengths up to 12000mm in 10mm increments. Longer lengths are available provided satisfactory transport and on-site handling can be arranged.

Features include:

- Custom cut lengths to avoid waste
- One sheet from roof ridge to gutter - no end laps
- Effective cover width of 762mm
- Minimum pitch of 2° (1 in 30) on roofs without end laps

LYSAGHT TRIMWALL

TRIMWALL is an economic, steel walling sheet with a profile similar to TRIMDEK HI-TEN, produced from ZINCALUME steel or COLORBOND prepainted steel. TRIMWALL conforms to AS1397 G550 AZ150; steel base thickness 0.35mm; sheet cover width 762mm.

TRIMWALL sheets are suitable for walling in non-critical rural applications. They are not suitable for roofing.

TRIMWALL is available through BHP Building Products distributors in stock lengths or custom cut to requirements.

LYSAGHT SPANDEK HI-TEN



SPANDEK HI-TEN[®] is a lightweight ZINCALUME steel roofing and wall cladding sheet, roll-formed to a modern profile. SPANDEK HI-TEN steel is also available in COLORBOND prepainted steel.

Material conforms to AS 1397 G550 AZ150; 700mm cover width. Two thicknesses are supplied:

Steel base thicknesses 0.42mm and 0.48mm

It is available in factory-cut lengths up to 12000mm in 10mm increments. Longer lengths are available provided satisfactory transport and on-site handling can be arranged.

Features include:

- Custom cut lengths to avoid waste
- Wide support spacings – regular product – internal spans up to 1900mm for roofing and up to 3500mm for walling for normal weather conditions
- One sheet from roof ridge to gutter – no end laps
- Effective cover width of 700mm
- Minimum pitch of 3° (1 in 20) on roofs without end laps
- Patented fluted side lap for protection against moisture entry by capillary action

LYSAGHT INTEGRITY 820



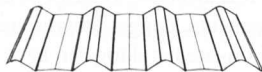
INTEGRITY 820 is a strong and attractive exterior cladding profile designed for commercial and industrial applications where long span and fast installation are required. Each sheet requires 3 fasteners per support. Available in ZINCALUME steel and COLORBOND prepainted steel.

Material conforms to AS 1397 G550 AZ150: 820mm cover width: steel base thicknesses 0.42mm and 0.48mm.

Features include:

- Custom cut lengths to avoid waste*
- Wide support spacing
- Fixing economics (fewer fasteners)
- Fixing down to 2° pitch
- Excellent rainfall drainage
- Also ideal for wall cladding

LYSAGHT INTEGRITY 890



INTEGRITY 890 is a strong and versatile exterior cladding profile designed for commercial and industrial applications where fast and simple installation is a prime requirement. Available in ZINCALUME steel and COLORBOND prepainted steel.

INTEGRITY 890 offers a very wide cover width of 890mm, which means fewer roof sheets. It requires fewer fasteners than other profiles, which in turn makes it faster and less costly to install.

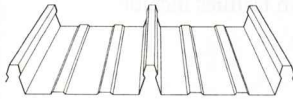
Material conforms to AS 1397 G550 AZ150: 890mm cover width: steel base thickness 0.42mm and 0.48mm.

Features include:

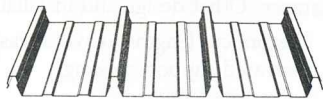
- Custom cut lengths to avoid waste*
- Wide cover
- Fixing down to 2° pitch
- Excellent rainfall drainage
- Fixing economics

*Both profiles available in factory cut lengths to 12000mm. Longer lengths available subject to satisfactory transport and on-site handling.

LYSAGHT KLIP-LOK 406 AND KLIP-LOK 700



406mm Cover



700mm Cover

KLIP-LOK is a lightweight, rigid roof decking or wall cladding roll-formed from ZINCALUME steel in a choice of three thicknesses.

Material specification is to AS 1397 G550 AZ150. The zinc/aluminium alloy coating provides outdoor exposure protection and long life. Effective cover width of KLIP-LOK decks is 406mm and 700mm.

Steel base thicknesses 0.42mm 0.48mm 0.60mm

	BMT mm	Width of coverage mm	Depth of Rib mm	Minimum recommended roof pitch mm	Max recommended spacing of supports for normal conditions		
					Roofs		Walls
					Internal Spans, mm	End Spans, mm	Internal Spans, mm
KLIP-LOK 406	0.42	406	41	2° (1 in 30)	2100	1700	1800
KLIP-LOK 406	0.48	406	41	1° (1 in 50)	3000	2400	2400
KLIP-LOK 406	0.60	406	41	1° (1 in 50)	3600	2700	3000
KLIP-LOK 700	0.42	700	41	2° (1 in 30)	2100	1700	—
KLIP-LOK 700	0.48	700	41	1° (1 in 50)	3000	2550	1900
KLIP-LOK 700	0.60	700	41	1° (1 in 50)	3600	2900	2900

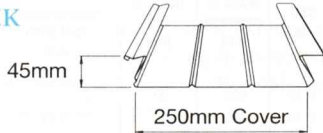
KLIP-LOK decks are designed particularly for low pitch roof applications. The interlocking ribs, together with concealed fastening (no puncturing), ensures weather resistance on roof pitches as low as 1° (1 in 50) where no end laps are used.

KLIP-LOK may be used as wall cladding to give a contrasting appearance. Other design and installation features include:

- Custom cut lengths to avoid waste
- Increased support spacing
- Long deck lengths
- Special rib design which makes the deck a structural member in itself, thus permitting more economical use of framework
- Positive side rib interlocking with concealed clips providing adequate fastening
- Effective spreading of loads from one deck to adjacent decks
- Modern architectural profile

KLIP-LOK decks are also available in COLORBOND prepainted steel. KLIP-LOK is factory cut to lengths in 10mm increments up to 15000mm. Longer lengths are available provided satisfactory transport and on-site handling can be arranged.

LYSAGHT FLATDEK

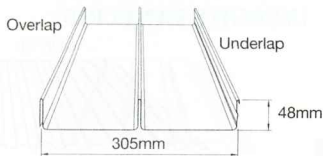


FLATDEK is a long span cladding with an attractive ceiling finish. Ideal for low pitches to 2°(1 in 30) and available in sheet lengths from 1200 to 8000mm custom cut.

To highlight the clean line of FLATDEK it is available in COLORBOND high gloss prepainted steel on the ceiling side in either Dover White or Smooth Cream whilst the topside is COLORBOND Off White. This makes it ideal for carports and outdoor areas where the ceiling is exposed.

FLATDEK'S excellent structural performance is derived from the profile's unique shape and the inherent strength of the high tensile BHP Steel.

LYSAGHT BROWNBUILT 305



Manufactured in NSW BROWNBUILT 305 is a strong and durable concealed fastened roof and wall cladding.

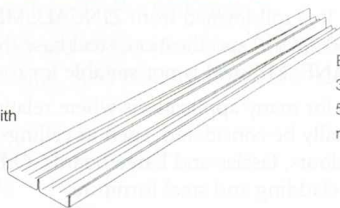
Material conforms to AS 1397-G300-AZ150 (and AS 2728 for COLORBOND). It is suitable for use on roof pitches as low as 1° (check local centre for availability).

Cover Width: 305mm

Steel base thickness: 0.55 and 0.70mm

LYSAGHT TAPERED BROWNBUILT 305

BROWNBUILT 305 with
no width reduction.

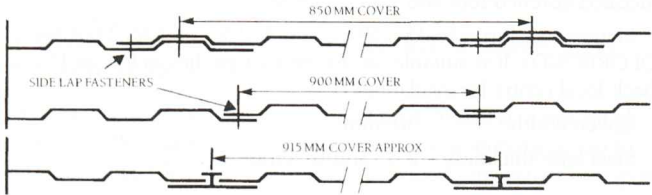


BROWNBUILT
305 with up to
50% width
reduction.

Designed to give total architectural freedom, Tapered BROWNBUILT 305 opens new horizons for fanned roof applications.

Using a tapering process developed entirely within BHP Building Products, the tapered BROWNBUILT 305 provides a striking solution to fanned roofs. The tapering process is capable of reducing the cover width by up to 50% over the length of the sheet.

LYSAGHT PANELRIB



PANELRIB is a fluted steel cladding for exterior or interior straight or curved walls. It is roll-formed from ZINCALUME steel conforming to AS 1397 G550 AZ150 specification; steel base thicknesses 0.35mm and 0.42mm. PANELRIB steel is not suitable for roofing.

It is suitable for many applications where relatively flat sheets would not normally be considered, such as ceilings, partition facings, screens, garage doors, fascias and barge boards. Other uses include bus and truck body cladding and steel furniture.

The longitudinal flutes improve rigidity and strength along the sheet length, but flexibility across the width is maintained. The longitudinal stiffness of PANELRIB steel approximates that of a flat sheet six times as thick.

PANELRIB is also available in COLORBOND prepainted steel.

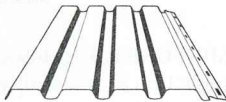
PANELRIB steel is available in stock lengths from 1000 to 5000mm or custom cut to lengths up to 4500mm. Longer lengths are subject to enquiry.

LYSAGHT EASYCLAD HI-TEN

2PF300



4P300



EASYCLAD HI-TEN is well suited to a variety of contemporary building needs. Recommended applications include fascias and wall cladding, feature and infill panels, screens, awnings, soffit linings and ceilings. It can be used on walls with panels running either vertically or horizontally. A wide range of trim sections and accessories cater for various design situations.

EASYCLAD is roll-formed from ZINCALUME steel AS1397 G550 AZ150 and is available in an attractive range of colours in COLORBOND prepainted steel.

Available custom cut from 650 to 9500mm.

Both 2PF300 (Flutes) and 4P300 (flat) have 300mm module trays utilising concealed fastening. Steel base thickness of 0.42mm.

Features include:

- Freedom of design
- Easy secret fixing
- Wide range of accessories
- Lightness and strength
- Attractive range of colours

LYSAGHT EASYCLAD EH300

(Manufactured in Darwin for Northern Market)

Having 300mm flat module trays, 0.55 steel base thickness ZINCALUME or COLORBOND – A range of trim sections and accessories are available.

LYSAGHT MINI ORB



820mm Cover – 795mm, 0.60

MINI ORB is a sophisticated corrugated profile commonly known as Ripple Iron or 1° corrugated steel. It has the same shape as CUSTOM ORB but on a much reduced scale. Mini Orb can be fixed either vertically or horizontally.

MINI ORB is suitable for use in exterior and interior applications on straight or curved surfaces. It is not suitable for roofing.

Material conforms to AS 1397 G300 or G550, AZ150; 820mm cover width; steel base thickness of 0.35, 0.42, 0.48 and 0.60mm.

It is available in sheet lengths from 300mm to 9000mm custom cut.

MINI ORB is available in a range of attractive colours in COLORBOND prepainted steel and in ZINCALUME zinc/aluminium alloy coated steel. A wide range of trim sections are available.

LYSAGHT MULTICLAD



840mm Cover

MULTICLAD is an economical and attractive wall profile suitable for a wide range of domestic, commercial and industrial applications. Although unsuitable for use as roofing, MULTICLAD is ideal for garages, walling, screens and fascias.

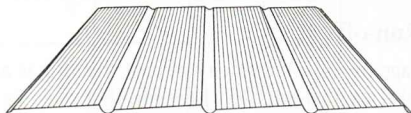
It is available in ZINCALUME steel and COLORBOND prepainted steel.

Material conforms to AS 1397 G550 AZ150: 840mm cover width; steel base thicknesses of 0.35mm and 0.42mm. Available 600mm to 7500mm custom cut.

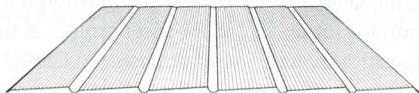
Features include:

- Attractive multi ribbed profile
- Quick and easy to install
- Versatile applications
- Attractive colour range

LYSAGHT MULTILINE 600 AND MULTILINE 900



593mm Cover



890mm Cover

MULTILINE 600 and MULTILINE 900 are attractive new profiles characterised by fluted pans and chamfer styling, suitable for exterior horizontal cladding of stud walls.

MULTILINE is available in two cover widths (593mm and 890mm) to suit most wall heights with a minimum of wastage. Manufactured from ZINCALUME steel which conforms to AS 1397 G550 AZ150: steel base thickness 0.35mm and 0.42mm. Available custom cut from 175mm to 6000mm.

Features include:

- Suitable for both wall cladding and fascias
- Quick and easy to fix
- Special flashings and trims available
- Wide range of COLORBOND steel colours

ROOF DRAINAGE

Rainwater Run-off

The drainage or run-off capacity of roof sheeting is another limitation on the total length of a sheet run that must be considered in roof design and construction.

As a guide, the table on page 97 lists the maximum recommended length of roof run for various LYSAGHT sheet profiles at the roof slopes and rainfall intensities shown. These are based on CSIRO research and BHP Building Products calculation of the behaviour of roofing profiles under peak rainfall conditions.

The roof run is the total length of roof sheeting draining rainwater in one direction, including any end laps, expansion joints or steps that may be present in the roof.

See the table on page 108 for rainfall intensities for selected localities.

Lysaght Sheet Profile	Rainfall Intensity mm/hr	Roof Slope					
		1 in 50 1°	1 in 30 2°	1 in 20 3°	1 in 12 5°	1 in 7.5 7.5°	1 in 6 10°
CUSTOM ORB and CUSTOM BLUE ORB	100					35	39
	150				30	23	26
	200				15	17	20
	250				12	14	16
	300				10	11	13
	400				8	9	10
SPANDEK HI-TEN	150			43	51	57	63
	200			32	38	43	47
	250			26	30	34	38
	300			22	25	28	31
	400			16	19	21	23
TRIMDEK HI-TEN	200		93	105	123	139	152
	250		74	84	98	111	121
	300		62	70	82	92	101
	400		46	52	61	69	76
INTEGRITY 820	250		128	145	169	192	210
	300		107	121	141	160	175
	400		80	91	106	119	131
	500		64	72	85	96	105
INTEGRITY 890	250		89	101	118	133	145
	300		74	84	98	111	121
	400		56	63	74	83	91
	500		44	50	59	66	73
KLIP-LOK 406	250	61	76	86	100	113	124
	300	51	63	71	83	94	103
	400	38	47	53	63	70	77
	500	31	38	43	50	56	62
KLIP-LOK 700	250	66	81	92	108	122	133
	300	55	68	77	90	102	111
	400	41	51	58	67	76	83
	500	33	41	46	54	61	67

*Maximum length limitations imposed by transport vary for each state.

Roofing & Walling

GUTTER CAPACITY

The gutter cross-sectional areas given in the table on page 100, are provided for guidance only. Where more precise design data are required, the following documents should be consulted:

- AS 2180 Metal rainwater goods – selection and installation.
- The Institution of Engineers, Australia, “First Report of the Stormwater Standards Committee, Australian Rainfall and Runoff”.

In each case, the latest available version of the document should be used, as research and development of rainwater goods is continuing, resulting in ongoing refinement of the design parameters and relevant data.

The table on page 100 lists a selection of roof catchment areas that are drained by one downpipe and shows the cross sectional area of gutter required for a range of rainfall intensities. The roof catchment area for each downpipe is the length of roof run (ridge to gutter) multiplied by the spacing between downpipes.

The table on page 108 is an extract from AS 2180-1986 (as amended) and shows rainfall intensities, for major and other selected localities, related to a storm of 5 minutes duration and a return interval of once in 20 years and once in 100 years.

Eaves gutter sizes are based on rainfall intensities for an overflow risk of once in 20 years, and internal box gutters for an overflow risk of once in 100 years.

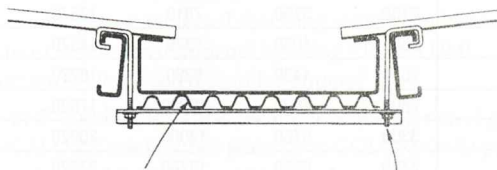
A further safety margin of 25mm freeboard on the depth of internal box gutters should be added to the cross sectional areas given in the table.

Australian Standard 2180-1986 states that eaves gutters should have a fall towards the outlets of 1 in 500 and internal box gutters a fall of 1 in 200. If for some design or other consideration gutters are installed without fall, ponding will result and this could reduce

the life of the gutter. In such situations the gutter should be cleaned out regularly. With high fronted eaves fascia-gutters, care should be taken to prevent overflow from the back of the gutter into the building, in the event of a blocked downpipe. This can be done by providing drainage slots along the front of the gutter, at a lower level than the back of the gutter, or by providing extra downpipes.

Internal box gutters of more than 15000mm² cross section, should be a minimum of 300mm wide and fully supported to allow workmen to walk along the bottom of the gutter. Sheetting such as Spandek Hi-Ten can be used under a wide box gutter to provide full support between the gutter hangers.

We emphasise that the values given in the table on page 100 are for guidance only. Any major rainwater disposal system should be specifically designed by an appropriate professional consultant. The sizes given in the table are based on systems which have been successfully used in the past.



Spandek Hi-Ten sheet to fully support bottom of box gutter

Gutter hanger with adjustment for fall

Note: This shows a traditional type of full-length support system for a box gutter. In some locations alternative systems are available, and we suggest you check with your local BHP Building Products Centre.

Gutter Sizes for Various Rainfall Intensities and Roof Catchment Areas Per Downpipe

Rainfall Intensity (mm/hr)	Roof Catchment Area				
	10m ²	20m ²	50m ²	100m ²	200m ²
	Cross Sectional Area of Gutter (mm ²) required to drain above roof catchment area into one downpipe				
80	1300	2200	4600	8000	14000
90	1420	2400	5100	8750	15220
100	1540	2600	5500	9450	16430
110	1630	2800	5890	10150	17630
120	1740	2990	6280	10850	18820
130	1850	3180	6670	11530	20000
140	1950	3370	7050	12210	21170
150	2050	3560	7430	12890	22330
160	2150	3750	7810	13570	23490
175	2300	4030	8370	14570	25210
200	2550	4480	9290	16220	28060
225	2800	4920	10200	17820	30860
275	3300	5760	12000	20920	36400
325	3780	6560	13750	23920	41700
425	4650	8060	16800	29250	51000

Note: For internal box gutters add 25mm of freeboard depth to cross sectional areas given in this table.

STEEL GUTTERS

Materials

Until recent years, steel gutters have traditionally been galvanized. The adequate service provided by these gutters was largely due to the protective films developed on the zinc coating by reaction with beneficial compounds gathered from the roof by rainwater; these included zinc oxides and carbonates from the early oxidation of galvanized roofs, and mainly calcium salts leached from asbestos cement or cement tile roofs.

Today, with the increased popularity of inert roofing materials such as COLORBOND prepainted steel, ZINCALUME steel and terracotta tiles, the lifespan of galvanized gutters can be shortened, especially in high rainfall areas near tropical coastlines, because of the high purity of the run-off water. The characteristics of the water running into gutters can be influenced by other factors such as atmospheric conditions, fallout, rainfall frequency and intensity.

It has now been established that long service can be assured in all but the most severe environments by using ZINCALUME zinc/aluminium alloy-coated steel for gutters.

The BHP Building Products recommendation for steel gutters is that ZINCALUME steel (either plain or as COLORBOND prepainted steel) specified in AS 2179 should be used in preference to galvanized steel.

Product Range

Gutters today are not just a simple means of water catchment; Sophisticated systems and profiles are now available that deliver strength, good looks and, above all, long life. For example, ZINCALUME steel can last up to four times as long as galvanized gutter under similar conditions.

Gutter profiles and dimensions can vary from state to state, and it is important to choose the product available that best suits your needs.

BHP Building Products supplies a range of gutters, cappings and accessories, some of which are listed here.

Features of all LYSAGHT gutters, cappings and fascia include:-

- Manufactured from light, strong high tensile G550 base ZINCALUME steel or COLORBOND prepainted steel
- Fast and easy to install
- Available in standard or custom cut lengths
- Compatible with steel or tile roofs
- Full range of colour matching accessories
- All COLORBOND steel delivered with a strippable plastic coating to avoid damage in transit and handling

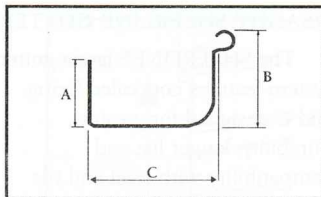
LYSAGHT QUAD GUTTER

Traditional Quad/D gutter is available in a variety of sizes to suit individual state requirements.

*Available slotted

LYSAGHT QUAD COMPONENTS

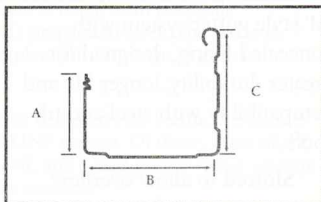
Gutter, Internal and External Brackets; Spike Brackets (QLD only); Internal and External Pressed Mitres; Internal and External Fabricated Mitres; End Stops; Downpipe; Accessories.



STATE	GUTTER	A	B	C
QLD*	175 Hi-Front	65	90	115
	150	75	74	150
	175	103	92	175
NSW*	115 Hi-Front	65	90	115
	125	61	66	125
	Lo-Front	65	70	115
VIC*	115 Hi-Front	65	90	115
TAS	115 Hi-Front	65	90	115
SA	115 Hi-Front	65	90	125
WA	125	70	80	125
	150	70	80	150

LYSAGHT TRIMLINE GUTTER

A strong economical gutter system with concealed fixing, designed for use with steel and tile roofs. Choice of **optional slotting** to allow overflow during heavy rainfall



LYSAGHT TRIMLINE COMPONENTS

Gutter; Clips; End Stops; Corners; Downpipe; Accessories.

STATE	A	B	C
NSW	73	124	117
VIC/TAS	72	124	116
QLD	70	124	116

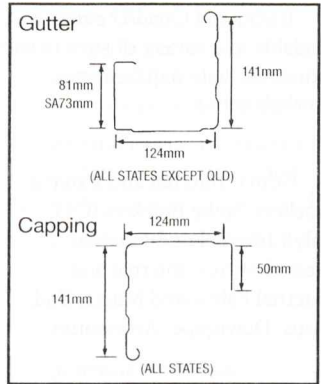
LYSAGHT SHEERLINE GUTTER AND CAPPING

The SHEERLINE® fascia gutter system features concealed fixing and is designed for greater durability, longer life and compatibility with steel and tile roofs.

Choice of **optional slotting** to allow overflow during heavy rains.

Sheerline Components

Gutter; Capping; Clips; End Stops; Corners; Downpipe; Accessories.



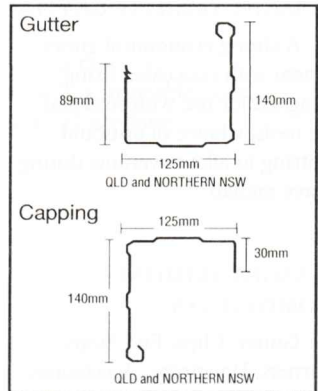
LYSAGHT EMLINE GUTTER AND CAPPING

EMLINE® is a strong, attractive 'M' style gutter system with concealed fixing, designed for greater durability, longer life and compatibility with steel and tile roofs.

Slotted to allow overflow during heavy rainfall, the EMLINE gutter has a generous rainwater carrying capacity.

Emline Components

Gutter; Capping; Clips; End Stops; Corners; Downpipe; Accessories.



LYSAGHT NOVALINE FASCIA AND GUTTER SYSTEMS

The basis of the system is a new spring clip that simply snaps onto the specially-designed NOVALINE® fascia, and makes fixing of gutters quick and easy.

Novaline Fascia (Additional components)

Standard rafter clip, barge rafter clip, hip rafter clip, splice plate, internal corner, external corner, internal cover cap, barge mould (right and left hand), apex cover end closer, plus all gutter accessories.

There are four core components to the BHP NOVALINE system:

- **Fascia**

The new LYSAGHT NOVALINE fascia is made from hi-tensile ZINCALUME steel or COLORBOND prepainted steel. The fascia is designed with stiffening ribs to complement our range of gutters.

- **Gutters**

BHP Building Products has numerous distinctive and attractive gutters that are compatible with the NOVALINE system. Of these, three of the most popular are TRIMLINE, EMLINE and Quad gutter. Please enquire for information on the other profiles available.

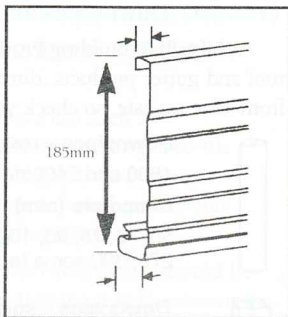
- **Spring clip**

The NOVALINE Spring Clip is of a standard size that quickly and easily snaps onto the fascia at a maximum of 1200mm centres, and holds your BHP Building Products gutter securely in place.

- **Overstrap**

Positioned beside every NOVALINE Spring Clip, these overstraps vary depending on the gutter used.

The overstrap ensures that a clean, straight, attractive line is maintained along the entire length of the gutter, whilst providing increased rigidity.



LYSAGHT Downpipes and Accessories

Whilst BHP Building Products supplies a range to complement its roof and gutter products, dimensions and even product name can vary from state to state, so check your local distributor for availability.



Downpipes – round

1800 and 2400mm lengths (custom cut on request)

Diameters (mm)

50, 65, 75, 90, 100, 125, 150, 175, 200, 225, 250, 275, 300 some tapered.

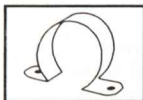


Downpipes – square/rectangular

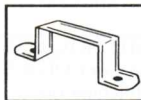
1800 and 2400mm lengths (custom cut on request)

Dimensions (mm)

100x50, 100x75, 100x100, 125x100, 150x100, 150x150 all tapered (other sizes on enquiry)



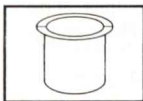
Round
Astragals/Straps



Square/
Rectangular
Astragals/Straps

Downpipe Nozzles/Pops

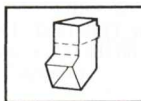
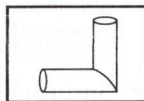
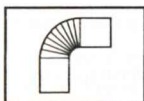
Downpipe Bends/Elbows
(made to 45 or 90° angle)



Round



Square/Rectangular



Crimped Bends
90/45°



Chinamens Hat
(on short pipe)

All sizes (diameters) to suit downpipes as ordered.

Downpipe Capacity

Gutters and downpipes should be made from coated steel conforming to AS 1397.

Rainwater run-off from inert roofing materials such as ZINCALUME steel, COLORBOND steel, aluminium or glazed tile surfaces should **not** be drained into a PLAIN galvanized gutter. ZINCALUME steel or COLORBOND prepainted steel gutters and downpipes are recommended for these roofing materials.

The cross-section of a downpipe from an eaves gutter should be 65mm^2 for each square metre of roof area draining into the downpipe.

The cross-section of a downpipe from an internal box gutter should be 95mm^2 for each square metre of roof area draining into the downpipe.

However, the minimum cross-section of any downpipe should be at least half that of the gutter from which it drains.

It is good practice to provide drainage sumps at downpipe connections to gutters, or at least have funnels at the head of each downpipe, particularly for internal box gutters.

Where possible, downpipes should be spaced at no more than 18m centres.

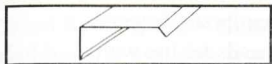
Refer to “**Design Rainfall Intensities**” table on the following page, and also the table on page 100 for gutter sizing.

Design Rainfall Intensities

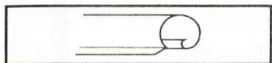
Locality	For overflow of Eaves Gutters Once in 20 Years mm/hr	For Overflow of Internal Box Gutters Once in 100 Years mm/hr
Australian Capital Territory		
Canberra	137	194
New South Wales		
Broken Hill	130	181
Bathurst	143	197
Sydney	214	273
Newcastle	181	233
Victoria		
Mildura	125	174
Melbourne	127	186
Ballarat	127	184
Queensland		
Cloncurry	172	228
Brisbane	251	333
Rockhampton	248	336
Mackay	273	363
Townsville	260	346
Cairns	282	368
South Australia		
Mount Gambier	108	168
Adelaide	123	186
Western Australia		
Geraldton	132	173
Perth	146	214
Tasmania		
Hobart	99	155
Northern Territory		
Alice Springs	139	204
Darwin	285	366

STANDARD FLASHINGS

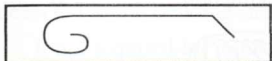
Dimensions vary to suit the particular roofing/walling profile. Check with your local distributor or ask for the capping/flashings to suit your LYSAGHT profile.



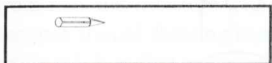
Barge Capping



Barge Roll



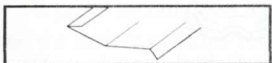
Barge Roll Capping



Spear Point

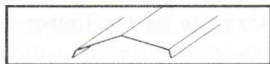


Apron Flashing



Tile Flashing

Note: A wide range of special flashings cappings and box gutters are available to complement LYSAGHT steel claddings.



Ridge Capping



Roll Top Ridge Capping

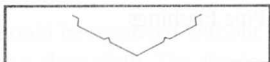
Custom Orb and Custom Blue Orb



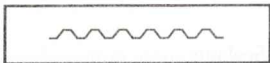
Valley Flashing



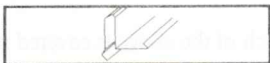
Ribbed Valley



Structural Valley



Valley Support



Barge Gutter

OTHER CONSIDERATIONS AND/OR REQUIREMENTS WHEN CONTEMPLATING A STEEL ROOF

- Type of Fastenings

Fixing to Steel or Timber – Select appropriate fasteners.
Painted heads for use with Colorbond steel

- * Are rivets or drive sockets required?



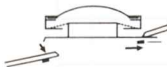
- Insulation – For Heat and/or Noise Reduction

- Roof Ventilators



- Skylighting

- Translucent Sheeting



- Pipe Flashings



- Infill Strips – Protect against dust, insects, birds etc

- Sealants



Each of the above is covered more fully elsewhere in the publication; refer to index.

INSTALLATION AND SITE NOTES

Installation Instruction

Installation instructions for each LYSAGHT roofing and walling product are provided in individual product literature. **A complete “Steel Roofing and Walling Installation Manual”, for all LYSAGHT claddings, is available from BHP Building Products offices or distributors.**

Care and storage prior to installation

BHP ZINCALUME steel, galvanized or organic-coated COLORBOND steel roofing and walling products are normally delivered to the building site in strapped bundles.

If not required for immediate use, sheets or bundles should be neatly stacked clear of the ground and, if left in the open, protected from rain and moisture with tarpaulins or similar covers. On no account should sheeting in any surface finish be allowed to get wet while still bundled or nested in stacks. Rain or condensation is easily drawn between the surfaces of nested sheets by capillary action, or driven in by wind action. This trapped moisture cannot evaporate normally and can cause deterioration of the coating, which may lead to a reduced life expectancy or poor appearance.

If packs become wet, the sheets should be separated without delay and the surface moisture removed with a clean cloth. The sheets should then be stacked so that air circulation completes the drying process.

Wet storage stain can occur from condensation alone – even in dry weather. Keep the product dry.

Atmospheric exposure conditions

If it is intended to use BHP steel products near salt marine locations, or in severe industrial or unusually corrosive atmospheric environments, its recommended that specialised advice be sought from a BHP office. However, as a general guide BHP Building Products recommendations are provided in The Referee under the heading “Atmospheric Exposure Conditions” (see index).

Handling on site

On large building projects, handling time can be reduced by lifting sheet bundles by crane direct from the delivery truck onto the roof frame. For long length sheets, the use of a spreader bar and fabric slings is recommended for this operation. For small to medium size projects, without mechanical handling facilities, sheets can be unloaded by hand and passed up to the roof one at a time.

To preserve the surface finish, and for personal safety, clean, dry gloves should be worn when handling sheets. Do not slide sheets over rough surfaces or over each other and do not drag tools etc. over sheets.

Cutting sheets on site

If it is necessary to saw cut sheets on site, care should be taken to avoid cutting over other sheeting, particularly when using power saws which project hot metal particles onto the lower sheeting. This is particularly the case with COLORBOND steel, because the fine particles can adhere to the sheeting. Where cutting over other sheeting cannot be avoided, a protective covering should be placed over the lower sheets. When saw-cutting COLORBOND steel, it is good practice to use padded supports and cut sheets with the face side downwards. Also, it is preferable to use metal cutting steel blades in power saws (minimum 4000 rpm) as they project fewer fine metal particles and leave less burred edges than carborundum discs.

Performance

LYSAGHT roofing and walling will perform as specified if installed in accordance with the recommendations set out in individual product literature, from BHP Building Products.

Walking on roof sheeting

When walking along the length of roof sheeting, walk in the trays of KLIP-LOK 406, KLIP-LOK 700, TRIMDEK HI-TEN, INTEGRITY 820 or 890, and on at least two ribs or corrugations of SPANDEK HI-TEN and CUSTOM ORB. When walking across the length of roof sheeting, walk over or close to the roofing supports. Generally, keep the load evenly distributed over the roofing supports, and evenly distributed over the soles of both feet. Try not to concentrate it on either heel or toe.

Always wear soft-soled shoes, avoid the ribbed type that pick up and hold small stones, etc.

Sheets taken freshly from packs may have an oily surface and care should be exercised when walking over them until the oil has had time to evaporate. This applies particularly to steeper pitched roofs.

Galvanic or Electro-Chemical Action

These terms refer to the corrosion set off when dissimilar metals are in contact with one another in the presence of moisture. In the case of zinc and steel, galvanic action leads to the protection of the steel by the sacrificial corrosion of the zinc. However, conditions can arise where zinc can be severely corroded by reason of its contact with dissimilar metals. In particular, contact with copper or brass, in the presence of moisture, will lead to the rapid removal of zinc from galvanized or ZINCALUME steel, and likewise the corrosion of the underlying steel.

DO NOT use lead head nails or any lead as flashings, washers etc, in contact with ZINCALUME steel or COLORBOND Steel.

Cleaning Up

Normal installation procedures for roofing and flashing using self-drilling screws, drills, hack-saws, power saws or files will usually deposit metallic particles on or near the roof sheeting or roof area. These metallic particles and all other debris, including blind rivet shanks, nails, screws, nuts, cuttings, swarf etc, should be swept from the roof sheeting, flashings and gutters as soon as possible; certainly at the end of each days' work and particularly on completion of the roof installation. Failure to take this precaution will result in unsightly staining of the surface as the metal particles oxidize during exposure. Corrosion and possible failure of the zinc/aluminium coating may take place when iron, lead or copper-based materials are allowed to remain in contact with ZINCALUME steel surfaces subjected to moisture or condensation.

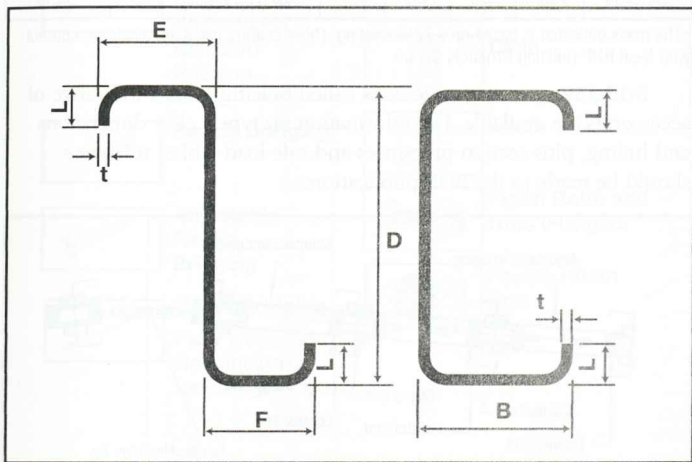
LYSAGHT PURLIN AND GIRT SYSTEM

Zed and Cee Sections

During the 1960's, a wide and narrow flanged Zed was introduced into Australia by BHP Building Products. Zeds and Cees have subsequently been widely accepted by the construction industry as being a highly efficient, versatile and robust cladding support systems. The lightweight structural steel members are designed in accordance with the SAA Cold Formed Steel Structures code AS1538-1988 utilising high strength zinc-coated steel.

The Zed profile has unequal flanges for lapping and additional strength. A down turn bottom lip is available on request.

LYSAGHT Zed and Cee purlins and girts are supplied PRE-PUNCHED to the various states code.

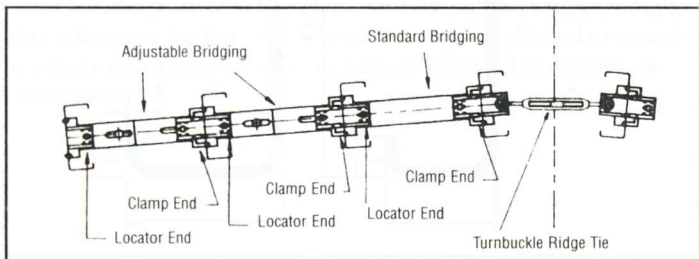


LYSAGHT Zed/Cee Sections – Dimensions

Catalogue Number	Dimensions (mm)							Mass * Per Unit Length (kg/m)
	t	D	Zeds			Cees		
			E	F	L	B	L	
Z/C10010	1.0	102	53	49	12.5	51	12.5	1.77
Z/C10012	1.2	102	53	49	12.5	51	12.5	2.10
Z/C10015	1.5	102	53	49	13.5	51	13.5	2.61
Z/C10019	1.9	102	53	49	14.5	51	14.5	3.29
Z/C15012	1.2	152	65	61	15.5	64	14.5	2.89
Z/C15015	1.5	152	65	61	16.5	64	15.5	3.50
Z/C15019	1.9	152	65	61	17.5	64	16.5	4.51
Z/C15024	2.4	152	66	60	19.5	64	18.5	5.67
Z/C20015	4.5	203	79	74	15.0	76	15.5	4.49
Z/C20019	1.9	203	79	74	18.5	76	19.0	5.73
Z/C20024	2.4	203	79	73	21.5	76	21.0	7.20
Z/C25019	1.9	254	79	74	18.0	76	18.5	6.50
Z/C25024	2.4	254	79	73	21.0	76	20.5	8.16
Z/C30024	2.4	300	100	93	27.0	96	27.5	10.09
Z/C30030	3.0	300	100	93	31.0	96	31.5	12.56
Z/C35030	3.0	350	129	121	30.0	125	30.0	15.19

*The mass indicated is based on a Z350 coating. Other coating mass are available, contact your local BHP Building Products Centre.

Bridging systems (sometimes called bracing) plus a full range of accessories are available. For information on types, cleat dimensions and holing, plus section properties and safe load tables, reference should be made to the BHP publications.



LYSAGHT Hooklok II Bridging & Accessories



**Standard
Bridging**



**Fascia
Adjustable
Bridging**



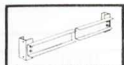
Ridge Tie



Girt Hanger



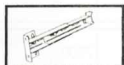
Girt Foot



**Bolt-off Bridging
(Clinched) &
Accessories
Standard
Bridging**



Fascia Bridging



**Adjustable
Fascia
Bridging**



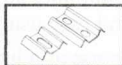
Ridge Bridging
Fully Threaded
Rod (Including
four flanged nuts)



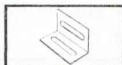
Clamp End



Locator End



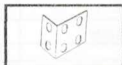
Clamp Plate



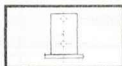
Angle Connector



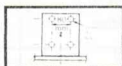
**Raking Girt
Bracket**



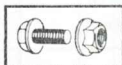
**General Purpose
Bracket**



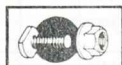
Cleat



Cleat



**Purlin Bolts and
Nuts (Flanged)**



**Fascia Purlin
Bolt**

LYSAGHT TOPSPAN LIGHT STEEL SECTIONS

BHP Building Products manufactures a range of light steel “TOPSPAN®” sections, all produced from high-tensile ZINCALUME steel. Being lighter than timber, they offer an economical alternative that will nest together making storage, carrying and handling easier. Consistent straightness simplifies alignment, sections can be lapped, and fastening is quick and easy using self-drilling screws.

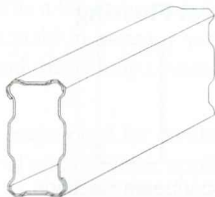
TOPSPAN is suitable use as a light weight purlin for rural applications down to the smaller batten sections for housing, as shown in the following selection chart.

Profile	Product	BMT mm	Stock Length mm
	TOPSPAN 20 † Tile Batten Tile Safe 600	* 0.48	6100
	TOPSPAN 22 Ceiling Batten	* 0.42 0.55	6100
	TOPSPAN 40 Roof Batten	* 0.55 0.75	7500
	TOPSPAN 50 Roof Batten	* 0.75	7500
	TOPSPAN 61 Light Steel Section	0.75 1.00	7500 7500
	TOPSPAN 120 Light Steel Section	0.70 0.90 1.00	4600 and 7000 6100 and 8600 6100 and 8600

* These sections are outlined more fully in the Steel House Framing section of the Referee.

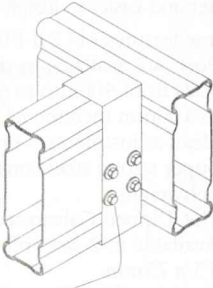
† TILESARE™ 600 tile batten is available in some states. TOPSPAN 40 (0.75) and TOPSPAN 50 (0.75) can be used in Cyclonic Areas. Contact your local BHP Building Products centre for availability.

LYSAGHT FIRMLOK BEAMS



There is a wide range of applications for FIRMLOK® Beams. The COLORBOND colour range allows total design flexibility. FIRMLOK beams are suitable for purlin and rafter applications in verandahs, extensions, carports and awnings.

Stock lengths or custom cut from 1000 to 2000mm.

DIMENSIONS AND WEIGHTS					STANDARD FIRMLOK CONNECTORS
SECTION DESIGNATION	DIMENSIONS D x B mm	THICKNESS mm	MASS kg/m COLORBOND		 <p>2 or 4 No. 10 x 16 Tek's each side (Depending on Shear Capacity)</p>
F100	11	100 x 47	0.55	1.94	
	15	100 x 47	0.75	2.61	
	20	100 x 47	1.00	3.44	
F125	11	125 x 47	0.55	2.17	
	15	125 x 47	0.75	2.91	
	20	125 x 47	1.00	3.85	
F150	11	150 x 47	0.55	2.38	
	15	150 x 47	0.75	3.21	
	20	150 x 47	1.00	4.23	
F175	11	175 x 47	0.55	2.61	
	15	175 x 47	0.75	3.51	
	20	175 x 47	1.00	4.64	
F200	11	200 x 47	0.55	2.82	
	15	200 x 47	0.75	3.79	
	20	200 x 47	1.00	5.01	

LYSAGHT SPANFLOOR

Spanfloor Domestic Steel Flooring



Firmlok Sections



Spanbeam Sections



Topspan Sections

SPANFLOOR™, is a flooring system consisting of a combination of profiles, such as lipped channels (SPANBEAM), top hat sections (TOPSPAN), boxed sections (FIRMLOK) and specially designed column supports, which are used primarily in domestic flooring applications.

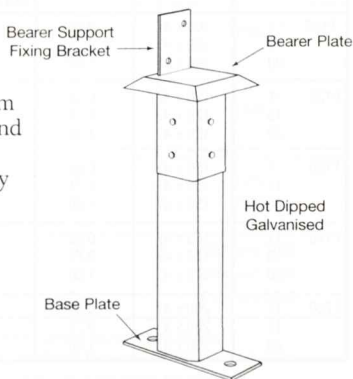
Ask BHP Building Products for the Spanfloor designs brochure.

LYSAGHT UNI-PIER

New UNI-PIER® is replacing brick piers concrete or timber stumps. It is faster and easier to install than any other Pier on any site (up to 6 metres).

Some features of UNI-PIER:-

- Posts are available in stock sizes from 400mm to 4000mm in 100mm increments.
- Head adjustments – up to 100mm
- Super strong steel construction and lightweight
- Hot-Dipped Galvanised durability
- Available in 2 sizes 65 x 65 and 75 x 75mm
- Superior "Hold Down" strength for high wind conditioning
- Provides better crawl space and sub-floor ventilation
- Fully integrated ant caps



LYSAGHT FENCING

Steel fencing has come a long way over the years. The traditional wire farm fence (eg. Waratah) in its many variations retains its purpose for rural applications, and this is fully covered in the rural section of this publication.

However, there is a major need for dividing and/or screen fences for commercial, industrial and domestic applications.

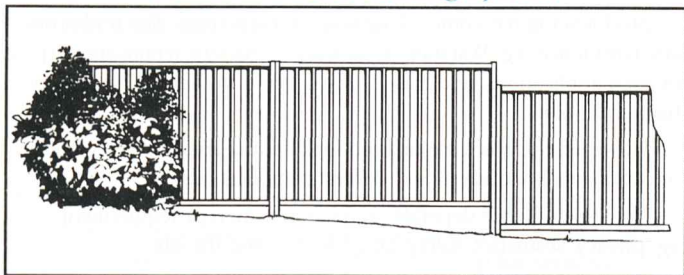
The type of fence depends on the application or requirement (eg. privacy, aesthetics, safety, long-life etc.) and the site.

Five types of fencing are described in this section:— **LYSAGHT NEETASCREEN, NEETASCREEN PLUS, MINISCREEN, MINISCREEN PLUS and STEELMESH**. All five are available with matching gates and all accessories. **NEETASCREEN, NEETASCREEN PLUS, MINISCREEN and MINISCREEN PLUS** are also available in a range of colours.

Features of all LYSAGHT fencing products include:—

- All components are high durability
- Total component system for simple, quick installation
- 10 year warranty from BHP Building Products
- Not effected by termites or rot

LYSAGHT Neetascreen Steel Fencing System



LYSAGHT NEETASCREEN fencing, roll-formed by BHP Building Products, is a strong, impact-resistant prepainted steel fencing system. It is ideal for dividing and wing fences, and for privacy around gardens and courtyards. The vertical-ribbed panels make it difficult for small children to climb the fence.

The system utilises double-sided COLORBOND steel panel infills and specially designed COLORBOND steel posts and rails in matching or contrasting colours. The panels are colour finished on both surfaces, ensuring the fence looks the same from either side. Single or double matching gates are optional.

Fence heights are 1500mm and 1800mm. Assembled panel lengths approximate 2360mm and, if required, these panel lengths may be stepped to follow slopes of 1 in 8, with maximum steps of 300mm. Steeper slopes require shorter panel lengths.

If using NEETASCREEN fencing in cyclonic areas, specialized advice should be obtained from BHP Building Products offices or product distributors.

Assembly and erection is simple and may be carried out by either the home handyman or a contractor.

Maintenance Tips

To keep your new NEETASCREEN or MINISCREEN fence looking its best, all that's needed is a simple hose down now and again. When hosing the garden, hose out the bottom rail to remove any dirt or leaf build up.

Avoid spraying the fence directly with any chemical garden sprays or fertilizers.

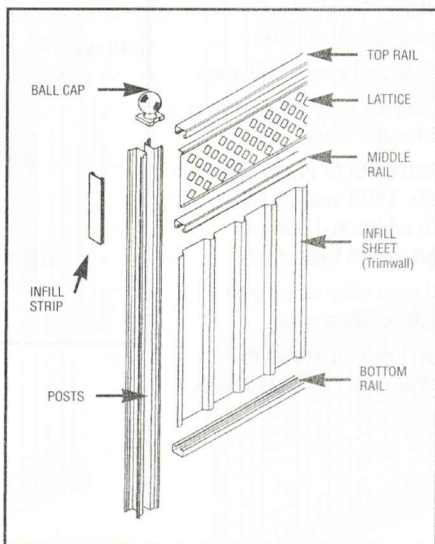
It is also recommended to maintain a 50mm gap between the fence and the ground, keeping panels clear of soil. Also posts must not be immersed in soil.

LYSAGHT

NEETASCREEN

PLUS® fencing has attractive steel lattice and post caps as optional extras to create a fence that's as beautiful as it is strong.

You can create a dramatic finish for your home with NEETASCREEN PLUS fencing, as all components and the wide range of colours can be mixed and matched. So it's versatile and modern.



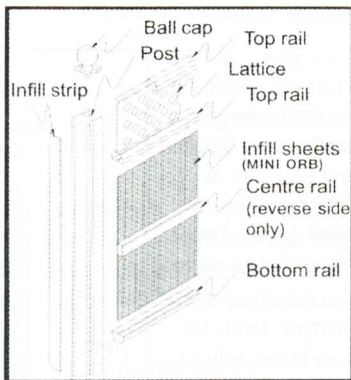
Enquiries may be directed to BHP Building Products offices.

LYSAGHT MINISCREEN AND MINISCREEN PLUS STEEL FENCING SYSTEM

LYSAGHT MINISCREEN is one of the most versatile, durable and attractive fencing systems available. Featuring MINI ORB infill sheets its classic lines and heritage based colours will compliment any Australian home.

Based on the popular NEETASCREEN DESIGN, MINISCREEN and MINISCREEN PLUS offer a range of features including:-

- All components available in COLORBOND range or plain ZINCALUME
- Mix or match colours
- Simple and easy installation
- Privacy of 1500 or 1800mm full height
- MINISCREEN PLUS offers:- 1200, 1500 and 1800mm with additional 300mm of lattice on top
- Ball caps offer an elegant finishing alternative



Please direct enquiries to BHP Building Products offices.

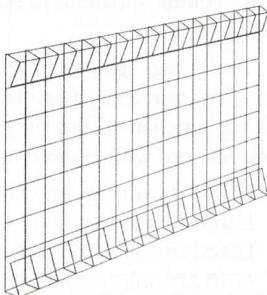
LYSAGHT Steelmesh

A range of wire-formed and welded fencing is an addition to the range of BHP fencing, offering a choice for boundary or sub-divisional fences. All are hot-dipped **galvanized**.

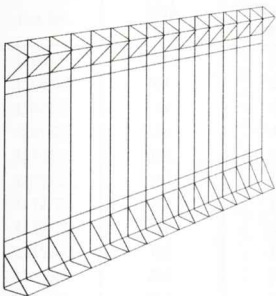
Avenue Fence Panels



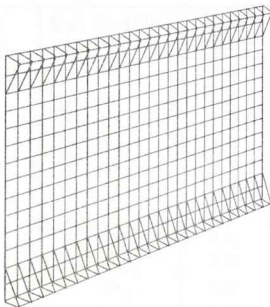
Garden Fence Panels



Pool Fence Panels



Boulevard Fence Panels



LYSAGHT COLD FORMED STEEL CHANNELS, ANGLES AND CONVEYOR SECTIONS

LYSAGHT steel sections are roll-formed from zinc-coated or hot-rolled steel strip as Angles, Plain Channels, Lipped Channels and Conveyor Sections (by arrangement) in steel thicknesses ranging from 1.6 to 3.0mm. Variations to standard dimensions may be produced by arrangement.

The strong, lightweight sections in a range of sizes have many uses in construction and general fabrication. Sections are readily fastened by welding, mechanical fastening, adhesives or integral fastening methods. Some sections will nest into others.

LC05116 will nest into LC05725

LC05130 will nest into LC05725

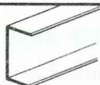
LC05116 will nest into LC05725

LC05725 will nest into LC06425

LC09530 will nest into LC10330

LYSAGHT Plain Channels

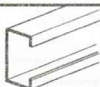
Standard length 6000mm



Cat No.	Web mm	Flange mm	Base Steel thick mm	Kg/m (Galv.)
LC01916	19	13	1.6	0.49
LC02516	25	13	1.6	0.58
LC03816	38	17	1.6	0.84
LC05116	51	15	1.6	0.97
LC05130	51	25	3.0	2.15
LC05725	57	26	2.5	2.00
LC06425	64	23	2.5	2.00
LC07630	76	38	3.0	3.34
LC08330	83	34	3.0	3.34
LC08930	89	31	3.0	3.34
LC09530	95	37	3.0	3.70
LC10230	102	55	3.0	3.70
LC10330	103	34	3.0	4.78
LC12730	127	50	3.0	5.26
LC15230	152	51	3.0	5.86

LYSAGHT Lip Channels

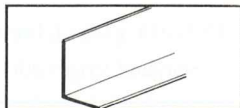
Standard length 6000mm



Cat No.	Web mm	Flange mm	Lip mm	Base Steel thick mm	Kg/m (Galv.)
LL05116	51	35	10	1.6	1.68
LL06425	64	38	13	2.5	2.91
LL07610	76	44	14	1.0	1.43
LL07625	76	44	14	2.5	3.33
LL10225	102	51	18	2.5	4.39
LL10230	102	51	18	3.0	5.25
LL12725	127	51	18	2.5	4.89
LL12730	127	51	18	3.0	7.16
LL15230	152	64	18	3.0	7.16
LL20330	203	76	21	3.0	9.07
LL25430	254	89	21	3.0	1.43

LYSAGHT Angles

Standard length 6000mm

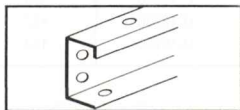


Leg lengths Cat No.	Leg Lengths mm	Base Steel thick mm	Kg/m (Galv.)
LA2725	27 x 27	2.5	1.0
LA3225	32 x 24	2.5	1.0
LA4030	40 x 40	3.0	1.79
LA4630	46 x 35	3.0	1.79
LA5130	51 x 30	3.0	1.79

Note: • Top hat sections are available subject to negotiation.
• Some sections/finishes subject to minimum order.

LYSAGHT Conveyor Sections

Standard lengths 5990mm to suit 6m conveyor modules, other lengths may be available by arrangement. Punched to customer needs.



*Subject to quantity

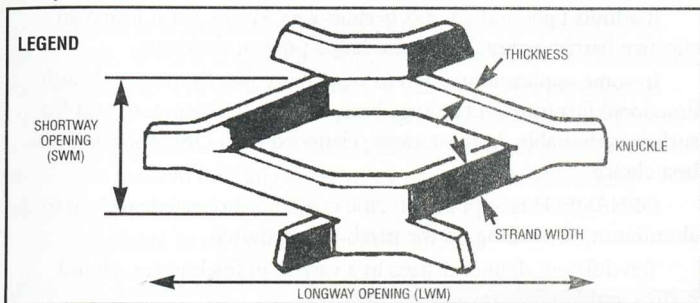
Designation	Web mm	Plain flange mm	Lipped flange mm	Lip mm	Steel thickness mm
CS10030*	100	45	50	24	3.0
CS15030	150	55	75	24	3.0
CS20030	200	55	75	24	3.0
CS25030*	250	55	75	24	3.0
CS30030*	300	80	100	29	3.0

Note: Custom Cold Roll-Forming is a service offered by BHP Building Products to manufacturers and designers to meet their requirements when standard sections are unsuitable. A great variety of shapes and sizes can be produced with accuracy and consistency.

LYSAGHT EXPANDED METAL MESHES

Expanded metal meshes are used in almost every branch of engineering and building. They are made from sheet metal which by slitting and expanding, without any waste of material, is converted into a network of diamond or other special shaped openings.

Unlike netting, expanded metal is not an interlacing of separate pieces; the strands are all part of the parent metal, rigidly unified at their junctions.



Catalogue reference numbers are expressed in four or five figures prefixed by the expanded metal reference letter.

The first two numbers represent the thickness of the metal and the last two or three indicate the strand width in mm x 10.

The reference letter indicates the size of the profile opening.

The short way of the opening is represented as SWM, while the long way of the opening is known as the LWM.

Expanded metal is produced in a variety of types, styles and sheet sizes to suit a vast array of applications.

Many metals such as steel, aluminium, stainless steel, copper and brass can be expanded, but the chief material for expanded metal meshes is high grade low carbon steel sheet or plate. Many meshes are also available galvanized and/or in a flattened condition.

LYSAGHT Ornameash

ORNAMESH® is used extensively for machinery guards, shelving pallets and racking; in manufactured products and equipment of all kinds; and in the building industry for partitions, room dividers and similar applications.



It admits light and air and permits easy vision, yet it forms an effective barrier against entry and helps prevent accidents.

In some applications, such as machinery guards, ironing boards, functional furniture and storage bins, a particularly smooth and flat surface is desirable. In these cases, Flattened Steel ORNAMESH is the best choice.

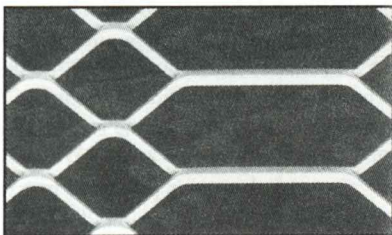
ORNAMESH is supplied in zinc-coated or uncoated steel, or in aluminium, depending on the mesh type required.

Ten different diamond sizes in a variety of thicknesses, strand widths and finishes are available.

LYSAGHT Balustmesh

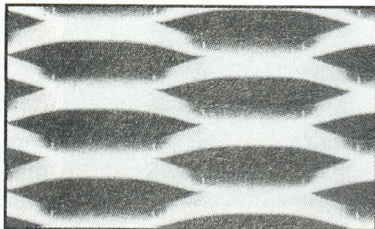
BALUSTMESH® is an ornamental expanded metal with a high percentage of open area, giving the appearance of delicate wrought iron.

It is designed for internal and external balustrades, grills and dividers, window and door protectors, security partitions, doors and stair railings. It is supplied in uncoated or zinc-coated steel or in aluminium in sizes to suit most domestic or architectural applications.



LYSAGHT Louvamesh

LOUVAMESH® is primarily a **sun screen** mesh. Because of the unique hooded mesh formation (which occupies only 20% of the total area,) it forms an effective shield from the sun's rays, yet it permits free passage of air. Durability is assured by the use of galvanized steel.

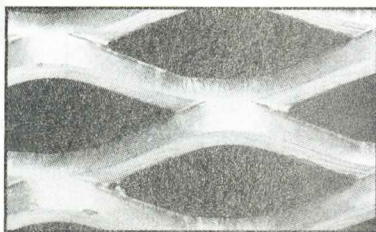


In addition to sun screens, LOUVRE MESH is also suitable for infill panels, facades, and soffits. When LOUVRE MESH is erected with the slit openings in a vertical position, it can form a highly effective wind deflector for exposed balconies, patios, enclosed verandahs and outdoor living areas. LOUVRE MESH can be left plain galvanized to blend with modern building styles or can be painted with readily available paints.

It is available in two patterns and thicknesses.

LYSAGHT Gridmesh

GRIDMESH® is the heavy duty mesh in the LYSAGHT range. Applications include heavy duty walkways and stair treads, gratings, ramps, flooring, work platforms, security screens, and abattoir floors.

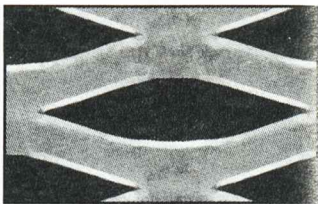


The GR series is a comparatively open mesh for general use. GM series is for heavy duty use and applications where a smaller mesh opening is desirable.

GRIDMESH is supplied in zinc-coated or uncoated steel in four styles.

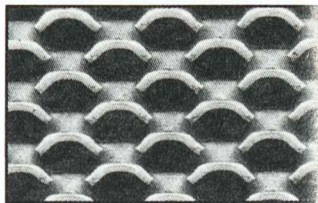
LYSAGHT Ruralmesh

Similar to GRIDMESH, it is a heavy duty mesh used mainly for livestock flooring. Meshes for farrowing (FM) in piggeries are supplied in a flattened condition and galvanized.



LYSAGHT Maximesh

MAXIMESH®, being heavier than ORNAMESSH, combines strength and the traditional charm of delicate wrought iron work. With a small hole and sharp edges, it is most suitable for perimeter barrier fencing in gaols, and for security screens and gates. It is available in two styles.



LYSAGHT RENDALOK

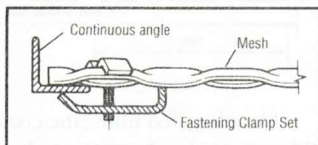
RENDALOK® is a galvanized steel lathing expanded metal used as a base or key for plaster. It is widely used when fire-proofing steel beams and columns, as well as for walls, ceilings and ornamental plasterwork.



RENDALOK is also a popular material for reinforcing the mortar bed under tile floors laid on sheet floor materials.

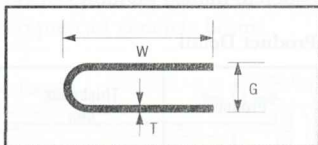
Expanded Metal Accessories

A galvanized steel fastening clamp set is available for "GM" & "GR" series GRIDMESH. The Clamp set consists of top and bottom plate and bolt.



Edge Trimming Sections

Seven steel edge beading sections and standard steel angle sections suitable for use as expanded metal trims are available. In addition, special width trim sections can be manufactured against order.

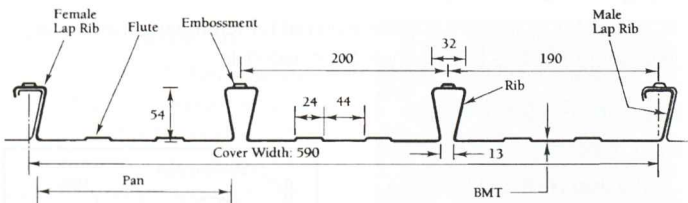


Note: The diagrams used for expanded metals and accessories are not actual size. Refer to appropriate BHP Building Products literature.

LYSAGHT STRUCTURAL DECKING

LYSAGHT Bondek II

Bondek[®] II from BHP Building Products is a high strength structural steel decking manufactured from zinc coated steel to AS 1397.



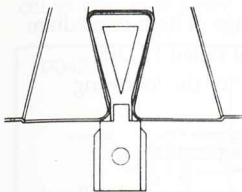
Manufactured from zinc-coated steel in three thicknesses, Bondek II is suitable for domestic applications such as home units and town houses, as well as commercial construction in steel-framed and concrete-framed buildings.

Product Detail

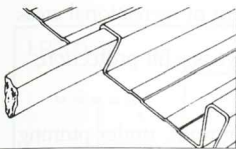
Product	Thickness mm	Kg/m	Kg/m ²	Coating mass g/m ²
Domestic Bondek	0.60	5.12	8.69	Z450
Bondek II	0.75	6.05	10.25	Z200
Bondek II	1.00	7.97	13.54	Z200

Bondek II composite slab construction conforms to SAA Concrete Structures Code AS 1480/3600. Bondek II provides an effective cover width of 590mm, with interlocking ribs at each edge for side lapping. Lengths can be custom cut to suit project requirements.

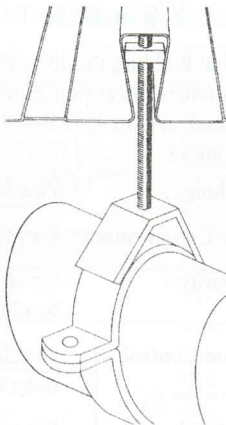
Bondek II Accessories



Bonwedge Suspension Bracket



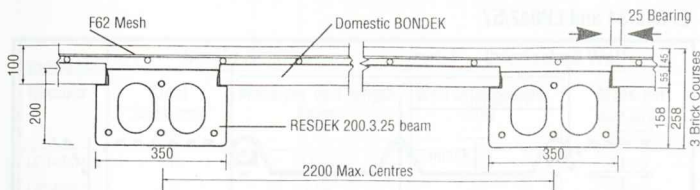
Bonfill



Pipe Suspension
Using Bon-Nut

Resdek – Domestic Bondek Flooring System

Resdek is a prop-free, suspended concrete flooring system that uses Domestic Bondek as infill sheets between pre-cast concrete beams.



Note: For Beam Spacings & Spans consult your local BHP Building Products Sales Office.

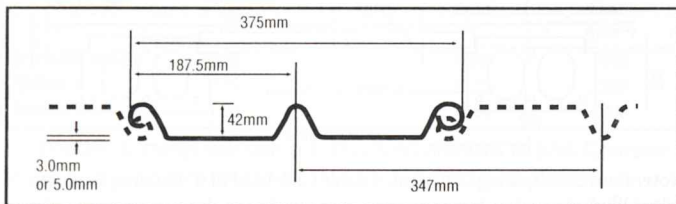
LYSAGHT SHEET PILING

BHP Building Products manufactures a range of light to medium high strength sheet pilings rollformed from hot rolled HU300 structural steel to AS 1594. They are designed for the following applications:

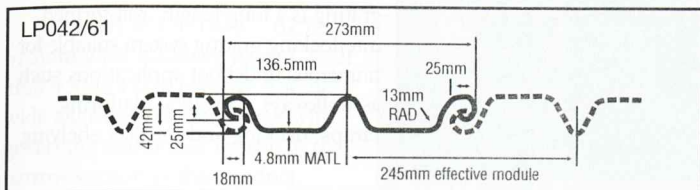
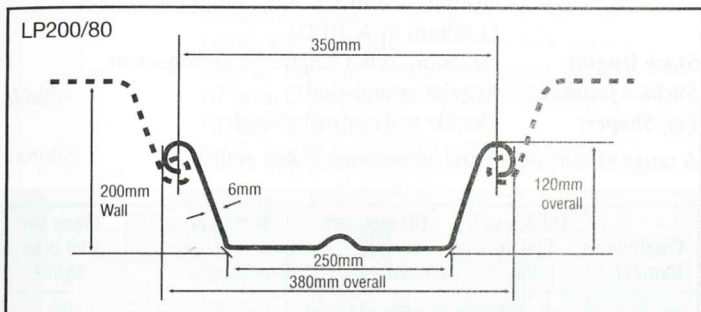
Trenching:	Pipe laying and similar operations
Water Conservation:	Dams, dam cores, well housing and coffer dams
Waterways:	Canal walls, lakeside walls, dock walls, bulk heading and development of recreational areas
Erosion Control:	Check dams, beach groynes, cliff protection, dyke walls
Structural:	Excavation and retaining walls, under-pinning form-work, machine well linings, bridgedecks and piers, footings, jetties, docks and causeways

A range of profiles are manufactured, from the LP042/34 in 3.00 material in table for lightweight applications up to 6mm (LP200/80) for medium duty projects.

LP042/34 and LP042/57



Available in standard lengths or can be manufactured to custom cut lengths as required.



Catalogue Number	Single Section		Interlocked Wall	
	Steel thickness mm	Mass per unit length kg/m	Wall thicknesses mm	Mass per unit area kg/m ²
LP042/34	3.0	11.78	42	33.95
LP042/61	4.8	14.9	42	60.9
LP042/57	5.0	19.63	42	56.6
LP 200/80	6.0	27.9	200	79.8

LYSAGHT STEEL GRATING



LYSAGHT INTERLOK® MARK 11 steel grating is a long-length, roll-formed, interlocking grating system suitable for numerous underfoot applications such as walkways, catwalks, platforms, ramps, decking and for rack shelving.

Material: Zinc-coated steel to AS 1397, G300, Z450, coating class in 1.2 and 2.0mm thicknesses. (1.60mm in 3CR12)

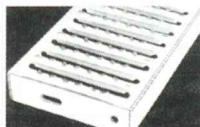
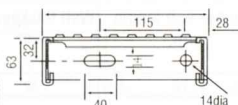
Stock lengths: 6075mm, other lengths by arrangement

Surface finishes: Regular or anti-skid

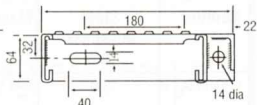
Leg Shapes: Double male or male/female

A range of stair treads and accessories is also available.

Catalogue Number	Thickness Finish mm	Dimensions mm				Mass per unit length kg/m	Mass per unit area kg/m ²
		A1	A2	B1	B2		
G06512	1.2 GALV	63	65	15	20	3.7	16.5
G06520	2.0 GALV	64	66	16	21	6.1	27.2
G06516	1.6 3CR12	63	65	15	20	4.6	20.6



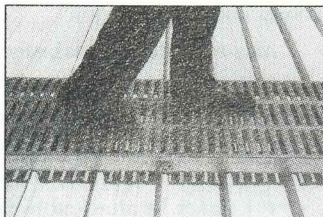
Heavy duty stair treads made from G06520 grating with welded 3.0mm carrier plates.



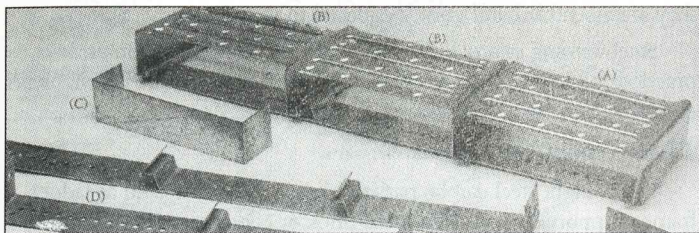
Extra Heavy Duty Stair Treads made from G06520 grating with welded 3.0mm carrier plates and floor plate nosing.

LYSAGHT ROOF TRAK 675 AND 450

LYSAGHT ROOF TRAK™ 675 is a 675mm wide walkway system. Roof Trak 450 is a cost effective 450mm wide alternate system. Check with governing authorities for use of the narrow version of this product.



- Material:** Zinc-coated steel to AS 1397 G300, Z450 coating class in 1.2 and 2.0mm thicknesses.
- Widths:** 675mm (3 sections wide) and 450mm (2 sections wide)
- Lengths:** Nom. 3m & 6m (Actual 3018 and 6074mm)



Component	Mass
(A) Plank (male/male) standard length 3m* or 6m†	3.78 kg/m
(B) Plank (male/female) standard length 3m* or 6m†	3.78 kg/m
(C) Blanking Plate or Butt Plate G065BP	0.24 kg
(D) Support Bracket	0.50 kg
(E) Heel/Toe End Plate Bracket	0.13kg

BUILDING A STEEL-FRAMED HOUSE

Construction of a steel-framed house is similar in many ways to conventional construction.

As a framing material, steel offers many benefits:-

- High strength with light weight
- Straightness and dimensional accuracy
- Long life and fire resistance
- It does not shrink, warp or twist
- Cannot be attacked by borers and termites
- Qualifies as a termite-resistant material under the Building Code of Australia

High strength and light weight make frames easy to handle and install. Long life and fire resistance mean a steel-framed house will still be around in many years time, and house insurance can be cheaper. As steel does not shrink, warp or twist, the frames remain straight after they are assembled and even if exposed to wet weather.

Steel framing in any building should be earthed as soon as practical following frame erection, in accordance with the requirements of the local electrical authority.

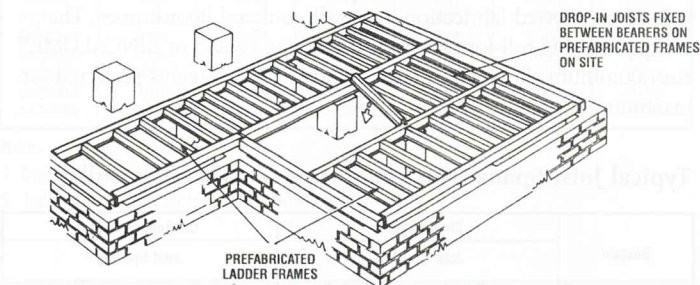
Floor Construction

Lightweight steel can be partially factory pre-fabricated as ladder frames supported on conventional brick or concrete piers with ant caps. Ladder frames use top hat sections with short lengths of joist fastened between them. They are laid, spaced apart so that rows of similar length joists can be used to join them on-site.

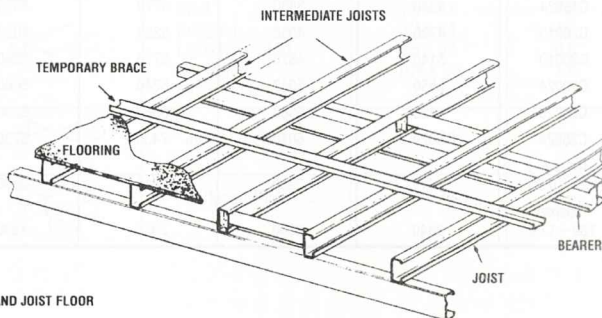
Alternatively, lightweight steel floor framing may be assembled on-site using top-hat or "C" section bearers and joists installed in the same way as traditional timber bearers and joists. The bearers are placed on conventional piers or stumps with ant caps and long length joists laid

over them. The bearers and joists are then bolted, nailed, screwed or rivetted together. As another alternative TOPSPAN 120 battens can be used as joists. Refer to construction manuals for further information.

Sheet flooring, either particle board or plywood, is normally used with steel floor framing and should be glued down and fixed with self-drilling screws or approved nails. All fixing details should be per the flooring manufacturers' instructions – generally 10mm from square edges and 25mm from tongue and grooved edges.



LADDER FLOOR FRAME



BEARER AND JOIST FLOOR

Wall Framing

Prefabricated steel wall framing can be used with all types of floor construction. Although the framing varies in detail between manufacturers, the structural members are all coated steel channels. Zinc/aluminium alloy-coated steel is preferred for maximum durability of the finished construction. Wall frames are normally pre-fabricated and delivered to site ready to erect as easily handled panels.

BHP Building Products supplies steel framing components for welded or screwed fabrication into wall, roof and floor frames. The components are roll-formed from either zinc-coated or ZINCALUME® zinc/aluminum alloy-coated steel. ZINCALUME® steel is preferred for maximum durability.

Typical Joist Spans (Not supporting load bearing walls)

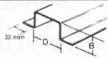
Section	Single Spans		Continuous Spans	
	Joist Spacing		Joist Spacing	
	450mm	600mm	450mm	600mm
C15015	3640	3310	4090	3710
C15019	3930	3570	4410	4010
C15024	4240	3850	4770	4330
C20015	4730	4050	5320	4020
C20019	5140	4670	5770	5240
C20024	5550	5040	6240	5660
C25019	6120	5560	6880	6250
C25024	6620	6010	7430	6750
Topspan 120 – 0.90	2310	2250	2810	2600
Topspan 120 – 1.00	2440	2380	2970	2830

Typical Bearer Spans (Floor loads only)

Section	Single Spans			Continuous Spans		
	Bearer Spacing, m			Bearer Spacing, m		
	1.8	3.0	4.2	1.8	3.0	4.2
C15015	2290	1930	1730	2570	2170	1800
C25019	2470	2090	1860	2780	2340	2090
C15024	2670	2250	2010	3000	2530	2260
C20015	2980	2510	2180	3220	2160	1620
C20019	3230	2730	2440	3630	3060	2670
C20024	3490	2950	2630	3920	3310	2960
C25019	3850	3250	2900	4320	3330	2570
C25024	4160	3510	3140	4670	3940	3520
2/C15015	2890	2430	2180	3240	2730	2440
2/C15019	3120	2630	2350	3500	2950	2640
2/C15024	3360	2840	2540	3780	3190	2850
2/C20015	3750	3160	2830	4210	3550	2870
2/C20019	4070	3430	3070	4570	3860	3450
2/C20024	4400	3710	3320	4940	4170	3730

Note:

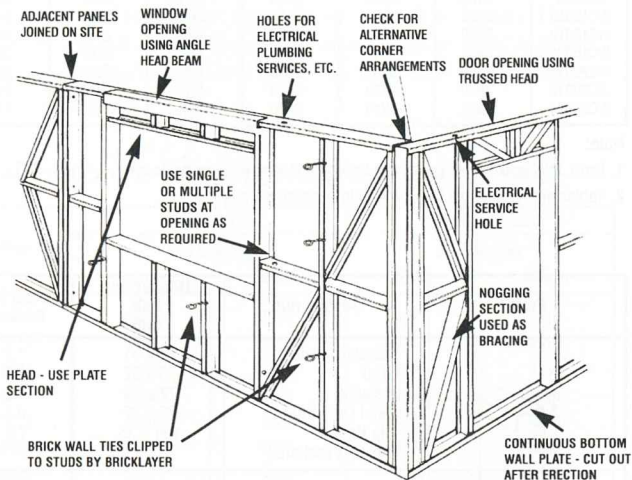
- Both Joist and Bearer tables are based on domestic floor loads only
- Tables are not suitable for use with load bearing walls

Profile	Section mm	Dimensions DxB mm	Steel base thickness
	Standard Plate	78 x 31	1.2
	Stud	75 x 32	1.2
	Nogging	72 x 34	1.2
	Light Duty Stud	75 x 32	0.8
	Hip Rafter (nesting sections)	104 x 35	1.6
	Junction Stud	75 x 38	1.2
	Stiffened Plate	79 x 75	1.6

BHP Building Products supplies steel framing components manufactured from ZINCALUME steel for “clinched” fabrication of the SUPRAFRAME® system.

This system is the result of many years of research and testing and is therefore amongst the most advanced systems available. The wall framing system is a lightweight mechanically jointed system. The QUIKLOK™ clinching system is a fast economical fastening method.

Erection of House Framing



Steel wall framing is erected in the same sequence as pre-fabricated timber, ensuring squareness and vertical alignment of individual frames. The general procedure is as follows:-

1. The wall layout is marked on the floor using string lines
2. Squareness is checked by accurately measuring diagonals in large areas of the house first, then individual rooms

3. Internal wall frames are stacked inside the boundaries; external walls around the foundations, with first frame on top
4. External frames are placed around the perimeter with their bottom plates adjacent to their final positions
5. Starting at any convenient external corner, stand and plumb a wall frame in its exact position
6. Stand and plumb the adjoining frame to make a self-supporting corner
7. Clamp the frames together and check again that both frames are in their exact locations and standing vertical
8. Connect the frames using the manufacturer's recommended method—generally nails, screws or rivets
9. Proceed with the erection of the frames around the house, standing internal and external frames as they occur
10. Provide adequate temporary bracing during wall frame erection. The line of top plates in a run of walling should be checked with a string.

Anchoring Wall Framing

Steel framing is fastened to the floor structure through the channel bottom plate after all panels have been correctly aligned and plumbed.

For concrete floor slabs, the frames are fixed in place by using masonry anchors, which are generally hammer driven nails located in pre-drilled holes, expanding shell anchors or chemical anchors.

Exact recommendations for the type and frequency of anchors should be available from the frame supplier or the builder's engineer.

With steel floor framing, the bottom plate of the wall frames can be screwed to the joists with self-drilling screws, and/or nails, depending on the specifications.

Wall frames are fixed to traditional timber floor framing at the ends of each frame and adjacent to the bracing with self-drilling screws which can drill through the steel bottom plate. They are then fixed to all intermediate joists with galvanized flat head nails driven through holes punched in the bottom plates.

Roof Framing

Prefabricated steel roof trusses are available to suit all types of roof designs – hip, gable, dutch gable, steel sheet roofing or tiles – for spans up to 15m. For long spans using raked ceilings, lightweight high tensile steel purlin sections may be used.

The BHP SUPRATRUS[®] roof framing system is a bolted truss design and can be screwed or nailed directly to the wall frame. Truss spacings are located at 600mm centres for sheet and tile roofs, or 1200mm centres for sheet roofs only. Depending on truss configuration, spans of up to 12 metres can be achieved.

The spacing of trusses varies depending on the truss design and the roofing material, but is generally 600mm or 1200mm. Fixing of trusses is dependent upon the precise design, but the procedure is substantially the same, regardless of the truss material or style. Recommendations from manufacturers should be followed at all times.

Sheet Roof Battens

Lightweight steel roof battens provide substantial benefit over their timber equivalents.

They are straight and remain so, long after they are installed.

Due to their top hat shape, steel battens nest together, simplifying transport and storage. They are also easy to install and can be lapped rather than butt-joined at a rafter.

These battens are suitable for use with all types of roof framing. They are fixed using nails or self-drilling screws to suit the trusses or rafters.

Tile Battens

The type and frequency of fixing is dependent on the cladding and wind category of the location.

Steel tile battens are fixed to the trusses, sometimes over reflective foil laminate, with nails or self-drilling screws. Roof tiles are secured to steel battens with wire clips simply hooked on to the tile batten.

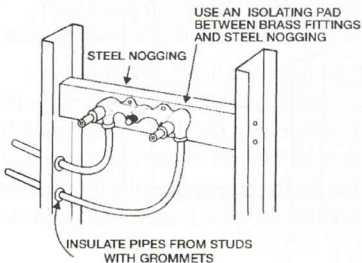
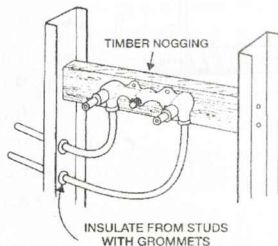
BHP TILESAFE™ 600 steel tile battens are the lightest, most durable and most economical way to support tiled roofs with 600mm spaced trusses.

Services in a Steel Framed House

Plumbing

In-wall gas and water piping is simply passed through the service holes to reach the required outlet locations. Plastic grommets are snapped into the service holes before copper piping is installed to prevent frame contact and possible corrosion.

Extra service holes, if required, must always be located close to the centreline of each stud.



In brick veneer construction, piping may be run in the cavity and fixed to the studs with full saddles and self-drilling screws. Copper piping must be isolated from the steel frame.

Pipe sets for baths, basins, showers, cisterns, etc, are supported in the normal way on timber or steel nogging. Neoprene sheeting should be inserted under each pipe set to isolate it from steel nogging.

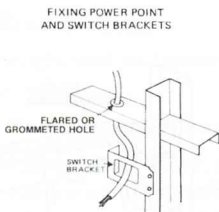
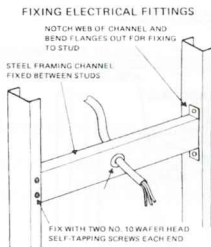
To provide support for the lip along the back of a bathtub, steel wall studs are notched, at the required height, and reinforced. This work is sometimes done during fabrication of the wall frame.

Electrical services

Steel house frames must be permanently earthed in accordance with the requirements of local electricity authorities. A temporary earth should be established until the permanent earthing is installed.

Installation of wiring for electrical services is also made quick and easy by provision of pre-punched service holes, which may be plain or flared. Plain holes either pre-punched, hand punched or cut out with a hole saw, require a grommet fitted before wiring is pulled through.

Wiring and backing plates may be secured as shown.



External door and window frames

The same door and window frames used in timber-framed construction are also used in steel-framed construction.

If aluminum window frames are fitted into timber, these can be installed by fastening through the jamb studs into the back of the reveal after positioning.

If it is not possible to secret fix the frame, as may be the case with a window or door head, No. 10 countersunk head self-drilling screws of appropriate length can be driven through the frame and packing into the steel framing. The same type of screws may also be used to fasten aluminum window frames direct to steel frame openings.

Internal door frames

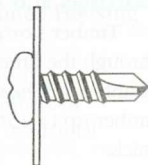
Timber door frames in internal walls can be secret-fixed through the back of the jamb studs with screws or nails. Alternatively, the frame may be fastened through the jamb into the studs with No. 10 countersunk head self-drilling screws.

External wall cladding

Reflective foil sarking if required in the external walls may be attached to the external flange of steel studs with self-drilling screws fitted with 25mm diameter flat fibre washers. Alternatively, wafer head screws may be used.

Wire brick ties which simply clip on to steel studs are available for brick veneer construction.

For single stud wall construction, fibre cement sheeting can be fixed to steel frames with self drilling, self-embedding head screws. Timber weatherboards can be fastened to steel studs with extended point countersunk head, self drilling-screws. Steel sheet cladding is also fixed with self-drilling screws.



Ceilings

When required, coated steel ceiling battens are fixed to the underside of the bottom chord of steel roof trusses or steel upper floor joists with self-drilling screws through the flanges.



Plasterboard ceiling lining is fixed to steel battens or furring channels with bugle head self-drilling screws. The bugle head (plasterboard) screws recess themselves into the plasterboard without damaging the surface.

Internal wall lining

To fix plasterboard wall linings in a steel frame house, bugle head self-drilling screws are used instead of plasterboard nails. The same adhesives are used on a steel frame. With a correctly set screw gun, bugle head screws can be tightened to finish slightly below the surface of the plasterboard without damaging the paper facing.

In wet areas, water resistant lining board is fixed with self-drilling, self-embedding head screws. Flashing and tiling are carried out in the usual manner.

Pre-finished wall linings may be glued to steel studs with a wallboard adhesive and braced in place until bonded.

Skirtings and mouldings

Timber skirtings and any other mouldings which need to be fixed through the linings into a steel frame may be readily secured with countersunk head, extended point self-drilling screws, 50mm long for timber up to 23mm thick and 65mm long for timber 23 to 30mm thick.

With some framing systems, the fix-out of skirtings, architraves and internal door frames can be secured by nailing. Follow manufacturers' recommendations for appropriate nail sizing and procedures.

History of steel framed-housing

Steel-framed housing construction in Australia dates back to the 1940's when a shortage of building materials led to the development of steel framing systems using bitumen coated steel sections. During the 1960's, galvanized steel (1.6mm) frames were introduced and houses were built in most states.

Over the following years steel-framed houses were constructed throughout Australia using a variety of thicknesses and profiles.

The first 'new era' 1.2 mm galvanized channel section frames were introduced in 1968 and fabricators have been developing individual steel framing systems since that time. Lighter gauge high tensile steel systems were introduced in the 1980s and are widely used today.

Steel framing systems have become popular with an increasing number of architects, project builders, kit home suppliers, owner builders and consumers generally. Builders, engineers and architects specify steel-framed houses because of design versatility and consistent performance. Every piece of galvanized or Zinalume® steel-framing section is cold-formed from consistent, quality assured material, with controlled uniform dimensions, coatings and strength. The overall cost of steel-framed housing today is comparable to alternative materials.



National Association Of Steel - Framed Housing

The Broad Aims of NASH are:

- To raise the profile and public awareness of the Steel-Framed Housing Industry in Australia and assist NASH members to increase market share for Steel-Framed Housing in residential construction.
 - To develop a pool of builders and trades with Steel-Framed Housing skills through education, training, and other promotional activities.
- For further information about NASH and its activities:—
Telephone (02) 9763 5219 Facsimilie (02) 9763 5216

EXTERNAL FASTENERS FOR ZINCALUME AND COLORBOND, STEEL ROOFING AND WALLING PRODUCTS

BHP COATED STEEL PRODUCTS manufactures a range of steel products for the roll-forming of roofing and walling for the building industry.

The premium products are hot dipped ZINCALUME zinc/aluminium alloy-coated steel with thicker coating class designated AZ150 for long life, and several COLORBOND prepainted steel finishes applied to ZINCALUME steel. The COLORBOND steel paint finishes not only add beauty to the product, but increase service life.

For the roofing and walling market, the COLORBOND steel products are COLORBOND XRW, COLORBOND XPD and COLORBOND XSE, each with its own characteristics and each tailored for specific environments (see table).

Just as there is an optimum choice of sheeting material for any particular service environment, so too there is an optimum choice of external fasteners for pierce fixing of roofing and walling profiles.

Australian Standard AS 3566, "SCREWS-SELF-DRILLING FOR THE BUILDING AND CONSTRUCTION INDUSTRY", sets out the performance requirements for these fasteners in various environments, Australian manufacturers of fasteners supply a range of fasteners which fulfil the requirements of the Standard. The correct choice of fastener is important. The more closely the service life of fasteners and sheeting are matched, the better – **Premature failure of fasteners is clearly not desirable.**

It should be noted that manufactures of both roofing and walling profiles and fasteners are continually developing new products. They should be consulted before making a final choice of either.

Fasteners with matching “pre-painted” heads are recommended for all Colorbond steel claddings.

Note: The tables listed in the section “Atmospheric Exposure Conditions Steel Claddings” on pages 167 & 168 should be read in conjunction with this section in choosing the correct fasteners. Table references are:–

- Guide to satisfactory service life of COLORBOND steel and ZINCALUME steel in various conditions of atmospheric exposure and
- Guide to Atmospheric Exposure Conditions

Fastener materials for use with roofing and walling manufactured from BHP strip and sheet products.

	BHP Products	Appropriate Fastener Type
1	COLORBOND XRW, XMA, XPD ZINCALUME AZ150	Fasteners conforming to AS 3566 Class 3
2	COLORBOND XSE COLORBOND XRW* *Applies to Colorbond XRW used 200 – 400m from marine environments (ie “severe” environments).	Fasteners conforming to AS 3566 Class 4 Where the colour match of fasteners is an overriding consideration, matching “painted heads” fasteners are considered more appropriate than plastic headed
3	COLORBOND Stainless	Quality stainless steel fasteners

Note: ‡ Fasteners conforming to AS 3566, class 3, should not be used within 400 metres of the ocean or other severe marine influence.

COMPATIBILITY

Stainless steel, lead, copper, and copper containing alloys (such as MONEL) should not be used with galvanized, ZINCALUME, COLORBOND XRW, COLORBOND XPD, COLORBOND XMA or COLORBOND XSE STEEL.

Fastener Types

There are two fastener designs to be considered for use with BHP materials:-

- Self-drilling screws complying with AS 3566 Amendment 1-1990 for fastening cladding to a building structure *and*
- Accessory fasteners for fastening roofing accessory items such as flashings/capping etc.

Where accessory fasteners such as pop rivets are required, they should be manufactured from aluminium when fastening galvanized, ZINCALUME, COLORBOND XRW, COLORBOND XSE and COLORBOND XPD material. However, in the case of COLORBOND Stainless Steel, compatible stainless steel pop rivets must be used.

Note: These recommendations are consistent with the classes of exposure and test methods in Australian standard AS 3566-1988, "Screws – Self-Drilling for the Building and Construction Industry". They take into account not only resistance to exposure conditions, but also compatibility of dissimilar metals.

In this regard, it is important that HOT DIPPED GALVANIZED 40um minimum coating thickness fasteners are fully compatible with ZINCALUME zinc/aluminium alloy coated steel products.

Although highly corrosion resistant in their own right, compatibility considerations rule out the use of stainless steel and stainless steel capped fasteners for use with COLORBOND XRW, COLORBOND XPD and COLORBOND XSE in intermediate and mild coastal environments.

For tropical environments it is recommended that Hot Dipped Galvanized 40um minimum coating thickness be used.

Because corrosion performance depends on so many variables, it is not practical to completely cover all possibilities in a brief description. For correct choice of fastener and roofing product, we recommend consultation with either the fastener manufacturers, roofing product manufacturers, or BHP Steel Sales offices. (Technical Bulletin TB16 Refers).

Fasteners

All fasteners used for external steel roofing and walling applications should conform with the requirements of Australian Standard AS 3566, "Screws – Self-Drilling for the Building and Construction Industries".

Fastener packages produced by leading Australian manufacturers are clearly labelled in accordance with AS 3566 so that correct choice can be made.

BHP Building Products – screw fasteners code

Fasteners used must be manufactured with protective coatings adequate for the product and service conditions.

Approved screw fasteners required for installation of BHP Building Products roofing/walling systems are obtainable from BHP Building Products roofing/walling distributors.

Fastener descriptions need to include the many features required. To avoid lengthy descriptions, a fastener code system is used by BHP Building Products. This comprises a set of three prefix letters followed by a set of four numbers:–

First letter:

S = For fastening to STEEL supports

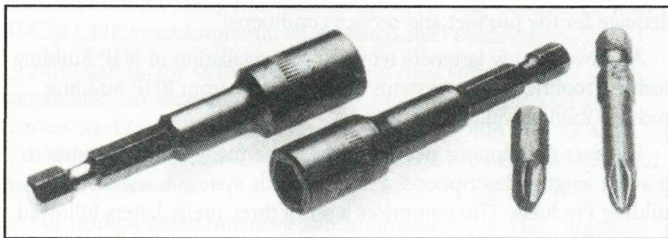
T = For fastening to TIMBER supports

Second letter:	H = HEXAGON head screw S = SLOTTED pan head screw W = WAFER head screw
Third letter:	S = SELF-DRILLING screw P = PREDRILLED hole is required
First two numbers:	Screw major diameter, classified as a number – 08, 10, 12, 14
Second two numbers:	Screw length in mm

Thus, code number SHS 1235 nominates a fastener for fastening to a Steel support, Hex head, Self-drilling, No 12 diameter screw, 35mm long.

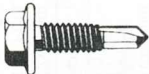
In some cases a fourth letter may be added at the end of the code number. This would either be N (indicating a screw without EPDM seal) or P (indicating a prepainted head).

Drive Bits & Sockets



FASTENERS - NON CYCLONIC

Fasteners with EPDM sealing washers should be tightened only until the washer is gripped firmly enough to provide a weatherproof seal. The fasteners should not be over-tightened as this may split the sealing washer or deform the sheet, either of which could lead to water penetration. On valley fasteners in wall sheeting, the sealing washers can easily be split by over-tightening, because the tray or valley of the sheet is hard against the support and has no flexibility.

Metal Fasteners	Timber Fastens
<p>Higrip – Hitek</p>  <p>(Supplied with sealing Washer)</p>	<p>Higrip – Type. 17</p>  <p>(Supplied with sealing Washer)</p>
<h3>Hexagon Headed</h3> <div>  </div> <div>  </div> <div> <p>Hex. Head Needle Point*</p> </div> <div>  </div> <div> <p>Also available with a sealing washer for use when a watertight finish is required.</p> </div>	
<div>  </div> <div>  </div>	

Note: For a full range of Fasteners consult your BHP Building Products sales office or distributor.

Notes: Coating of fasteners shall comply with AS 3566 Class 3 for exterior applications. XRW – Climaseal, XSE – consult your local BHP Building Products office, Stainless – Stainless Steel. Fasteners are available with colour matched painted heads – enquire at your local BHP Building Products office for availability/minimum order quantities for XSE and Stainless fasteners. *Climaseal, Hi-Grip, Shank Guard and Tekes are registered trade marks of ITW Construction Products. Equivalent products complying with AS 3566 Class 3 may be used.*

Recommended screw fasteners for Custom Orb and Custom Blue Orb (non-cyclonic)

	Fixing to Steel Batten Material 0.42mm to 1.0mm BMT	Fixing to Cold Formed Steel Purlin & Girt Material 1.2mm to 4.5mm BMT	Fixing to Hot Rolled Steel Purlin & Girt Material 4.5mm to 6.4mm (Non Stocked Item)	Fixing to Timber Supports TYPE 17	Number of Fasteners Approx. per m ²
Crest Fixed	SHS 12-11x38mm Hi Grip®-Shank Guard Hex. Washers Hd. Self-drilling Batten Tekes Screws	SHS 12-14X35mm Hi Grip-Shank Guard Hex. Washer Hd. Self-drilling and Tapping Screws	SHS 14-20x45mm Hex. Washer Hd. Hi Grip-Shank Self-drilling and Tapping Screws	THS 12-11x50mm Hi Grip-Shank Guard Hex Washer Hd. Self-drilling Screws	5 to 6
Valley Fixed	SHS 10-16x16mm Hex. Washer Hd. Self-drilling Screws	SHS 10-16x16mm Hex. Washer Hd. Self-drilling and Tapping Screws	SHS 14-20x22mm Hex. Washer Hd. Self-drilling and Tapping Screws	THS 12-11x25mm Hex Washer Hd. Self-drilling Screws	5
Side Lap & Accessories	SHS 10-12x20mm Needle or 'S' Point. Hex. Washer . Hd Self-drilling Stitching Screws				2

Recommended screw fasteners for Trimdek Hi-Ten and Spandek Hi-Ten (non-cyclonic)

	Fixing to Steel Batten Material 0.42 mm to 1.0mm BMT	Fixing to Cold Formed Steel Purlin & Girt Material 1.2mm to 4.5mm BMT	Fixing to Hot Rolled Steel Purlin & Girt Material 4.5mm to 6.4mm (Non Stocked Item)	Fixing to Timber Supports TYPE 17	Number of Fasteners (depending on purlin spaces) Approx. per m ²
Crest Fixed	SHS 12-11x50mm Hi Grip®-Shank Guard Hex. Washers Hd. Self-drilling Batten Tek Screws	SHS 12-14x45mm Hi Grip-Shank Guard Hex. Washer Hd. Self-drilling and Tapping Screws	SHS 14-20x65mm Hex. Washer Hd. Self-drilling and Tapping Screws	THS 12-11x65mm Hi Grip-Shank Guard Hex Washer Hd. Self-drilling Screws	5 to 6
Valley Fixed	SHS 10-16x16mm Hex. Washer Hd. Self-drilling Screws Tapping Screws	SHS 10-16x16mm Hex. Washer Hd. Self-drilling and Tapping Screws	SHS 14-20x22mm Hex. Washer Hd. Self-drilling and Tapping Screws	THS 12-11x25mm Hex Washer Hd. Self-drilling Screws	5
Side Lap & Accessories	SHS 10-12x20mm Needle or 'S' Point. Hex. Washer. Hd Self-drilling Stitching Screws				2

Working with Steel

Recommended screw fasteners for Integrity 890 and Integrity 820 (non-cyclonic)

	Fixing to Steel Batten Material	Fixing to ColdFormed Steel Purlin & Girt Material 1.2mm to 4.5mm BMT	Fixing to Hot Rolled Steel Purlin & Girt Material 4.5mm to 6.4mm (Non Stocked Item)	Fixing to Timber Supports	Number of Fasteners Approx. per m ²
	0.42mm to 1.0mm BMT			TYPE 17	
Crest Fixed	SHS 12-14x68mm Hi Grip®-Shank Guard Hex. Washers Hd. Self-drilling Batten Tek Screws	SHS 12-14x68mm Hi Grip-Shank Guard Hex. Washer Hd. Self-drilling and Tapping Screws	SHS 14-20x65mm Hex. Washer Hd. Self-drilling and Tapping Screws	THS 12-11x80mm Hi Grip-Shank Guard Hex Washer Hd Self-drilling Screws	4
Valley Fixed	SHS 10-16x16mm Hex. Washer Hd. Self-drilling Screws	SHS 10-16x16mm Hex. Washer Hd. Self-drilling and Tapping Screws	SHS 14-20x22mm Hex. Washer Hd. Self-drilling and Tapping Screws	THS 12-11x25mm Hex Washer Hd. Self-drilling Screws	4
Side Lap & Accessories	SHS 10-12x20mm Needle or 'S' Point. Hex. Washer Hd Self-drilling Stitching Screws				2

Recommended screw fasteners for Wall Clad (Increase length if wall is insulated)

	Fixing to Steel Batten Material	Fixing to ColdFormed Steel Purlin & Girt Material 1.2mm to 4.5mm BMT	Fixing to Hot Rolled Steel Purlin & Girt Material 4.5mm to 6.4mm (Non Stocked Item)	Fixing to Timber Supports	Number of Fasteners Approx. per m ²
	0.42 mm to 1.0mm BMT			TYPE 17	
Valley Fixed	SHS 10-16x16mm Hex. Washer Hd. Self-drilling Screws	SHS 10-16x16mm Hex. Washer Hd. Self-drilling and Tapping Screws	SHS 14-20x22mm Hex. Washer Hd. Self-drilling Screws	THS 12-11x25mm Hex Washer Hd. Self-drilling Screws	5

Recommended screw fasteners for Multiclad

	Fixing to Steel Batten Material 0.42 mm to 1.0mm BMT	Fixing to Cold-Formed Steel Purlin & Girt Material 1.2mm to 4.5mm BMT	Fixing to Hot Rolled Steel Purlin & Girt Material 4.5mm to 6.4mm (Non Stocked item)	Fixing to Timber Supports TYPE 17	Number of Fasteners	
					Approx. per m ²	M/Clad
Valley Fixed	SHS 10-16x16mm Hex. Washer Hd. Self-drilling Screws	SHS 10-16x16mm Hex. Washer Hd. Self-drilling and Tapping Screws	SHS 14-20x22mm Hex. Washer Hd. Self-drilling Screws	THS 12-11x25mm Hex Washer Hd. Self-drilling Screws	6	M/Clad

Recommended screw fasteners for Panelrib and Mini Orb

	Fixing to Steel Batten Material 0.42 mm to 1.0mm BMT		Fixing to Steel Purlin & girt Material 1.2mm to 2.5mm BMT		Fixing to Timber Supports TYPE 17	
Valley	Panelrib	Mini Orb	Panelrib	Mini Orb	Panelrib	Mini Orb
Fixed (Screw)	SPS 8-18x12mm Pan Hd Self- drilling screw	SP10-16 x 20mm Self drilling screw #SP1020NM03	SPS 8-18 x 12 mm Pan Hd Self- drilling screw	SP10-16x20 Self drilling screw #SP1020NM03	TPS 8-15x20-mm Pan Hd Self- drilling screw	TP10-16x20mm Self-drilling screw #TP1020NM03
Valley Fixed (Rivet)	4.8 mm Aluminium Sealed Blind Rivet		4.8 mm Aluminium Sealed Blind Rivet			
Side Lap & Accessories	3.2 mm Aluminium Sealed Blind Rivet					

Recommended side lap and flashing fasteners

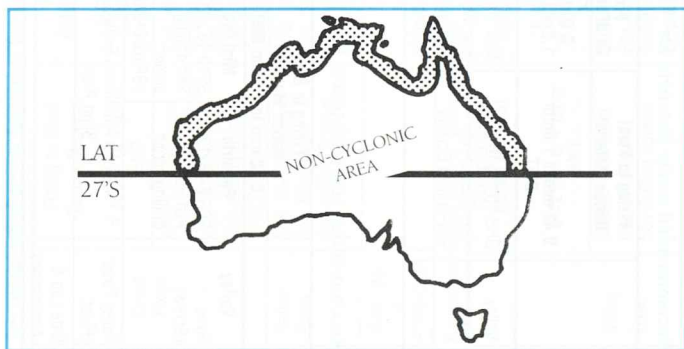
All Sheet Profiles		Tapping Hole Size	
		Support Thickness mm	Drill Dia. mm
Aluminium Sealed blind rivet 4.8mm	Pan head thread-forming screw with metal washer and EPDM Seal. No. 8 x 13mm	Up to 1.0 1.2 1.5	3.2 3.3 3.4

Note: BHP Building Products does NOT recommend the use of monel metal rivets, due to the copper content of this alloy.

Climaseal, Hi-Grip, Shank Guard, Tekes and ZAC are registered trade marks of ITW Construction Products, ACN 004 235 063

Equivalent Products complying with AS 3566 Class 3 may be used.

A non-cyclonic area is defined as one in which a tropical cyclone is unlikely to occur, in accordance with AS 1170.2 – 1989, “SAA Loading Code, Part 2 Wind Loads”.



Fastener selection – cladding to batten (cyclonic areas)

Profile	Fixing to Steel		Fixing to Timber	
	1.0 - 2.5 mm thick	2.5 - 5.0 mm thick	Hardwood J1-J3	Softwood J4
Custom Orb/ Custom Blue Orb	No.14 -10x42mm Hex Head Self-drilling Tapping Screw	No.14-20x45mm Hex Head Self-drilling Tapping Screw	No.14-10x50mm Hex Head Type 17 Self-drilling Screw	No.14-10x65mm Hex Head Type 17 Self-drilling Screw
	No.14-10x50mm Hex Head Self-drilling Tapping Screw	No.14-20x50mm Hex Head Self-drilling Tapping Screw	No.14-10x65mm Hex Head Type 17 Self-drilling Screw	No.14-10x75mm Hex Head Type 17 Self-drilling Screw
Trimdek Hi-Ten Spandek Hi-Ten	No.10-16x16mm Wafer Head Self-drilling Tapping Screw	No.10-24x16mm Wafer Head Self-drilling Tapping Screw	No.3.75x40mm Nail No. 3.75 x 60mm Nail No. 10-12x25mm Wafer Head Type 17 Self-Drilling Wood Screw	No.14-10x50mm Hex Head Type 17 Self-drilling Screw
	No.14-10x20mm Hex Head Self-drilling Tapping Screw	No.14-20x22mm Hex Head Self-drilling Tapping Screw	No.14-10x25mm Hex Head Type 17 Self-drilling Screw	No.14-10x50mm Hex Head Type 17 Self-drilling Screw

Note: Fixing to supports thinner than 1.0mm may be with the screws listed for 1.0 - 2.5mm steel or with Type 17 screws of the same size. All fasteners exposed directly to the weather should be fitted with sealing washers. It is recommended that crest fixed profiles be installed with fasteners containing cyclonic washers.

SERVICE CONDITIONS AND SUITABLE PRODUCTS

(Information under this heading is derived in part from Appendix C to AS 2728. Acknowledgement and thanks to Standards Australia).

In the selection of an appropriate coated steel building product, it is important to assess the atmospheric conditions expected in the location of the intended building. This includes an assessment of both macro and micro-environmental conditions.

On-site factors require additional consideration because a mildly corrosive atmosphere can be converted into an aggressive environment by rain, dew or humid conditions, and can thus affect the choice of a particular category of prefinished metal product.

Typical on-site factors or types of microclimates which may cause a breakdown of protective coatings include:-

- Concentrations of industry
- Contaminations from agricultural fertilizers or insecticides
- Damp locations not dried out by sunlight
- Exposure to sea breezes
- Alkaline or acidic fallout (eg fossil fuel combustion)
- Hot or cold surfaces
- Abrasion or impact
- Concentrations of organic matter (leaves, etc)
- Unwashed Areas*

Prevailing winds which can transport contamination from one location to another also require consideration.

High levels of ultra-violet light and humidity have adverse effects on the performance of organic coatings and thus reduce their durability. Because of the effects of high humidity, the designer of a building should take special care to ensure that the effects of condensation are minimized.

It should also be borne in mind that bending or roll-forming operations will cause stressing and may cause cracking of paint films. In moderate exposure conditions, cracking does not adversely affect the expected life of a product. However, in severe environments products designed for such environments should be specified in order to ensure the required service life is achieved.

***Area Unwashed by Rain**—Particles of dust, salt and other grime settle on building cladding but are usually washed away by rain. However, some areas such as upper wall or upper garage door regions, under eaves, soffits, exterior ceilings, etc, remain unwashed because they are protected by overhangs (eaves, lintels). Galvanized ZINCALUME steel and COLORBOND steel in such areas should be regularly maintained by washing with a fresh water and mild detergent solution to remove grime which could otherwise generate early corrosion. In hard-to-reach areas a hosing would suffice.

ATMOSPHERIC EXPOSURE CONDITIONS - STEEL CLADDING

Performance of steel roofing and walling

General applications

The performance of steel roofing and walling is affected by many factors, some of which are controllable and some are not. The main factor which is not controllable is the environment. The effect of this, however, can be minimised by choosing a material appropriate to the conditions under which the steel sheet must perform.

Environmental factors

- 1 Atmospheric exposure conditions
- 2 Unusually harsh service conditions due to the nature of the activity in a building, eg, intensive animal farming.

Atmospheric Exposure Conditions

In a country the size of Australia, with its wide variety of climatic conditions ranging from the tropical north to the alpine regions in the south-east, and from the heavy surf characteristics of much of the coastline to the desert regions of the interior, it is clearly not possible in a brief general description to cover all possibilities in detail.

In addition, the concentration and nature of industrial activity and the effects of the combustion of fossil fuels must also be taken into account in some localities, and the direction, intensity and nature of prevailing winds can also exert an influence. Any distances quoted therefore can only be indicative.

The following environmental descriptions and table are therefore intended to serve as **A Guide Only**. BHP maintains a central record of the performance of steel products in sites in practically every locality in Australia, and the wise thing to do is consult with your roofing supplier or BHP Coated Products Sales for the best advice on the most suitable choice of COLORBOND steel and ZINCALUME steel product.

In general, atmospheric exposure conditions can be categorised under four main group; very severe, severe, moderate and benign, as shown in table 1.

Table 1 Guide to satisfactory service life of COLORBOND steel and ZINCALUME steel in various conditions of atmospheric exposure.

↑
ATMOSPHERIC EXPOSURE
INCREASING SEVERITY

Very severe	Colorbond Stainless
Severe	Colorbond XSE Colorbond XRW*
Moderate	Colorbond XRW Colorbond XPD
Benign	Colorbond XRW Colorbond XPD Zincalume

***Note:**

Applies to Colorbond XRW used 200-400 metres from marine environments, ie, "severe" environments.

Table 2 Guide to atmospheric exposure conditions

Exposure Condition Distance from source	Corrosive Element	Affected Area
VERY SEVERE (immediate vicinity of active surf, industrial pollution and fumes) Rough, active surf Industrial emission Fossil fuel combustion	Salt laden, moist air Fallout Acid laden air	From 0 up to 100 metres From 0 up to 100 metres From 0 up to 100 metres
SEVERE (close to surf, industrial pollution and fumes) Rough, active surf Industrial emission Fossil fuel combustion	Salt laden, moist air Fallout Acid laden air	From 100 up to 400 metres From 100 up to 250 metres From 100 up to 250 metres
MODERATE (some distance from surf, industrial pollution and fumes, close to calm water) Rough, active surf Calm, still water (eg harbour) Industrial emission Fossil fuel combustion	Salt laden, moist air Salt laden, moist air Fallout Acid laden air	From 400 up to 1 000 metres From 0 up to 100 metres From 250 up to 500 metres From 250 up to 500 metres
BENIGN (outer urban, semi-rural and rural areas, well removed from shoreline, industrial pollution) Rough, active surf Calm, still water Industrial emission Fossil fuel combustion	Salt laden, moist air Salt laden, moist air Fallout Acid laden air	More than 1 000 metres More than 100 metres More than 500 metres More than 500 metres

It is essential to consult BHP Coated Steel Australia or a BHP Building Products Sales office for advice on the correct product to use for very severe and severe conditions.

Information should also be sought concerning the correct choice of fasteners and accessories, and good installation practice. In relation to suitability of fasteners, fastener manufacturers are also familiar with these recommendations and will give the appropriate advice (refer TB-16; Fasteners for Roofing and Walling Product – selection Guide)

Intensive animal farming and unusually harsh service conditions

There are many activities carried out in sheds and industrial buildings which are quite severe in their effects on steel cladding products.

The micro-environment inside sheds for intensive animal farming provides an example of this. The products recommended by BHP for best performance under these conditions are profiles rollformed from a heavy coating mass, zinc-coated base i.e. ZINCFORM G300 or G550 (depending on profile), with a Z450 or Z600 coating class.

ZINCALUME steel is not suitable for use in intensive animal farming environments.

Any proposed structure for industrial activity involving acids, chemicals, heat and moisture, fossil fuel combustion etc, or any site immediately adjacent to such activity, should be referred to BHP for specific recommendations on suitable product.

Note: This information is an abridged version of BHP Coated Steel Division Technical Bulletin TB -1.

HANDLING AND STORAGE OF COATED STEEL SHEET PRODUCTS

Provided they are kept dry, all coated steel products may be satisfactorily stored without deterioration in quality.

Both sheet and coils should be transported and stored so that water is unable to penetrate between adjacent sheet or wrap surfaces. Products must be kept dry in transit and stored in weatherproof buildings. Under conditions of high humidity, condensation must be prevented by adequate ventilation and air circulation.

If sheet storage racks are used, they should be constructed so that sheets are stored on edge, not flat. COLORBOND steel sheets are best stored main surface to main surface. Access should be available at each end of racks so that sheets can be lifted, not dragged. Cleanliness is important in sheet storage; dirt fall-out, even inside buildings, can promote corrosion on unprotected steel.

Where practical, flat sheet products are best left in the protective pack until required for use. It is good practice to convey sheet packs to machinery for feeding direct from the pack.

Keep the product dry

It must be stressed that should water become trapped between adjacent surfaces on any sheet or coiled strip product, the resulting corrosive reactions are far more aggressive than those encountered in normal service. In extreme cases, and with COLORBOND steel or lighter coating class qualities such as ZINCSEAL™ and ZINCANNEAL zinc coated steel, this may lead to early failure of the coated steel.

If, inadvertently, a stack or pack of any sheet product becomes wet, the suggested remedial action depends greatly on the nature of the product, its finish or coating, the length of time any water is

present and the condition of the sheets on examination. In all cases, excess water should be wiped off with a clean cloth without delay and the separated sheets stacked so that air circulation completes the drying process. In some cases, it may be practical to immerse sheets in a tank containing a dewatering agent.

Obviously these procedures are not practical with coil, and technical advice should be sought without delay from the nearest BHP Coated Steel Products Sales Office.

Formed Cladding Profiles

Plain ZINCALUME Steel, galvanized or organic coated steel roofing and walling products are normally delivered to the building site in strapped bundles.

If not required for immediate use, sheets or bundles of formed building profiles should be neatly stacked clear of the ground and, if left in the open, should be protected by loose tarpaulins or similar covers allowing for adequate air circulation. On no account should packs be left exposed to the weather. Rain or condensation is easily drawn in between tightly nested sheets by capillary action. Because this moisture cannot then evaporate in the normal way, it can cause unsightly stains which detract seriously from the finish appearance of the installation. In the extreme, a significant loss of coating can occur.

On large building projects, handling time can be reduced by using a crane to lift bundles directly onto the roof. If required, BHP Building Products Sales Offices will give advice on lifting long-length bundles.

For small and medium jobs without mechanical handling facilities, sheets can easily be passed up one at a time by hand. **Gloves should always be worn.**

When handling COLORBOND steel, do not drop sheets or drag one sheet over another. Always wear soft-soled shoes and avoid the ribbed type that pick up and hold small stones, etc.

Do not drag tools and equipment over painted surfaces. Carefully sweep away any metal shavings caused by drilling or sawing.

To assist in handling and protecting “COLORBOND Steel” accessories (Gutter, Fascia, Flashings and Cappings, Downpipe, etc) most manufacturers and certainly BHP Building Products supply the particular products with a **strippable film**.

If a strippable protective film is present on any steel building product, it is essential that the film be stripped away as soon as possible after installation.

Failure to do this can result in problems with stripping.

In other words, use sensible care to protect the high-quality finish so that it can perform properly.

In both handling and storage of all steel product, **safety** issues must be of uppermost importance.

BHP Coated Steel Australia can assist with literature on recommended practices.

SOLDERING GALVANIZED STEEL SHEETS

All qualities of BHP zinc-coated steel sheets may be soldered quickly and effectively if the simple procedures given below are followed. However, it is not practical to solder ZINCALUME steel in the field, and the practice is therefore not recommended; suitable polymeric sealants should be used. (See note in this section).

Common Soldering Problems

The most common causes of problems in soldering are:—

Refer to comments under

- | | |
|--|----------------------|
| • Dirty soldering iron | Cleanliness |
| • Overheated soldering iron and abrasion | Applying the Solder |
| • Dirty and poor quality flux | Cleanliness; Fluxing |
| • Poor quality solder | Solder |
| • Use of percussion tools | Forming |
| • Resistance to wetting by flux | Fluxing |
| • Covering spangle cracks | Fluxing |
| • Soldering ZINCANNEAL steel | Fluxing |

Storage of Sheets or products for soldering should be stored appropriately to avoid water damage or oxidation of the surface, as it is necessary to remove any surface deposit with abrasive paper before soldering.

Forming – the manner in which the material is formed before soldering has an important bearing on its soldering properties. It is important to ensure correct tailoring of seams and to avoid mechanical bruising in either:—

- **Hand Seaming** – use a wooden dresser or mallet in preference to a steel hammer. A groover of the correct size should be used.
- **Machine Seaming** – the size of the seam should be carefully tailored to suite the grooving machine.

Cleanliness in Forming and Soldering – forming tools and working surfaces should be thoroughly clean. Before seaming, sheets which are obviously dirty should be cleaned and, where applicable, surface deposits should be removed from the area to be soldered by the use of abrasive paper.

Flux pots and flux brushes must be clean, and flux which has become contaminated through excessive use should be discarded. It is most important that the soldering iron be clean and well tinned, and that the solder be free from contamination.

Keep the Zinc on the Sheet – the technique of soldering, as described in both **Fluxing** and **Applying the Solder**, is built around the maxim “Keep the zinc on the sheet”.

Fluxing – three types of flux are recommended; the conventional spirits flux and two proprietary fluxes, Kemtex Pinnacle Soldering Fluid and Baker’s No 47 Soldering Fluid, with the latter two being preferred. A spirits flux is not recommended for ZINCANNEAL steel.

Spirits Flux

A spirits flux is normally a mixture of killed spirits and raw spirits in equal proportions, but good results can be obtained with killed spirits alone or with raw spirits alone. Excessive use of raw spirits can effectively remove significant amounts of the zinc coating. This may lead to soldering problems or corrosion of adjacent areas.

Raw spirits, spirits of salts and muriatic acid are popular names for hydrochloric acid. Killed spirits (or zinc chloride) is hydrochloric acid to which zinc has been added until gas bubbles stop rising from the solution.

Proprietary Soldering Fluids

Kemtex Pinnacle and Baker's No 47 soldering fluids are the preferred choice for soldering. These fluxes instantly wet and superficially etch the zinc surface.

They are easier to control than a spirits flux, fluxing time is reduced and, normally, greater speed and ease of soldering results in better joint penetration. For best results, the time between fluxing and soldering should be minimised by fluxing small areas.

As a flux is corrosive, only the portions of the work to be covered with solder should be fluxed. This should be observed with particular care when using a high proportion of raw spirits, as it is very reactive with zinc.

The flux should be applied until it has uniformly covered the whole of the joint and has penetrated into the joint. With a spirits flux, it is essential to ensure that the area to be soldered has been thoroughly wetted with flux; a second application may be necessary.

The wetting action and joint penetration of a spirits flux is improved by the use of a wetting agent in the proportion of one drop per cup of flux. This approach may be used with Pinnacle or Baker's flux for ensuring joint penetration, although usually penetration of both lapped and grooved seams is complete if sufficient flux is used.

When forming or seaming operations involve severe stretching of the coating relative to the base, minute surface fissures, or spangle cracks, may result. Spangle cracking does not normally interfere with the penetration of solder into the seam; but when appearance is important and smooth coverage of these areas is necessary, careful attention must be given to cleanliness and fluxing technique, and the speed of soldering must be reduced, particularly when a spirits flux is used. At regular intervals the flux pot should be cleaned and filled with fresh flux.

Solder – a good quality 50-50 solder with a maximum antimony content of 0.5 per cent should be used. Australian Standard 1834 gives full details of a suitable composition.

To obtain the best results, the required heat should be applied in the shortest possible time at a minimum working temperature. Overheating may result in local buckling and an excessive solution of the zinc coating, giving a rough sandy finish. The seal must, however, be adequately heated if good penetration is to be obtained. To achieve these objectives, the following points should be observed:–

- Avoid heat conduction away from the joint
- Avoid soldering in draughty conditions
- Use a soldering iron with a high rate of heat transfer
- The soldering iron should be clean and well tinned
- Do not overheat the soldering iron
- Avoid applying a direct flame to the work
- Solder the joint in one run wherever possible
- Avoid undue abrasion of the zinc surface with the soldering iron
- The soldering iron should always be drawn along the seam toward the operator, because the iron preheats the seam, and should be drawn in a straight line with no movement from side to side

After Soldering – it is most important that the job be wiped with clean cloths dampened in clean water to remove excess flux and so prevent corrosion.

SPECIAL NOTE ON THE SOLDERING OF ZINCALUME STEEL

Although it is possible to solder ZINCALUME steel, the process is impractical in the field and is not recommended.

As indicated, alloy solder in a joint is primarily a low mechanical strength sealer capable only of holding joint members in place. Where any significant strength is required the joint needs to be mechanically fastened (screwed, rivetted) or integrally formed (seamed) prior to sealing. For situations where soldering would formerly have been considered, suitable polymeric sealants are available for use in conjunction with mechanical or other fastening systems. The ZINCALUME steel coating is a zinc/aluminium alloy. Essentially due to the aluminium content (55%) special solder alloys, fluxes, techniques and high soldering temperatures are required for soldering ZINCALUME steel.

To ensure that the most up-to-date information on soldering ZINCALUME steel is obtained, advice should be sought from BHP Coated Steel Australia Sales Offices.

ADHESIVES FOR JOINING STEEL SHEET PRODUCTS

In the manufacture of products from steel sheet, adhesives are playing an increasingly important role as the benefits of adhesive joining become more widely known and accepted, and as new adhesives are introduced. The progression from simple natural rubbers to adhesives and resins has seen the achievement of new dimensions in strength, flexibility and resistance to environmental conditions.

Reasons For Using Adhesives

Adhesive bonding is often a preferred method for joining and sealing steel sheet. It is particularly beneficial for bonding precoated sheet.

Subject to a uniform surface condition, the performance of modern adhesives is both reliable and predictable, and joints of moderate strength can be produced. But as with any fastening method, there are limitations as well as advantages.

Advantages include:–

- Uniform stress distribution
- Vibration dampening
- Seals as well as bonds
- Joins other materials to steel
- Joins thin steel sheets
- High joint security when combined with mechanical or integral fastening
- Smooth contoured outer surface
- Reduces corrosion caused by galvanic cells

Limitations include:–

- Difficulty in the correct choice of adhesive from the large range available, although this gives more flexibility of choice to suit specific requirements

- Need for careful surface preparation for some types
- Relatively long curing times for some adhesives
- Non-destructive inspection of joint is difficult
- Jigs and fixtures may be needed

Joint Design

To take full advantage of adhesives, joint design in steel sheet must be considered early in the development of the manufactured product. The two main aspects of study are joint bonding and service environment.

Joint loading must be known, including direction and type, ie. whether the loading is in compression, tension, shear or whether a cleavage or peel loading predominates.

Application

Adhesives are used both for joining steel sheet surfaces together and for affixing attachments.

Service environment must be known and the appropriate adhesive chosen to withstand all likely temperature, moisture or corrosive conditions. In many instances an adhesive can have the dual roll of supporting the design load and acting as a sealant.

Adhesives may be combined with mechanical fastening or welding systems to give a highly desirable combination of strength combined with the advantage of load distribution over a wide area.

Common methods for applying adhesives include brush, spatula, rolled cartridge extrusion, pneumatic and electric hand guns and, for automated assembly lines, multi-nozzle applicators. Adhesives are often in tape form, with some double sided tapes in varying thicknesses offering high strength under many service conditions.

The complexity of the variations possible with the use of adhesives makes it mandatory for adhesive suppliers to be consulted in the design stage of both the product being made and the method of manufacture.

Types and Selection

The variety of adhesives available to a manufacturer is rapidly increasing so it is important to understand the characteristics. However, the properties of an adhesive can be altered by a change in formulation from a basic type to suit many different requirements, and by mixing the basic types themselves to give a combination of desirable characteristics.

The basic types of adhesives can be broadly categorised into three main groups: **thermoplastic**, **thermoset**, **elastomeric**.

Thermoplastic adhesives

Thermoplastic adhesives soften when heated. The hot melt group needs heat for application whereas reactive acrylics, anaerobic and cyanoacrylates set at room temperature.

Hot melt adhesives – soften in the general working range of 170–200°C. Available as tapes, films, powders, rods, pellets and blocks, they are applied by equipment such as hand-held or automated self-heating guns. At temperature, the adhesive flows onto the surfaces to be joined, giving adhesion and strength as cooling and hardening occurs. No chemical change takes place as the adhesive sets and so it will soften again if reheated.

In general terms, hot melt adhesives are less expensive than other adhesive types and have:–

- Good flexibility
 - High impact resistance
 - Tolerance to surface condition
 - Low creep strength
- (less surface preparation)

Differences in the formulation of hot melt adhesives means there is a wide range of strength properties.

Reactive acrylics – are two-pack adhesives and have the advantage of a simple no-mix application with each part applied to one of the faces to be joined, a rapid bond at ambient temperature, good mechanical properties, and a lesser need for surface preparation.

Anaerobic adhesives – set when starved of oxygen, such as between closely matching metal surfaces. They are stored in low density polyethylene containers permeable to oxygen to prevent setting before use. Anaerobics are often used to secure tightly fitting joints such as threaded fasteners, gaskets, keyways and splines.

Cyanoacrylates – polymerise or harden at room temperature when pressed into a thin film between two tightly fitting surfaces. The hardening is initiated by the presence of a very thin film of moisture always present on surfaces at room temperature.

Both anaerobics and cyanoacrylates produce a high strength bond in tension or shear but are very low in cleavage or peel loadings.

Thermoset adhesives

Thermoset adhesives, for example, the well known epoxy group, undergo chemical change during hardening at room temperature for the two-pack, or elevated temperature for single-pack types. They will not soften when reheated. Characteristics are:–

- High strength bonds (often called structural adhesives)
- High creep strength
- Low impact resistance
- Less flexible bond than thermoplastic bond

Elastomeric adhesives

Elastomeric adhesives are the synthetic rubber-based group and usually set with the evaporation of a solvent. They can also be formulated as contact types which produce instant adhesion when adhesive coated surfaces are brought together.

Surface preparation

The object of surface preparation is to remove a sufficient degree of contamination from a surface at a processing cost, compatible with the bond strength required from most adhesives, not only for the initial bond strength but also for the durability of the bond when exposed to normal environmental conditions.

BHP organic finished steel sheets usually require only a solvent wipe. Uncoated and metal coated steels invariably require more cleaning to remove any oil and dirt contamination and oxide layers from the surface, the degree of removal depending on the adhesive to be used.

Mechanical cleaning, abrasive blasting and chemical etching can also be used for surface preparation of adhesive joints. Because of the many possible differences in both surfaces and adhesives, the adhesive manufacturers' directions should be followed explicitly.

Any calculations for bond areas to give the required joint strength must make allowances for variations in surface treatment likely to be encountered in normal production conditions.

SEALANTS FOR ZINCALUME STEEL AND COLORBOND STEEL

Sealant is the descriptive word (used in this handbook), for polymeric sealants. Polymeric sealants provide a continuous surface-polymer bonding layer to both opposing surfaces, to fill (seal) a gap and to set (cure), either by polymerization initiated by curing agents or by evaporation of constituent solvents, generally followed by polymerization of the resins. Polymerization is a process whereby small organic molecules chemically combine to form very large molecules. Polymeric sealants include natural rubber and synthetic elastomers of nitrite, Neoprene, Silicone and butyl generic types.

Although, as part of their sealing function, sealants are designed to hold components together, for joining sheet steel they always require some form of supportive element such as a mechanical fastener (screw, rivet) or integral fastening (seam).

Sealants are not adhesives; their prime purpose is to exclude moisture.

Joints for exterior applications such as steel roofs, walls, flashing and ducting constitute a special case due to the number of exposure environments and variables. The wide use of precoated steel for exterior use contributed to the development of sealants suitable for seams and joints. Many steel roofing and walling shapes marketed under various respected brand names are formed from COLORBOND steel and ZINCALUME steel.

Neutral curing silicone rubber sealants (**acetic acid-free** and **Amine-free**) have the most complete list of properties required to service the total range of BHP steel sheet exterior finishes.

**Extracted from BHP Coated Steel Technical Bulletin TB-9 –
“Sealants for exterior finishes.”**

PAINTING OF ZINC-COATED, ZINCALUME STEEL SHEET

The painting of BHP ZINCALUME zinc/aluminium alloy-coated steel or galvanized steel for either decoration or added protection can be easily and effectively carried out, providing certain basic requirements are observed. Ordinary painting techniques and readily available appropriate paints should be used, but care must be taken in the choice of paint to ensure its suitability for the application in the field; (see Section 1) or in the factory. (see Section 2)

Painting in the field requires **air drying** paints. Table 1 summarizes the general approach to the field painting of BHP sheet products.

Painting in the factory, normally on a line designed specifically for the purpose and using elaborate cleaning and pretreatment, usually requires **specialist** paints systems.

Selection of paint for factory use is dictated by the final use and exposure conditions, and should be chosen in consultation with a reputable paint manufacturer. Interior exposure tends to be less severe than exterior, but many corrosive interior conditions are encountered, eg in washing machine cabinets.

Selection of paint for field use should take into account the severity of the environment in which the paint will be exposed, eg. rural, coastal, industrial or special conditions.

Section 1 – Field Painting

For satisfactory priming, the surface to be painted must be clean and dry. Dirt should be removed by washing with water, greasy deposits should be wiped with paint thinners, and any loose corrosion product removed by wire brushing.

Table 1 General approach to the field painting of zinc-coated or ZINCALUME steel.

Cleaning	Priming and Finishing
<ol style="list-style-type: none"> 1. Remove dirt by washing with water 2. Wipe off greasy deposits with paint thinners 3. Remove any corrosion product by wire brushing, taking care not to unnecessarily remove any of the metal coating 	<ol style="list-style-type: none"> 1. Select paint system with due regard to environmental requirements 2. Follow the paint manufacturer's instructions explicitly 3. Do not mix different proprietary brands of primer and finisher 4. Apply two finishing coats in addition to the primer. Principal exception is zinc-dust/zinc-oxide coatings applied to galvanized steel where two coats in total is usually sufficient 5. Finishing coats may be applied directly to ZINCANNEAL steel without priming, but when the two pack type etch primer is used, the overall protection given by the paint system is very much improved 6. Care should be taken to provide adequate ventilation as some volatile compounds may be toxic 7. Where possible, contact with the skin should be avoided

Weathering, formerly considered to improve long term paint adhesion, has since been found to give inconsistent results and is no longer recommended. One exception to this is for water-based acrylic-type paint, where two weeks weathering makes painting easier by improving the wettability of the surface. The choice of paint, as stated earlier, depends principally on the environmental conditions.

Use of the recommended brands should produce a satisfactory result provided care is taken to follow the manufacturers mixing and application instructions. The mixing of different brands of priming and finishing coats should be avoided.

A minimum of two finishing coats in addition to the priming coat is advised, except for zinc-dust/zinc-oxide paints on galvanic coatings, where a total of two is sufficient. Spray painting can be used providing the paint is suitable for this method of application.

At all times it is important to avoid excessive paint build up, as may occur in the valleys of formed roofing panels.

Section 2 – Factory Painting

For factory painting, GALVABOND, ZINCFORM and ZINC-HITEN is usually pretreated with a phosphate coating system prior to painting. GALVALUME steel uses a chromate-based pretreatment. **ZINCALUME steel uses a chromate-based pretreatment, plus a clear acrylic coating.**

Chromate coatings or two-pack etch primers may also be used. This combines a high degree of adhesion and increased corrosion resistance under the types of paints, often stoving varieties, normally applied in factories. Pretreatment is particularly important if the products are to be used outdoors, and for many interior applications where the product is exposed to humid conditions or the risk of mechanical damage.

Cleaning and appropriate pretreatment systems are available from companies dealing in metal pretreatment and known to the trade. Two suppliers whose systems have been found satisfactory are Henkel (Australia) Pty Ltd and Dulux Australia Limited. Where pretreatment facilities are not available, two pack etch primers may be used.

Material to be pretreated should be ordered unpassivated and oiled. The light mineral oil used on unchromated strip for protection during transit does not provide the same resistance to corrosion as the chromate treatment. Particular care should be taken to keep packages dry prior to use. Water staining, usually a white corrosion product, should be removed by light abrasion before or during the normal cleaning, before the phosphate process.

Usually, pretreatment is applied to the article after forming and immediately before painting, but the practice of prepainting before forming is increasing. This latter procedure requires special attention to the type and efficiency of the pretreatment system used and also to the selection of appropriate finish coats. Should forming occur after painting, it is often more economical to use prepainted sheet or strip, such as COLORBOND steel.

A wide variety of basic paint types are available for factory finishing, but it is important to select the most appropriate paint for the particular application. Usually this involves consultation with a reputable supplier in the field, and it is advisable that the supplier's recommendations and directions for the paint systems be incorporated into an integrated process and paint technique. As with 'field' painting, any doubts or queries should be referred to the supplier as quickly as possible.

Acrylics are very popular in the appliance and building industries because of their mar resistance, and general resistance to the effect of heat and household chemicals.

The technique of post-forming painted strip requires special, flexible paint systems and this technique should only be considered in close consultation with a paint manufacturer experienced in this particular field.

Colorbond Steel

In many instances, it is possible – and desirable – to avoid either field or factory painting. COLORBOND prepainted steel is available in a wide range of roofing and cladding profiles or as coil or sheet for fabrication.

Overpainting and Restoration of COLORBOND steel

COLORBOND prepainted steel for exterior applications is zinc/aluminium alloy-coated or zinc coated steel sheet that is painted on one of BHP continuous strip coating lines. The paint system used is specially formulated for the intended purpose and is oven-cured during the production process.

Several different but related circumstances are encountered in the maintenance of COLORBOND steel surfaces. To avoid confusion, the following terms and their meaning are given:

Restoration	the repair of COLORBOND steel surfaces by the use of one or more of the techniques described below
Overpainting	the complete overpainting of the surface, as in the case of normal maintenance after years of service, or where a change of colour is desired
Accessory Painting or Match Painting	the application of colour-matched paint of unpainted small accessory items to match the COLORBOND steel colour being used on the building. Such small accessories may include gutter corners, down pipes, fastener heads, windows, pergolas, fascias, and gutter brackets
Repair of minor scratches & blemishes	the application of small amounts of colour-matched touch-up paint to repair only small scratches on the COLORBOND steel surface. This is distinct and separate from overpainting. It must be noted however that TOUCHING UP OF COLORBOND STEEL SURFACES IS NOT RECOMMENDED
Galling	generally only superficial damage caused by surfaces rubbing together as a result of vibration and interwrap movement during transport

WELDING

There is a wealth of welding and joining information available for those manufacturing or fabricating steel products. **The Welding Technology Institute of Australia (WTiA)** is a non-profit organisation whose mission is “**to assist in making Australian industry locally and globally competitive in welding related activities**”.

Amongst the services provided to industry are concise technical publications, known as Technical Notes, covering a variety of specific welding applications. Additionally, videos are available covering a wide variety of welding topics from Welding Robots through to Non-Destructive Testing.

Listed is an abbreviated list of Technical Notes and Videos available. For further information, call the WTiA on 1800 620 820, (02) 9748 4443 or fax on (02) 9748 2858.

Codes	Titles
TN01	The Weldability of Steels (1996)
TN02	Welding Aluminium with the Inert Gas Processes (1997)
TN03	Care & Conditioning of Arc Welding Consumables (1994)
TN04	The Industry Guide to Hardfacing for the Control of Wear (1996)
TN05	Flame Cutting of Steels (1994)
TN05-2	Flame Cut Replica
TN06	Control of Lamellar Tearing (1985)
TN07	Health & Safety in Welding (1994)
TN08	Economic Design of Weldments (1979)
TN09	Welding Rates in Arc Welding Processes: Part 1 (1979)
TN10	Fracture Mechanics (1980)

Codes	Titles
TN11	Commentary on Structural Steel Welding Code (1992)
TN12	Minimising Corrosion in Welded Steel Structures (1996)
TN13	Stainless Steels for Corrosive Environments (1983)
TN14	Design and Construction of Welded Steel Bins (1984)
TN15	Welding and Fabrication of Quenched and Tempered steel (1996)
TN16	Welding Stainless Steels (1985)
TN17	Automation in Arc Welding (1986)
TN18	Welding of Castings (1987)
TN19	Cost Effective Quality Management for Welding (1995)
TN20	Repair of Steel Pipelines (1994)
V8	Metal Transfer in Arc Welding
V10	Pulse Welding Techniques
V18	Stainless Steel Welding
V25	Welding Robots -- The Second Generation
V28	Understanding Welding Fumes
V38	Manual Metal Arc (Stick) Welding
V39	MIG/MAG Welding
V42	MIG Welding – Mild Steel with Low Current Sets
V48	Introduction to the Metal Fabrication & Welding Trade

BASIC TRAINING MANUALS (WTIA)

Manual Metal Arc Welding (*Prices on application*)

Aluminium Welders Training Manual (*Prices on application*)

Also refer to BHP steel's Technical Bulletin TB-21

"Resistance Spot Welding of BHP Metallic-Coated Steel Sheet"

AVOIDANCE OF CONTACT BETWEEN INCOMPATIBLE METALS OR METAL ROOFING/GUTTER SITUATIONS

This information is not intended to cover all contingencies where metals incompatibility can cause problems. The subject matter is selective in that it relates to metal roofing/gutter situations, and as such is also pertinent for steel rainwater tanks.

Data provided is based on a relatively small section of AS 2179 and AS 2180, published as one booklet by Standards Australia. These two standards combine 'Metal Rainwater Goods' together with 'Selection and Installation of Metal Rainwater Goods'. All trades and professions associated with this subject should read and observe the practices and recommendations contained in this useful publication.

Drainage systems should be designed so that direct contact between two or more incompatible metals or alloys does not occur. Drainage from copper or copper alloy roofs, pipes, etc, must not be discharged onto or into aluminium alloy, zinc, zinc-coated or zinc/aluminium alloy-coated steel gutters, downpipes and the like.

The table which follows is an extract from the BHP Coated Products Technical Bulletin, Corrosion Dissimilar Metals CTB – 12 and should be read in conjunction with this.

Compatibility of Direct Contact between Metals or Alloys

Cladding Material	Accessory or Fastener Material					
	Stainless Steel (300 Series)	Zinc-Coated Steel & Zinc	Zinc/Aluminium coated steel	COLORBOND [®] XRW	COLORBOND [®] XSE	COLORBOND [®] Stainless
	Atmospheric Classification					
	SI and VS Mild	SI and VS Mild	SI and VS Mild	SI and VS Mild	SI and VS Mild	SI and VS Mild
Zinc-coated steel & zinc	No No	Yes Yes	Yes Yes	Yes Yes	Yes Yes	No No
Zinc/aluminium-coated steel	No No	Yes Yes * *	Yes Yes	Yes Yes	Yes Yes	No No
COLORBOND [®] XRW	No No	Yes Yes * *	Yes Yes	Yes Yes	Yes Yes ** **	No No
COLORBOND [®] XSE	No No	Yes Yes * *	Yes Yes	Yes Yes ** **	Yes Yes	No No
COLORBOND [®] STAINLESS	Yes Yes	No No	No No	No No	No No	Yes Yes

Key: SI, VS, Mild = severe industrial, very severe marine and mild classification

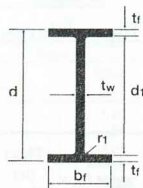
* Inert catchment situation may apply.

** Differential colour durability may apply.

Any technical information or advice is provided as a service to the industry. The use of such information or advice may produce unexpected results, and any persons intending to make use of the information are urged to carry out tests of their own to satisfy themselves that they are using the correct materials, approach and techniques. Correctly following the information and advice should produce a satisfactory result but BHP assumes no responsibility whatsoever in relation to such information or advice. For further information, contact the BHP Steel's Customer Support Centre.

STRUCTURAL STEEL

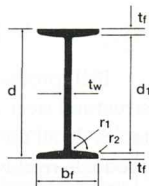
BHP produces a large range of hot-rolled structural steel shapes and sections. The following tables detail the lighter range of BHP Structural Steel products readily available in grade 300Plus™ from steel stockists. They include Universal Sections, Taper Flange Beams, Parallel Flange Channels and Equal and Unequal Angles.



Universal Sections

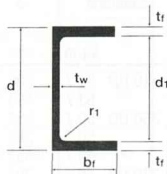
BHP 300PLUS™ Steel Sections	Depth of Section d	Flange		Web Thickness tw	Root Radius r1	Depth Between Flanges d1	Gross Area of Cross Section Ag
		Width bf	Thickness tf				
kg/m	mm	mm	mm	mm	mm	mm	mm²
410 UB 59.7	406	178	12.8	7.8	11.4	381	7640
53.7	403	178	10.9	7.6	11.4	381	6890
360 UB 56.7	359	172	13.0	8.0	11.4	333	7240
50.7	356	171	11.5	7.3	11.4	333	6470
44.7	352	171	9.7	6.9	11.4	333	5720
310 UB 46.2	307	166	11.8	6.7	11.4	284	5930
40.4	304	165	10.2	6.1	11.4	284	5210
32.0	298	149	8.0	5.5	13.0	282	4080
250 UB 37.3	256	146	10.9	6.4	8.9	234	4750
31.4	252	146	8.6	6.1	8.9	234	4010
25.7	248	124	8.0	5.0	12.0	232	3270
200 UB 29.8	207	134	9.6	6.3	8.9	188	3820
25.4	203	133	7.8	5.8	8.9	188	3230
22.3	202	133	7.0	5.0	8.9	188	2870
18.2	198	99	7.0	4.5	11.0	184	2320
180 UB 22.2	179	90	10.0	6.0	8.9	159	2820
18.1	175	90	8.0	5.0	8.9	159	2300
16.1	173	90	7.0	4.5	8.9	159	2040
150 UB 18.0	155	75	9.5	6.0	8.0	136	2300
14.0	150	75	7.0	5.0	8.0	136	1780
150 UC 37.2	162	154	11.5	8.1	8.9	139	4730
30.0	158	153	9.4	6.6	8.9	139	3860
23.4	152	152	6.8	6.1	8.9	139	2980
100 UC 14.8	97	99	7.0	5.0	10.0	83.0	1890

Taper Flange Beams



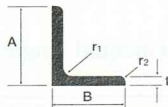
BHP 300PLUS™ Steel Sections	Mass per Metre kg/m	Depth of Section d mm	Flange		Web Thickness tw mm	Radii		Depth Between Flanges d1 mm	Gross Area of Cross Sections Ag mm ²
			Width bf mm	Thickness tf mm		Root r1 mm	Toe r2 mm		
125 TFB	13.1	125	65.0	8.5	5.0	8.0	4.0	108	1670
100 TFB	7.2	100	45.0	6.0	4.0	7.0	3.0	88	917

Parallel Flange Channels



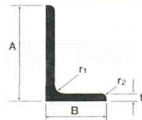
BHP 300PLUS™ Steel Sections	Mass per Metre kg/m	Depth of Section d mm	Flange		Web Thickness tw mm	Root Radius r1 mm	Depth Between Flanges d1 mm	Gross Area of Cross Section Ag mm ²
			Width bf mm	Thickness tf mm				
380 PFC	552	380	100	17.5	10.0	14.0	345	7030
300 PFC	40.1	300	90	16.0	8.0	14.0	268	5110
250 PFC	35.5	250	90	15.0	8.0	12.0	220	4520
230 PFC	25.1	230	75	12.0	6.5	12.0	206	3200
200 PFC	22.9	200	75	12.0	6.0	12.0	176	2920
180 PFC	20.9	180	75	11.0	6.0	12.0	158	2660
150 PFC	17.7	150	75	9.5	6.0	10.0	131	2250
125 PFC	11.9	125	65	7.5	4.7	8.0	110	1520
100 PFC	8.31	100	50	6.7	4.2	8.0	86.6	1060
75 PFC	5.90	75	40	6.1	3.8	8.0	62.8	757

Equal Angles



BHP 300PLUS™ Steel Sections	Nominal thickness mm	Mass per metre kg/m	Actual Thickness t, mm	Radii	
				Root r_1 mm	Toe r_2 mm
200 x 200	26	76.8	26.0	18.0	5.00
	20	60.1	20.0	18.0	5.00
	18	54.4	18.0	18.0	5.00
	16	48.7	16.0	18.0	5.00
	13	40.0	13.0	18.0	5.00
150 x 150	19	42.1	19.0	13.0	5.00
	16	35.4	15.8	13.0	5.00
	12	27.3	12.0	13.0	5.00
	10	21.9	9.50	13.0	5.00
125 x 125	16	29.1	15.8	10.0	5.00
	12	22.5	12.0	10.0	5.00
	10	18.0	9.50	10.0	5.00
	8	14.9	7.80	10.0	5.00
100 x 100	12	17.7	12.0	8.00	5.00
	10	14.2	9.50	8.00	5.00
	8	11.8	7.80	8.00	5.00
	6	9.16	6.00	8.00	5.00
90 x 90	10	12.7	9.50	8.00	5.00
	8	10.6	7.80	8.00	5.00
	6	8.22	6.00	8.00	5.00
75 x 75	10	10.5	9.50	8.00	5.00
	8	8.73	7.80	8.00	5.00
	6	6.81	6.00	8.00	5.00
	5	5.27	4.60	8.00	5.00
65 x 65	10	9.02	9.50	6.00	3.00
	8	7.51	7.80	6.00	3.00
	6	5.87	6.00	6.00	3.00
	5	4.56	4.60	6.00	3.00
55 x 55	6	4.93	6.00	6.00	3.00
	5	3.84	4.60	6.00	3.00
50 x 50	8	5.68	7.80	6.00	3.00
	6	4.46	6.00	6.00	3.00
	5	3.48	4.60	6.00	3.00
	3	2.31	3.00	6.00	3.00
45 x 45	6	3.97	6.00	5.00	3.00
	5	3.10	4.60	5.00	3.00
	3	2.06	3.00	5.00	3.00
40 x 40	6	3.50	6.00	5.00	3.00
	5	2.73	4.60	5.00	3.00
	3	1.83	3.00	5.00	3.00
30 x 30	6	2.56	6.00	5.00	3.00
	5	2.01	4.60	5.00	3.00
	3	1.35	3.00	5.00	3.00
25 x 25	6	2.08	6.00	5.00	3.00
	5	1.65	4.60	5.00	3.00
	3	1.12	3.00	5.00	3.00

Unequal Angles



BHP 300PLUS™ Steel Sections	Nominal Thickness mm	Mass per Metre kg/m	Actual Thickness t, mm	Radii	
				Root r^1 mm	Toe r^2 mm
150 x 100	12	22.5	12.0	10.00	5.00
	10	18.0	9.50	10.00	5.00
150 x 90	16	27.9	15.8	10.00	5.00
	12	21.6	12.0	10.00	5.00
	10	17.3	9.50	10.00	5.00
	8	14.3	7.80	10.00	5.00
125 x 75	12	17.7	12.0	8.00	5.00
	10	14.2	9.50	8.00	5.00
	8	11.8	7.80	8.00	5.00
	6	9.16	6.00	8.00	5.00
100 x 75	10	12.4	9.50	8.00	5.00
	8	10.3	7.80	8.00	5.00
	6	7.98	6.00	8.00	5.00
75 x 50	8	7.23	7.80	7.00	3.00
	6	5.66	6.00	7.00	3.00
	5	4.40	4.60	7.00	3.00
65 x 50	8	6.59	7.80	6.00	3.00
	6	5.16	6.00	6.00	3.00
	5	4.02	4.60	6.00	3.00

- For details on the complete range of BHP Structural Steel products please refer to BHP's "Hot Rolled and Structural Steel Products" Manual available through BHP Steel Direct, telephone 1800 800 789.
- BHP Structural Steel products are made to Australian Standard AS/NZS 3679.1: "Structural Steel Part 1: Hot Rolled Bars and Sections."

Merchant Bar Product Range

Round and Squares

BHP Steel Sections	Rounds		Squares		
	Mass kg/m	Length m/tonne	Mass kg/m	Length m/tonne	Corner Radius * mm
10	0.616	1621	0.79	1273.9	*
12	0.887	1126	1.13	884.6	*
13	1.04	959	-	-	-
14	1.21	827	-	-	-
15	1.39	721	-	-	-
16	1.58	633	2.01	467.6	*
17	1.78	561	-	-	-
18	1.99	500	-	-	-
19	2.23	449	-	-	-
20	2.46	405	3.14	318.5	*
21	2.72	368	-	-	-
22	2.98	335	-	-	-
23	3.26	307	-	-	-
24	3.55	282	-	-	-
25	-	-	4.91	203.8	*
26	4.17	240	-	-	-
27	4.49	222	-	-	-
30	5.55	180	-	-	-
32	6.31	158	-	-	-
33	6.71	149	-	-	-
36	7.99	125	-	-	-
39	9.38	107	-	-	-
40	-	-	12.5	79.6	1.5
42	10.9	92	-	-	-
45	12.5	80	15.7	63.7	5.5
48	14.2	70	-	-	-
50	15.4	65	19.4	51.7	6.5
56	19.3	52	-	-	-
60	22.2	45	-	-	-
63	-	-	30.7	32.5	8
65	26	38	-	-	-
75	34.7	29	43.6	23	9.5
80	39.5	25	-	-	-
90	49.9	20	62.8	16	11.5
100	61.7	16	77.4	12.9	12.5

*Corner radius as square as possible but may be up to 1mm

Flats

Mass Kg/m

Width mm	Thickness mm										
	3	5	6	8	10	12	16	20	25	40	50
16				1.00							
20	0.471	0.479	0.940		1.57						
25	0.589	0.981	1.18	1.57	1.96	2.36					
32	0.754	1.26	1.51	2.01	2.51						
40	0.942	1.57	1.88	2.51	3.14	3.77	5.02				
50	1.18	1.96	2.36	3.14	3.93	4.71	6.28	7.85	9.81		
65	1.53	2.55	3.06	4.08	5.10	6.12	8.16	10.2			
75		2.94	3.53	4.71	5.89	7.06	9.42	11.8	14.7	23.6	
90		3.53	4.24	5.65	7.06	8.48					
100		3.93	4.71	6.28	7.85	9.42	12.6	15.7	19.6		39.3
110		4.32	5.18	6.91	8.64	10.4					
130		5.10	6.12	8.16	10.2	12.2	16.3	20.4	25.5		
150		5.88	7.06	9.42	11.8	14.1	18.8	23.6	29.4		58.9
180		7.07	8.48		14.1	17.0		28.3			
200			9.42	12.6	15.7	18.8	25.1	31.4	39.3		
250		9.81	11.8	15.7	19.6	23.6					
300		11.8	14.1	18.8	23.6	28.3					

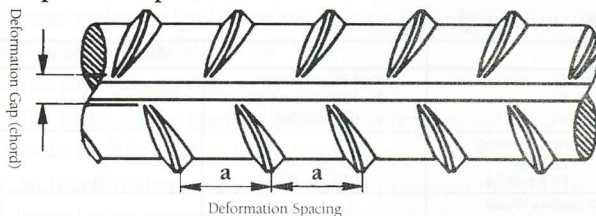
- From August 1997 the base grade for the BHP merchant bar product range (rounds, squares and flats) changed from grade 250 to BHP Grade 300Plus™ Structural Steel.

REINFORCING BARS

BHP Steel currently produces three types of hot-rolled reinforcing bars:

- **TEMPCORE Deformed Bar – 400 Y Grade**

Tempcore bar pattern



A high strength reinforcing bar made by a mill heat treatment process to produce a combination of physical properties to suit the building and construction industry.

TEMPCORE bar complies with Australian Standard, Steel Reinforcing Bars for Concrete, AS 1302 grade 400Y in all respects including tensile properties, bending properties, chemical composition and deformation pattern.

TEMPCORE bar is fully weldable under the terms of Australian Standard, Structural Steel Welding Code, Welding of Reinforcing Steel, AS 1554 Part 3.

Dimension and mass of tempcore bar

Bar size mm	Calculated mass per metre kg/m	Calculated area mm ²	Nominal area mm ²	Deformation requirements		
				Maximum average spacing (a) mm	Minimum average height mm	Maximum gap mm
12	0.888	113.1	110	8.4	0.5	4.7
16	1.579	201.1	200	11.2	0.7	6.3
20	2.466	314.2	310	14.0	1.0	7.9
24	3.551	452.4	450	16.8	1.2	9.4
28	4.834	615.8	620	19.6	1.4	11.0
32	6.313	804.2	800	22.4	1.6	12.6
36	7.991	1017.9	1020	25.2	1.8	14.1

Tensile properties

Specification	Yield strength MPa	Tensile strength/yield strength ratio	Total elongation (5.65 √S0)%	Modulus of elasticity MPa
TEMPCORE AS 1302:400Y	460 mean 400 min	1.21 mean 1.10 min	25 mean 16 min	200 x 10 ³

Ductility and toughness

Bending	180°	Minimum former Dia
Rebending (i) (ii)	Bend 90°, Rebend 20° Bend 90°, Rebend 90° (Restraighten)	2 – 4d 3 – 5d
Low Temperature Bending (i) Notch (ii) Arc Strike	180° @ – 50°C 180° @ – 50°C	3d 3d
Low Temperature Impact (Drop Weight Test) (i) Notch (ii) Arc Strike	@ – 50°C @ – 50°C	No Fracture No Fracture

TEMPCORE bar exceeds the bending requirements of AS 1302 for all grades including the ductile lower strength grade 250S

180° Bends	Minimum former diameter
Tempcore	1d (12 – 28 mm) 2d (32 & 36 mm)
AS 1302:250S requirement	3d
AS 1302:400Y requirement	4d

• Plain round bars – 250 R Grade

In structural grade AS 1302-230R. Available in 10, 12, 20, 24, 27, 33 and 36mm diameters. Material complying with AS 3679. 1 Grade 250 is deemed to comply with this designation.

• Deformed reinforcement – 250 S Grade

Available to AS 1302 grade 250 in 12mm diameter only

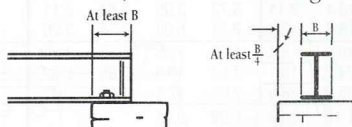
Note: It is anticipated that a new joint Australian and New Zealand reinforcement code will be published in 1998. This code will cover both reinforcement and fabric in strength grades of 250, 300 and 500 MPa yield strength, and as applicable in ductility classes L (Low), N (Normal) and E (Seismic).

Ribbed Re-inforcing Mesh Refer to Concrete Section – Re-inforcing Fabric for Concrete

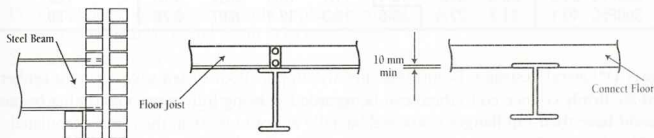
BEAM SELECTION

These following tables gives the maximum load in tonnes which can be supported by the lighter range of BHP Structural Steel sections. Connection details are also provided with sufficient strength to support the beams under the load specified. In using these tables, the following points should be carefully noted.

- The tables are for BHP 300PLUS™ steel.
- The tables do not apply to impact or other types of dynamic loads, such as hoist or crane runway.
- All beams deflect under load and it is important that this be limited to an acceptable amount. Typical limits are:
 - Span / 250 for general beam design
 - Span / 500 for beams supporting masonry.
- The supporting structure must be stable and strong enough to support the loads from the beam. The following rule of thumb may be of assistance, where B is the flange width.



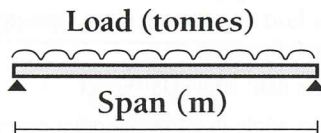
- Restraint will be available at the beam supports, to prevent twisting about the longitudinal axis. For example, this can be achieved in any of the following ways:



Beam Selection-Full Lateral Restraint

Uniformly Distributed Load

Deflection Limit Span/250



Load (Tonnes) - Uniformly Distributed
 1 tonne = 10kN (approx.)

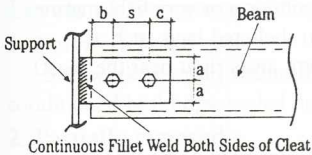
BHP 300PLUSTM Steel Sections kg/m	SPAN							Maximum centres of lateral* restraint mm
	2m	3m	4m	5m	6m	7m	8m	
125TFB 13.1	6.25	2.98	1.65	1.02	0.68	0.46	0.32	505
150UB 14.0	7.94	4.59	2.55	1.60	1.07	0.75	0.54	590
180UB 16.1	10.8	7.16	4.08	2.58	1.75	1.24	0.91	720
200UB 18.2	14.0	9.33	6.11	3.87	2.64	1.89	1.40	780
200UB 25.4	20.2	13.4	9.14	5.79	3.95	2.84	2.11	1090
250UB 25.7	25.0	16.6	12.4	8.74	6.00	4.34	3.26	990
250UB 31.4	30.9	20.6	15.4	11.0	7.55	5.47	4.10	1180
310UB 32.0	36.4	24.2	18.1	14.4	10.8	7.85	5.93	1160
310UB 46.2	48.3	35.6	26.6	21.2	17.1	12.5	9.42	1420
100PFC 8.31	2.71	1.19	0.65	0.39	0.25			395
125PFC 11.9	5.68	2.73	1.51	0.94	0.62	0.42	0.29	515
150PFC 17.7	10.0	5.75	3.19	2.00	1.34	0.94	0.67	590
180PFC 20.9	13.3	8.82	5.44	3.43	2.33	1.66	1.21	610
200PFC 22.9	16.2	10.8	7.38	4.67	3.19	2.28	1.69	610
230PFC 25.1	19.9	13.2	9.86	6.59	4.51	3.25	2.42	600
250PFC 35.5	30.9	20.6	15.4	11.1	7.63	5.52	4.13	725
300PFC 40.1	41.2	27.4	20.5	16.3	12.4	8.97	6.76	720

Note: i)*Lateral Restraint: Beams that directly support floor systems (concrete or timber) and are firmly connected to them can be regarded as being fully restrained. Other beams should have their top flanges restrained laterally at not more than the centres tabulated.
 ii) The design information provided for the connection details is not applicable to the shaded area.

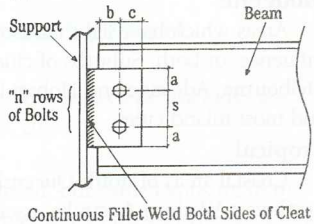
Connection Table

Beam Size	Flat Bar mm D x t x W	Dimensions mm				No. of Bolts 'n'	Bolt Size	Hole Diameter mm	Weld Size mm	Connection Details
		a	b	c	s					
125TFB	75 x 8 x 130	37.5	30	30	60	2	M16	18	8	Type A
100PFC	75 x 8 x 130	37.5	30	30	60	2	M16	18	8	
125PFC	75 x 8 x 130	37.5	30	30	60	2	M16	18	8	
150UB	110 x 6 x 75	30	30	30	50	2	M16	18	6	Type B
180UB	120 x 6 x 75	30	30	30	60	2	M16	18	6	
200UB	120 x 6 x 75	30	30	30	60	2	M16	18	6	
250UB	140 x 8 x 90	35	35	35	70	2	M20	22	8	
310UB	210 x 8 x 90	35	35	35	70	3	M20	22	8	
150PFC	110 x 6 x 75	30	30	30	50	2	M16	18	6	
180PFC	120 x 6 x 75	30	30	30	60	2	M16	18	6	
200PFC	120 x 6 x 75	30	30	30	60	2	M16	18	6	
230PFC	140 x 8 x 90	35	35	35	70	2	M20	22	8	
250PFC	140 x 8 x 90	35	35	35	70	2	M20	22	8	
300PFC	210 x 8 x 90	35	35	35	70	3	M20	22	8	

Type A



Type B



- 1) The above connections are only applicable to the non shaded areas of the Beam Selection Tables.
- 2) Plate Grade: 300
- 3) Bolt Category: 8.8/S
- 4) Weld Consumables: grade E48XX or W50X

SURFACE PROTECTION GUIDE FOR STRUCTURAL STEEL

In selecting a suitable surface treatment, the following choices need to be made:

1. The appropriate Atmospheric Classification
2. The Level of Exposure of Structural Steelwork

Once this is complete, the appropriate specification can be easily selected by working through the following information.

It should be noted that steel does not require corrosion protection in many interior situations.

Atmospheric Classification

Mild

Areas remote from the coast, industrial activity and the tropics. Also, sparsely settled regions such as outback Australia and rural communities away from the coast.

Moderate

Areas which have light industrial pollution or very light marine influence, or both. Suburbs of cities on sheltered bays such as Melbourne, Adelaide and Hobart (except areas right near the coast) and most inland cities.

Tropical

Coastal areas of north Queensland, Northern Territory and northwest Western Australia, except where directly affected by salt spray.

Industrial

Areas around major industrial complexes such as Port Pirie and Newcastle. There are few such areas in Australia. Areas within major industrial complexes are beyond the scope of this booklet.

Marine

Areas influenced to a moderate extent by coastal salts. The extent

depends on winds, topography and vegetation. For sheltered areas, such as those around Port Phillip Bay, this classification extends from 100m from the beach to 1km inland. However, for most ocean front areas, such as those that occur along the southwest corner of Western Australia, the southeast coast of South Australia, the New South Wales coast and the surf beach regions of Queensland, it generally extends from 1km from the coast to about 10km inland. Much of Perth, the Gold Coast, Wollongong, Sydney and Newcastle are in this zone. (Note: In exceptional circumstances, this area can extend 50km inland.)

Severe marine

Around sheltered bays, the region extends inland about 100m. In ocean fronted areas, the region extends from the beach front to 1 km inland. However, it is heavily dependent on prevailing winds, extent of wave and marine, surf and land topography.

NOTE: For further detail on these environments, please refer to the Australian Standard AS/NZS 2312:1994.

For specific guidance on extent of zones, contact Corrosion Protection Centre on: (03) 9544 0066, or Fax (03) 9543 5905.

Levels of Exposure of Structural Steelwork

1. Fully enclosed

Steelwork is sealed within the building envelope. Includes air conditioned buildings, sealed houses, etc.

2. Partially exposed

Steelwork is predominantly enclosed, but some exposure to the environment is inevitable. For example, warehouses with large doors, garages, roof steelwork above perforated eaves soffit sheeting, etc.

3. Fully exposed

In this instance, steelwork is exposed to elements such as sun, wind, rain, wind blown pollutants, etc. This includes roofed structures with no walls, balconies, open carports, etc.

EXCLUSIONS – Swimming pools, industrial activities involving contaminants.

Specification Selection

CLASSIFICATION	1. FULLY ENCLOSED	2. PARTIALLY EXPOSED	3. FULLY EXPOSED
MILD	A	A	B
MODERATE	A	A	B
TROPICAL	A	B	Refer AS/NZS 2312:1994
INDUSTRIAL	A	B	C
MARINE	A	B#	D
SEVERE MARINE	B	C	Refer AS/NZS 2312:1994

– Specification C may be required locally at zones extending 2 - 3 metres from openings, depending on conditions. (For instance, prevailing wind, size of opening and duration of exposure.)

SPECIFICATION		Dulux	International Protective Coatings	Jotun	Wattyl
A	No treatment required.	–	–	–	–
B	Hand/power tool clean to AS 1627 Class 1 standard. One coat (50µm) alkyd primer (Zinc Phosphate).	Luxprime Zinc Phosphate	Interprime 205	Cromoprimer	1624 Zinc Phosphate
C	Abrasive blast to AS 1627 Class 2 1/2 standard. One coat (75µm) inorganic Zinc Silicate to AS 2105 class 3 or 4.	Zincanode 320	Interzinc 7	Jotaprime 15	Galvit ES600
D	Hot Dip Galvanize to AS 1650 Part 1; or Abrasive blast to AS 1627, Class 2 1/2 standard. One coat (75µm) inorganic Zinc Silicate, plus one coat (50µm) Acrylic Gloss; or	Zincanode 320 + Duershield	Interzinc 7 + Intercryl 853	Jotaprime 15 + Jotacote 604	Galvit ES600 + Industrial Acrylic
	Abrasive blast to AS 1627 Class 2 1/2 standard. One coat (300µm) epoxy mastic.	Amerlock 400	Interseal 2020	Jotamastic 87	Epinaamel Mastic STC

Note: The above recommendations are only sufficient to protect steel members and an additional coating may be required to obtain the desired colour and gloss.

STRUCTURAL STEEL IN HOUSING

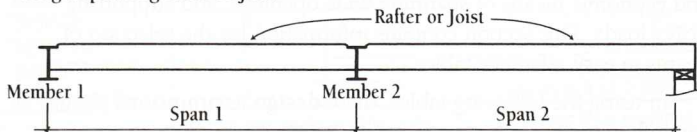
Steel beams are commonly used in home building to provide a safe and economic means of spanning wide openings, and supporting heavy loads. This section contains information for the selection of beams in easy reference tables.

In using the following tables, these **design assumptions** should be carefully noted:

- i) BHP 300PLUS™ Steel must be specified, unless noted otherwise.
- ii) All roof structure tables conform to wind classification up to and including category N3 (or W41N).
- iii) All applied loads are uniformly distributed along the span of the member.
- iv) End support bearing distance for single spans is to be at least that of the width of the member or 70mm, whichever is less. For continuous spans, internal bearing is to be at least 2 times the width of the member.
- v) Joists, bearers and lintels are to be restrained from lateral movement or twisting along their length by other construction, as set out by AS 4100. For example, this criterion is usually met where rafters or joists prevent the top flange of the member from moving laterally.
- vi) For continuous floor bearers, the variation in span length should not be more than 10%.
- vii) Effective spacing is a measure of the width of the load area being supported by the member.

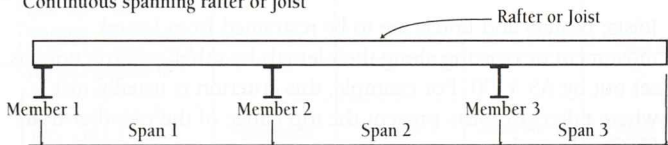
Effective Member Spacing for Structural Steel Bearers and Strutting Beams

Single spanning rafter or joist



Design Member	Member 1	Member 2
Effective Member Spacing	$0.5 \times \text{Span 1}$	$0.5 \times (\text{Span 1} + \text{Span 2})$

Continuous spanning rafter or joist



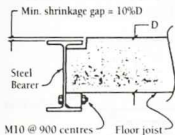
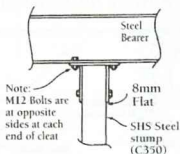
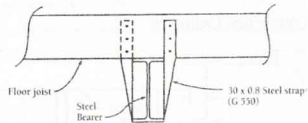
Design Member	Member 1	Member 2	Member 3
Effective Member Spacing	$0.4 \times \text{Span 1}$	$0.6 \times (\text{Span 1} + \text{Span 2})$	$0.5 \times (\text{Span 2} + \text{Span 3})$

Bearer Supporting A Timber Floor and Non-Load Bearing Stud Wall

Single and Continuous Spans

BHP 300PLUS™ Steel Sections	SINGLE SPAN						CONTINUOUS SPAN					
	Effective Bearer Spacing (m)						Effective Bearer Spacing (m)					
	1.8	2.4	3.0	3.6	4.2	4.8	1.8	2.4	3.0	3.6	4.2	4.8
	MAXIMUM SPAN OF BEARER (m)						MAXIMUM SPAN OF BEARER (m)					
125TFB	4.1	3.8	3.6	3.4	3.2	3.0	5.1	4.7	4.2	3.9	3.6	3.3
150UB14.0	4.5	4.2	4.0	3.8	3.7	3.6	5.2	4.9	4.6	4.4	4.0	3.8
180UB16.1	5.1	4.7	4.5	4.3	4.1	4.0	5.9	5.5	5.2	5.0	4.7	4.4
200UB18.2	5.6	5.2	5.0	4.7	4.6	4.4	6.5	6.0	5.7	5.5	5.3	5.0
200UB25.4	6.2	5.8	5.5	5.2	5.0	4.9	7.1	6.7	6.3	6.0	5.8	5.6
250UB25.7	6.8	6.4	6.0	5.8	5.6	5.4	7.9	7.4	7.0	6.7	6.4	6.2
250UB31.4	7.2	6.7	6.4	6.1	5.9	5.7	8.3	7.8	7.4	7.1	6.8	6.6
310UB32.0	7.9	7.3	7.0	6.7	6.4	6.2	9.1	8.5	8.1	7.7	7.4	7.2
310UB46.2	8.7	8.2	7.8	7.5	7.2	7.0	10.1	9.5	9.0	8.6	8.3	8.0
100PFC	3.1	2.8	2.6	2.5	2.3	2.2	3.5	3.3	3.0	2.7	2.5	2.4
125PFC	3.9	3.7	3.5	3.3	3.1	2.9	5.0	4.5	4.0	3.7	3.4	3.2
150PFC	4.8	4.5	4.2	4.0	3.9	3.8	5.5	5.1	4.9	4.7	4.5	4.3
180PFC	5.4	5.1	4.8	4.6	4.4	4.3	6.3	5.9	5.6	5.3	5.1	5.0
200PFC	5.9	5.5	5.2	5.0	4.8	4.6	6.8	6.3	6.0	5.7	5.5	5.3
230PFC	6.4	6.0	5.6	5.4	5.2	5.0	7.4	6.9	6.5	6.2	6.0	5.8
250PFC	7.2	6.7	6.4	6.1	5.9	5.7	8.4	7.8	7.4	7.1	6.8	6.6
300PFC	8.1	7.6	7.2	6.9	6.6	6.4	9.4	8.8	8.3	8.0	7.7	7.4

Connection Examples



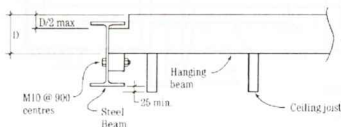
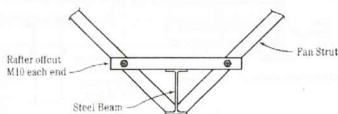
Strutting Beam Supporting a Roof and Ceiling

BHP 300PLUS™ Steel Sections	STEEL SHEET ROOF						TILED ROOF					
	Effective Strutting Beam Spacing (m)						Effective Strutting Beam Spacing (m)					
	1.8	2.4	3.0	3.6	4.2	4.8	1.8	2.4	3.0	3.6	4.2	4.8
	MAXIMUM SPAN OF BEAM (m)						MAXIMUM SPAN OF BEAM (m)					
125TFB	5.7	5.4	5.1	4.9	4.6	4.4	4.9	4.6	4.4	4.2	4.1	3.9
150UB14.0	6.4	6.0	5.7	5.4	5.1	4.8	5.5	5.2	4.9	4.7	4.5	4.4
180UB16.1	7.2	6.7	6.4	6.1	5.9	5.6	6.2	5.8	5.5	5.3	5.1	4.9
200UB18.2	7.9	7.4	7.1	6.8	6.5	6.2	6.9	6.4	6.1	5.8	5.6	5.4
200UB25.4	8.6	8.1	7.7	7.4	7.2	7.0	7.5	7.1	6.7	6.4	6.2	6.0
250UB25.7	9.5	9.0	8.6	8.2	7.9	7.7	8.3	7.8	7.4	7.1	6.9	6.6
250UB31.4	10.0	9.4	9.0	8.7	8.4	8.1	8.8	8.2	7.8	7.5	7.2	7.0
310UB32.0	10.9	10.3	9.8	9.5	9.1	8.9	9.6	9.0	8.6	8.2	7.9	7.7
310UB46.2	11.9	11.3	10.8	10.5	10.1	9.8	10.6	10.0	9.5	9.1	8.8	8.6
100PFC	4.4	4.2	4.0	3.7	3.5	3.3	3.8	3.5	3.3	3.2	3.1	3.0
125PFC	5.5	5.2	4.9	4.7	4.5	4.4	4.7	4.4	4.2	4.1	3.9	3.8
150PFC	6.7	6.3	6.0	5.8	5.6	5.4	5.8	5.5	5.2	5.0	4.8	4.6
180PFC	7.6	7.2	6.8	6.6	6.3	6.1	6.6	6.2	5.9	5.7	5.5	5.3
200PFC	8.2	7.7	7.4	7.1	6.8	6.6	7.2	6.7	6.4	6.1	5.9	5.7
230PFC	8.9	8.4	8.0	7.7	7.4	7.2	7.8	7.3	6.9	6.6	6.4	6.2
250PFC	10.0	9.4	9.0	8.7	8.4	8.1	8.8	8.2	7.8	7.5	7.3	7.0
300PFC	11.1	10.5	10.1	9.7	9.4	9.1	9.8	9.3	8.8	8.4	8.2	7.9

• Design Assumptions

1. If point load applied it should be located within the middle third of the strutting beam span.
2. Top and bottom flanges of strutting beam must be laterally restrained at the loading point.
3. Strutting beam must be tied down at the support points in the case of steel roofs.

Connection Examples



Lintels Supporting Roofs and Masonry Wall

Before using the table opposite, please note the design assumptions made on page 207 along with the following points:–

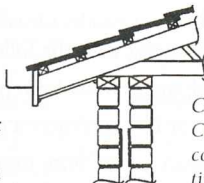
- 1) Long Leg of angles must be vertical.
- 2) Each Angle or Flat can carry a maximum 110 mm wall thickness
- 3) For Clear span < 1000mm, minimum Bearing Length at each end = 100mm.
- 4) For Clear span > 1000mm, minimum Bearing Length at each end = 150mm.
- 5) All lintels should be propped during brickwork construction.
- 6) The maximum rafter spacing should not be greater than 600mm.
- 7) There must be at least three courses of brickwork over span opening.
- 8) All loads are uniformly distributed (point loads are not allowed).
- 9) The effective roof load width must not exceed 4.8m.
- 10) For lintels supporting masonry in a lower floor of two storey construction, refer to a structural engineer.

For more information on the use of structural steel in housing applications, please refer to BHP's "Structural Steel in Housing" manual available through BHP Steel Direct, Tel 1800 800 789

Construction Types:



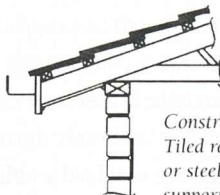
Construction Type A:
Typical brick veneer construction with non load bearing brickwork and roof supported on internal timber or steel frame.



Construction Type B:
Cavity wall construction with timber or steel truss tiled roof supported equally on both leaves of brickwork.



Construction Type C:
Light weight metal sheet roof supported on single leaf of brickwork.



Construction Type D:
Tiled roof with timber or steel ceiling supported on single leaf of brickwork.

BHP 300PLUS™ Steel Sections	Mass (kg/m)	Construction Type			
		A	B	C	D
		MAXIMUM CLEAR SPAN OF LINTEL mm			
90x90x6EA	8.22	3010	2050	2050	1570
90x90x8EA	10.6	3010	2170	2170	1810
100x100x6EA	9.16	3130	2290	2290	1810
100x100x8EA	11.8	3370	2410	2410	1930
150x90x8UA	14.3	4210	3370	3370	2770
150x100x10UA	18	4330	3490	3610	3010
Flats					
75x8SEF		490	250	—	—
75x10SEF		610	250	250	250

STRUCTURAL AND PIPELINE PRODUCTS

BHP Structural & Pipeline Products is Australia's major manufacturer of steel hollow sections and open profiles. The manufacturing divisions and their products are:-

STRUCTURAL PRODUCTS

Australia's leading manufacture of RHS and CHS steel hollow sections and profiles. For more information about the following products, technical data and support ring freecall 1800 065 415

Product Range

TUBELINE – Circular and rectangular steel hollow sections

Circular DN 8 to DN 150, extra light to extra heavy

Square 13 x 13 x 1.8 to 250 x 250 x 9.0

Rectangular 50 x 20 x 1.6 to 250 x 150 x 9.0

Finish

Black a clear polymer coat is applied to the external surface

Painted external even coat of general purpose zinc phosphate primer

Galvanized hot-dip galvanized coating applied internally and externally

NOP not coated with oil or paint

DURAGAL® – Circular, square, rectangular steel hollow sections, other hollow section shapes and open profiles.

Size Range

Circular DN 20 to DN 50 extra light (21.6 x 2.0 to 60.3 x 2.3)

Square 20 x 20 x 1.6 to 100 x 100 x 6.0

<i>Rectangular</i>	50 x 20 x 1.6 to 150 x 50 x 6.0
<i>Post</i>	90 x 90 x 2.0
<i>Rail</i>	67 x 48 x 1.6; 120 x 48 x 2.0
<i>Silo Section</i>	75 x 64 x 2.3/3.0/4.0
<i>Angles</i>	30 x 30 x 2.5 to 150 x 150 x 8.0
<i>Channels</i>	75 x 40 x 4.0 to 300 x 90 x 8.0
<i>Flats</i>	50 x 4.0 to 300 x 8.0

Finish

DURAGAL is externally in-line, hot-dip galvanized over a shot blasted and chemically cleaned surface. The minimum average zinc coating is 100g/m² (14.5 microns). The zinc surface is then treated with Galcote surface preparation and corrosion inhibitor. DuraGal angles, channels and flats are also coated with approximately 8 microns of a clear Polymer.

BLUE PLUS – Rectangular and square steel hollow sections.

Size range

<i>Square</i>	13 x 13 x 1.8 to 150 x 150 x 9.0
<i>Rectangular</i>	50 x 20 x 1.6 to 200 x 100 x 9.0

Finish

Smooth coat of sapphire blue (AS 2700 B14) general purpose Zinc Phosphate primer.

GALTUBE PLUS – Circular, rectangular and square steel hollow sections offering superior corrosion protection. Galtube Plus has a unique triple external and double internal protection system.

Size range

<i>Circular</i>	DN 20 – DN 65 (21.6 x 2.0 to 76.1 x 2.6)
<i>Square</i>	20 x 20 x 1.6 – 65 x 65 x 2.5
<i>Rectangular</i>	50 x 20 x 1.6 – 75 x 25 x 2.5

Finish

Is the same as DuraGal except the minimum average Zinc Coating is 125g/m^2 (18 microns thick).

Internally, a mechanically cleaned surface, to AS 1627.4 class 3, followed by a 20 to 30 micron DFT coating of organic zinc rich (cold galv.) paint.

FIRELITE – Light weight, mechanically coupled pressure pipe for the fire protection industry. Suitable for use to AS 4118. For use in sprinkler and hydrant systems.

Size range

Circular 26.7 x 1.65 (DN 20) to 323.9 x 3.0 (DN 300)

Finish

Hot-dip galvanized for full size range, externally hot-dip in-line galvanized up to 114.3 x 2.11 (DN 100) and externally red painted for 165.1 x 2.77 (DN 150).

End finish

The standard is grooved ends, the options are shouldered and plain ends.

VICTUALITE – Light weight mechanically coupled, pressure pipe for the mining industry.

Size range

Circular 60.3 x 2.0 (DN 50) to 323.9 x 3.0 (DN 300)

Finish

Hot-dip galvanized.

End finish

The standard is shouldered ends, the options are grooved and plain ends.

For more comprehensive Product and Technical Information of the BHP-SPP range visit their **INTERNET SITE** at www.spec.net.com.au

DURAGAL Flooring System – A complete steel flooring system that can be assembled without welding. Panel flooring and tongue and groove floor boards can be attached using normal timber floor techniques and tools, plus a tek gun and saw with a metal cutting blade. Maximum joist spans up to 6.73m, stump spacings up to 5.01m. Stumps are adjustable for height, using only a spanner, even after the house is completed. A comprehensive range of fittings can be supplied to permit simple installation Australia-wide.

For more details, freecall 1800 065 415.

Standard size range

Stumps or piers 90 x 90 x 2.0 DuraGal square hollow sections internally painted.

Bearers & joists 150 x 50 x 2.0, 100 x 50 x 1.6 and 2.0 and 75 x 50 x 1.6 DuraGal RHS, internally painted.

Finish

DuraGal external finish for bearers, joists and stumps. The internal surface is shot blasted and painted with a 30 Micron, nominal thickness coating of a Zinc Phosphate Primer.

ULTRA PIPE

Large diameter ERW steel line pipe

ULTRA PIPE® is produced to meet the following Standard (API 5L Pipe can be produced in Grades up to x 80)

API 5L Grade B & X42	ASTM A 53
AS 1836 (TW9 TC2)	AS 1163 - C350 L0
AS 1396	

Lengths: Stock lengths 9m and 12m; up to 18.3m available.

End finish: Normally supplied with ends bevelled for welding – can supply square ends for mechanical joining.

Dimensions and Mass

O.D. mm	W.T. mm	Nominal Pipe Size mm	Mass	
			kg/m	m/t
88.9	4.8	80	9.995	100.5
	5.5		11.31	88.42
114.3	4.8	100	12.96	77.16
	6.0		16.02	62.42
168.3	4.8	150	19.35	51.68
	6.4		25.55	39.14
	7.1		28.22	35.44
219.1	4.0	200	21.21	47.15
	4.8		25.37	39.42
	6.4		33.57	29.79
	8.2		42.65	23.45
273.1	4.0	250	31.76	31.49
	6.4		42.09	23.76
	9.3		6.50	16.53
323.9	6.4	300	50.11	19.96
	9.5		73.65	13.58
	12.7		97.46	10.26
355.6	6.4	350	55.11	18.15
	9.5		81.08	12.33
	12.7		107.4	9.312
406.4	6.4	400	63.13	15.84
	9.5		92.98	10.76
	12.7		123.3	8.110
457.0	6.4	450	71.12	14.06
	9.5		104.8	9.538
	12.7		139.2	7.186

B T M

– A major manufacturer of ERW precision steel tubing in Australia.

Product Range

EZYFORM – Low carbon steel commercial and bright tubing for furniture and general applications

HI FORM 28 – Aluminised and mild steel tubing and T409 stainless steel tubing for exhaust systems

HI-LITE – High strength, light weight precision tubing for general applications

GALVABOND – Galvanized tubing especially suited for fencing and other outdoor applications

TUBECOLOR – Powder-coated galvanized tubing for verandas and patios.

Availability of DURAGAL and TUBELINE Rectangular Hollow Sections

These products are Generally AS 1163 GRADE C350 or C450. For the exceptions see notes 2, 3 & 4

Minimum yield strength (MPa) =						450	450	350	350	350	350	350
Size and Thickness			Mass – kg/m	Standard length – metres		DuraGal	DuraGal – with Internal coat	Blue Plus – external coat	External Clear Coat	Uncoated	Galvanized ⁵	Galtube Plus
d	b	t										
mm	mm	mm										
250 x 150	x	9.0 RHS	51.8	8.0 & 12.0					●	X	X	
		6.0 RHS	35.6						●	X	X	
		5.0 RHS	29.9						●	X	X	
200 x 100	x	9.0 RHS	37.7	8.0 & 12.0				X	●	X	X	
		6.0 RHS	26.2					X	●	X	X	
		5.0 RHS	22.1					X	●	X	X	
		4.0 RHS	17.9					X	●	X	X	
		3.0 RHS	13.7					X	X	X	X	
200 x 50	x	6.0 RHS	21.4	8.0				X		X	X	
		5.0 RHS	18.2					X		X	X	
		4.0 RHS	14.8					X		X	X	
		3.0 RHS	11.3					X		X	X	
185 x 65	x	6.0 RHS	21.4	8.0				X		X	X	
		5.0 RHS	18.2					X		X	X	
		4.0 RHS	14.8					X		X	X	
		3.0 RHS	11.3					X		X	X	
152 x 76	x	6.0 RHS	19.4	8.0				X		X	X	
		5.0 RHS	16.5					X		X	X	
150 x 100	x	9.0 RHS	30.6	8.0 & 12.0				●	X	X	X	
		6.0 RHS	21.4					●	●	X	X	
		5.0 RHS	18.2					●	●	X	X	
		4.0 RHS	14.8					●	●	X	X	
150 x 50	x	6.0 RHS	16.7	8.0		X	X	●	X	X	X	
		5.0 RHS	14.2			●	X	●	●	X	X	
		4.0 RHS	11.6			●	X	●	●	X	X	
		3.0 RHS	8.96			●	X	●	●	X	X	
		2.5 RHS	7.53			●	X	●	X	X	X	
		2.0 RHS	6.07			X	●	X	X	X	X	
						X	X	●	X	X	X	
125 x 75	x	6.0 RHS	16.7	8.0		X	X	●	X	X	X	
		5.0 RHS	14.2			●	X	●	●	X	X	
		4.0 RHS	11.6			●	X	●	●	X	X	
		3.0 RHS	8.96			●	X	●	●	X	X	
		2.5 RHS	7.53			X	X	X	X	X	X	
		2.0 RHS	6.07			X	X	X	X	X	X	
						X	X	X	X	X	X	

● Standard products and finish

X Can be made but minimum order quantities may apply

Not available or outside mill capabilities. 4. The grade of these sizes is Tubeline 350L0-Type 3

Notes:

1. The grade of these sizes is AS 1163 C350L0
2. The grade of all Galtube Plus is Tubeline C350L0-Type 1
3. The grade of these sizes is Tubeline 350L0-Type 2
4. The grade of these sizes is Tubeline 350L0-Type 3

Availability of DURAGAL and TUBELINE Rectangular Hollow Sections

These products are Generally AS 1163 GRADE C350 or C450. For the exceptions see notes 2, 3 & 4

Minium yield strength (MPa) =					450	450	350	350	350	350	350
Size and Thickness			Mass - kg/m	Standard length - metres	DuraGal	DuraGal - with Internal coat	Blue Plus- external coat	External Clear Coat	Uncoated	Galvanized ⁵	Galtube Plus
d	b	t									
mm	mm	mm									
100 x 50	x	6.0 RHS	12.0	8.0	●	X	X		X	X	
		5.0 RHS	10.3		●	X	X		X	X	
		4.0 RHS	8.49		X	X	X		X	X	
		3.5 RHS	7.53		●	X	●		X	X	
		3.0 RHS	6.60		●	X	●		X	X	
		2.5 RHS	5.56		X	X	X		X	X	
		2.0 RHS	4.50		●	X	●		X	X	
		1.6 RHS	3.64		X	●	X		X	X	
75 x 50	x	6.0 RHS	9.67	8.0	X	X	●		X	X	
		5.0 RHS	8.35		X	X	●		X	X	
		4.0 RHS	6.92		●	X	●		X	X	
		3.0 RHS	5.42		●	X	●		X	X	
		2.5 RHS	4.58		●	X	●		X	X	
		2.0 RHS	3.72		●	X	●		X	X	
		1.6 RHS	3.01		X	●	X		X	X	
75 x 25	x	2.5 RHS	3.60	8.0	●	X	●		X	X	X
		2.0 RHS	2.93		X	X	X		X	X	
		1.6 RHS	2.38		●	X	X		X	X	X
					X	X	X		X	X	
65 x 35	x	4.0 RHS	5.35	8.0	X	X	X		X	X	
		3.0 RHS	4.25		●	X	●		X	X	
		2.5 RHS	3.60		●	X	●		X	X	
		2.0 RHS	2.93		●	X	●		X	X	
50 x 25	x	3.0 RHS	3.07	8.0	●	X	●		X	X	
		2.5 RHS	2.62		●	X	●		X	X	●
		2.0 RHS	2.15		●	X	●		X	X	
		1.6 RHS	1.75		●	X	●		X	X	●
50 x 20	x	3.0 RHS	2.83	8.0	X	X	●		X	X	
		2.5 RHS	2.42		●	X	●		X	X	X
		2.0 RHS	1.99		●	X	●		X	X	
		1.6 RHS	1.63		X	X	●		X	X	●

5. The mass of Galvanized product will be slightly heavier than that listed

6. These products are generally pressure pipe products that comply with the requirements of AS 1163 C350L0 but are not marked as such, for example Victaulite, Superlight & Frelite

7. Shouldered or grooved ends are standard (for use with mechanical couplings and seals as a pressure pipeline system)

Availability of DURAGAL and TUBELINE Square Hollow Sections

These products are Generally AS 1163 GRADE C350 or C450. For the exceptions see notes 2, 3 & 4

Minium yield strength (MPa) =					450	450	350	350	350	350	350
Size and Thickness			Mass - kg/m	Standard length - metres	DuraGal	DuraGal - with Internal coat	Blue Plus- external coat	External Clear Coat	Uncoated	Galvanized ⁵	Galtube Plus
d mm	b mm	t mm									
250 x 250	x	9.0 SHS	65.9	8.0 & 12.0				●	X	X	
		6.0 SHS	45.0					●	X	X	
200 x 200	x	9.0 SHS	51.8	8.0 & 12.0				●	X	X	
		6.0 SHS	35.6					●	X	X	
		5.0 SHS	29.9					●	X	X	
150 x 150	x	9.0 SHS	37.7	8.0 & 12.0			●	●	X	X	
		6.0 SHS	26.2				●	●	X	X	
		5.0 SHS	22.1				●	●	X	X	
		4.0 SHS	17.9				X	X	X	X	
		3.0 SHS	45.0				X	X	X	X	
125 x 125	x	9.0 SHS	30.6	8.0 & 12.0			●	●	X	X	
		6.0 SHS	21.4				●	●	X	X	
		5.0 SHS	18.2				●	●	X	X	
		4.0 SHS	14.8				●	●	X	X	
100 x 100	x	9.0 SHS	23.5	8.0			●	●	X	X	
		6.0 SHS	16.7		●	X	●	●	X	X	
		5.0 SHS	14.2		●	X	●	●	X	X	
		4.0 SHS	11.6		●	X	●	●	X	X	
		3.0 SHS	8.96		●	X	●	X	X	X	
		2.5 SHS	7.53		X	X	X	X	X	X	
		2.0 SHS	6.07		X	X	X	X	X	X	
					X	X				X	
90 x 90	x	3.0 SHS	8.01	8.0	X	X				X	
		2.5 SHS	6.74		X	X				X	
		2.0 SHS	5.45		X	●				X	
89 x 89	x	6.0 SHS	14.6	8.0	X	X	●	●	X	X	
		5.0 SHS	12.5		X	X	●	●	X	X	
		3.5 SHS	9.06		X	X	●	X	X	X	
75 x 75	x	6.0 SHS	12.0	8.0	●	X	●		X	X	
		5.0 SHS	10.3		●	X	●		X	X	
		4.0 SHS	8.49		●	X	●		X	X	
		3.5 SHS	7.53		●	X	●		X	X	
		3.0 SHS	6.60		●	X	●		X	X	
		2.5 SHS	5.56		●	X	●		X	X	
		2.0 SHS	4.50		X	X	X		X	X	



Standard products and finish



Can be made but minimum order quantities may apply



Not available or outside mill capabilities.

Notes:

- The grade of these sizes is AS 1163 C350L0
- The grade of all Galtube Plus is Tubeline C350L0-Type 1
- The grade of these sizes is Tubeline 350L0-Type 2
- The grade of these sizes is Tubeline 350L0-Type 3

Availability of DURAGAL and TUBELINE Square Hollow Sections

These products are Generally AS 1163 GRADE C350 or C450. For the exceptions see notes 2, 3 & 4

Minium yield strength (MPa) =			450	450	350	350	350	350	350
Size and Thickness			DuraGal	DuraGal - with Internal coat	Blue Plus-external coat	External Clear Coat	Uncoated	Galvanized ⁵	Galtube Plus
d mm	b mm	t mm	Mass - kg/m	Standard length - metres					
65 x 65	x	6.0 SHS	10.1	8.0	X	X	X		
		5.0 SHS	8.75		X	X	●	X	X
		4.0 SHS	7.23		X	X	●	X	X
		3.0 SHS	5.66		●	X	●	X	X
		2.5 SHS	4.78		●	X	●	X	X
		2.0 SHS	3.88		●	X	●	X	X
		1.6 SHS	3.13		X	X	X	X	●
50 x 50	x	5.0 SHS	6.39	8.0	X	X	●	X	X
		4.0 SHS	5.35		●	X	●	X	X
		3.0 SHS	4.25		●	X	●	X	X
		2.5 SHS	3.60		●	X	●	X	X
		2.0 SHS	2.93		●	X	●	X	X
		1.6 SHS	2.38		●	X	●	X	X
40 x 40	x	4.0 SHS	4.09	8.0	X	X	●	X	X
		3.0 SHS	3.30		●	X	●	X	X
		2.5 SHS	2.82		●	X	●	X	X
		2.0 SHS	2.31		●	X	●	X	X
		1.6 SHS	1.88		●	X	●	X	X
35 x 35	x	3.0 SHS	2.83	8.0	●	X	●	X	X
		2.5 SHS	2.42		●	X	●	X	X
		2.0 SHS	1.99		●	X	●	X	X
		1.6 SHS	1.63		●	X	●	X	X
30 x 30	x	3.0 SHS	2.36	8.0	X	X	X	X	X
		2.5 SHS	2.03		X	X	X	X	X
		2.0 SHS	1.68		●	X	●	X	X
		1.6 SHS	1.38		●	X	●	X	X
25 x 25	x	3.0 SHS	1.89	6.5	X	X	●	X	X
		2.5 SHS	1.64		●	X	●	X	X
		2.0 SHS	1.36		●	X	●	X	X
		1.6 SHS	1.12		●	X	●	X	X
20 x 20	x	1.6 SHS	0.873	6.5	●	X	●	X	X
15 x 15	x	1.8 SHS	0.618	6.5			●	X	X
13 x 13	x	1.8 SHS	0.568	6.5			●	X	X

5. The mass of Galvanized product will be slightly heavier than that listed

6. These products are generally pressure pipe products that comply with the requirements of AS 1163 C350L0 but are not marked as such, for example Victaulite, Superlight & Firelite

7. Shouldered ends are standard (for use with mechanical couplings and seals as a pressure pipeline system)

Availability of TUBELINE, FIRELINE and Other Circular Hollow Sections

These products are Generally AS 1163 GRADE C350L0 or C250L0. For the exceptions see notes 2, 3 & 4. Pressure pipe is also produced to AS 1074, ASTM A 135 and/or API 5L X42 to X80

Minium yield strength (MPa) =				350	350	350	350	350	350	350	350
Nominal Inside Diameter - DN	Outside Diameter and Thickness b mm t mm	Mass - kg/m	Standard length - metres	Firelite ILG (Inline galv)	Firelite HDG (hot dip galv)	Victaulite (hot dip galv)	Red plant - external coat	External Clear Coat	Uncoated	Galvanized ⁵	Galtube Plus
	457.0 x 12.7 CHS	139	12					X	X	X	
	9.5 CHS	105						X	X	X	
	6.4 CHS	71.1						X	X	X	
	406.4 x 12.7 CHS	123	12					X	X	X	
	9.5 CHS	93.0						X	X	X	
	6.4 CHS	63.1						X	X	X	
	355.6 x 12.7 CHS	107	12					X	X	X	
	9.5 CHS	81.1						X	X	X	
	6.4 CHS	55.1						X	X	X	
	4.0 CHS	34.7						X	X	X	
	323.9 x 12.7 CHS	97.5	12					X	X	X	
	9.5 CHS	73.3						X	X	X	
	6.4 CHS	50.1						X	X	X	
	4.8 CHS	37.8						X	X	X	
	4.0 CHS	31.8						X	X	X	
	3.0 CHS 6/7	23.7			X			X	X	X	
								X	X	X	
	273.1 x 12.7 CHS	81.6	12					X	X	X	
	9.3 CHS	60.5						X	X	X	
	6.4 CHS	42.1						X	X	X	
	4.8 CHS	31.8						X	X	X	
	3.0 CHS 6/7	20.0			X			X	X	X	
	219.1 x 8.2 CHS	42.6	12					X	X	X	
	6.4 CHS	33.6						X	X	X	
	4.8 CHS	25.4						X	X	X	
	4.0 CHS	21.2						X	X	X	
	3.0 CHS 6/7	16.0			X			X	X	X	
	168.3 x 7.1 CHS	28.2	12					X	X	X	
	6.4 CHS	25.6						X	X	X	
	4.8 CHS	19.4						X	X	X	
	3.2 CHS	10.0						X	X	X	
150	165.1 x 3.5 CHS	13.9	6.5				X	●	X	X	
	3.0 CHS 6/7	12.0				X	X	●	X	X	
	2.77 CHS 6/7	11.5			X		X	●	X	X	
	2.5 CHS 6/7	10.0				X	X	●	X	X	
	152.4 x 6.0 CHS	21.7	6.5				X	●	X	X	
	4.8 CHS	17.5					X	●	X	X	
	4.0 CHS	14.6					X	●	X	X	
125	139.7 x 3.5 CHS	11.8	6.5				X	X	X	X	
	3.0 CHS	10.1					X	X	X	X	
	2.5 CHS 6/7	8.46				X	X	X	X	X	
	127.0 x 6.0 CHS	17.9	6.5				X	●	X	X	
	4.8 CHS	14.5					X	●	X	X	
	4.0 CHS	12.1					X	●	X	X	
	3.6 CHS	11.0					X	X	X	●	
	3.2 CHS	9.77					X	●	X	X	

Availability of TUBELINE, FIRELITE and Other Circular Hollow Sections

These products are Generally AS 1163 GRADE C350L0 or C250L0. For the exceptions see notes 2, 3 & 4
Pressure pipe is also produced to AS 1074, ASTM A 135 and/or API 5L X42 to X80

Minimum yield strength (MPa) =				350	350	350	350	350	350	350	350	350	350
Nominal Inside Diameter - DN	Outside Diameter and Thickness		Mass - kg/m	Standard length - metres	DuraGal	Firelite ILG (Inline galv)	Firelite HDG (hot dip galv)	Vicalulite (hot dip galv)	Red plant - external coat	External Clear Coat	Uncoated	Galvanized ⁵	Galube Plus
	b mm	t mm											
100	114.3 x	6.0 CHS	16.0	6.5					X	X	X	X	
		4.8 CHS	13.0						X	X	X	X	
		3.6 CHS	9.83						X	X	X	X	
		3.2 CHS	8.77					X	X	X	X	X	
		3.0 CHS 6/7	8.23					X	X	X	X	X	
		2.5 CHS 6/7	6.89					X	X	X	X	X	
		2.11 CHS 6/7	5.84					X	X	X	X	X	
		2.0 CHS 6/7	5.54					X	X	X	X	X	
90	101.6 x	6.4 CHS	15.0	6.5						X	X	X	
		4.0 CHS	9.63							X	X	X	
		3.6 CHS	8.70							X	X	X	
		3.2 CHS	7.77						X	X	X	X	
		2.6 CHS	6.35						X	X	X	X	
									X	X	X	X	
80	88.9 x	5.5 CHS	11.3	6.5						X	X	X	
		4.8 CHS	9.96							X	X	X	
		3.2 CHS 6/7	6.76							X	X	X	
		3.0 CHS	6.36					X		X	X	X	
		2.6 CHS	5.53					X		X	X	X	
		2.11 CHS 6/7	4.52					X		X	X	X	
		2.0 CHS 6/7	4.29					X		X	X	X	
								X		X	X	X	
65	76.1 x	3.2 CHS	5.75	6.5					X	X	X	X	
		2.6 CHS	4.71						X	X	X	X	
		2.3 CHS	4.19						X	X	X	X	
		2.11 CHS 6/7	3.85						X	X	X	X	
									X	X	X	X	
50	60.3 x	3.0 CHS 6/7	4.24	6.5				X		X	X	X	
		2.9 CHS	4.11					X		X	X	X	
		2.3 CHS 6/7	3.29					X		X	X	X	
		2.0 CHS	2.88					X		X	X	X	
40	48.3 x	3.2 CHS	3.56	6.5					X	X	X	X	
		2.9 CHS	3.25						X	X	X	X	
		2.3 CHS	2.61						X	X	X	X	
32	42.4 x	2.6 CHS	2.55	6.5					X	X	X	X	
		2.0 CHS	1.99						X	X	X	X	
25	33.7 x	2.6 CHS	1.99	6.5					X	X	X	X	
		2.0 CHS	1.56						X	X	X	X	
20	26.9 x	2.3 CHS	1.40	6.5					X	X	X	X	
		2.0 CHS	1.23						X	X	X	X	
15	21.3 x	3.2 CHS	1.43	6.5					X	X	X	X	
		2.6 CHS	1.20						X	X	X	X	
		2.0 CHS	0.952						X	X	X	X	
10	17.2 x	2.9 CHS	1.02	6.5						X	X	X	
		2.3 CHS	0.845							X	X	X	
8	13.5 x	2.9 CHS	0.758	5.8							X	X	
		2.3 CHS	0.635								X	X	

Key and Notes – Refer to Previous pages.

Availability of TUBELINE, FIRELITE and Other Circular Hollow Sections

Generally the STRUCTURAL GRADE PRODUCED is AS 1163 C250L0. Size from DN 15 to DN 150 are also produced as pressure pipe to AS 1074 or ASTM A 135.

Minimum yield strength (MPa) =				250	250	250	250	250	250
Nominal inside Diameter – DN	Outside Diameter and Thickness D mm t mm	Mass - kg/m	Standard length - metres	Firelite ILG (Inline galv)	Firelite HDG (hot dip galv)	Red Paint – external coat	External Clear Coat	Galvanized ⁵	Galtube Plus
	610.0 x 12.7 CHS	187					X	X	
	9.5 CHS	141					X	X	
	6.4 CHS	95.3					X	X	
	508.0 x 12.7 CHS	155					X	X	
	9.5 CHS	117					X	X	
	6.4 CHS	79.2					X	X	
150	165.1 x 5.4 CHS	21.3	6.5			X	X	●	
	5.0 CHS	19.7				●	X	●	
125	139.7 x 5.4 CHS	17.9	6.5			X	X	●	
	5.0 CHS	16.6				X	X	●	
100	114.3 x 5.4 CHS	14.5	6.5			X	X	●	
	4.5 CHS	12.2				●	X	●	
	3.2 CHS 6/7					X	X	X	
90	106.1 x 5.0 CHS	11.9	6.5			X	X		
	4.0 CHS	9.63				X	X	●	
80	88.9 x 5.9 CHS	12.1	6.5			X	X	●	
	5.0 CHS	10.3				X	X	●	
	4.0 CHS	8.38				●	X	●	
65	76.1 x 5.9 CHS	10.2	6.5			X	X	●	
	4.5 CHS	7.95				X	X	●	
	3.6 CHS	6.44				●	X	●	
50	60.3 x 5.4 CHS	7.31	6.5			X	●	X	
	4.5 CHS	6.19				X	●	X	
	3.6 CHS	5.03				●	●	X	
	1.65 CHS 6/7			X	X				
40	48.3 x 5.4 CHS	5.71	6.5			X	●	X	
	4.0 CHS	4.37				X	●		
	3.2 CHS	3.56				●	●	X	
	1.65 CHS 6/7			X	X				
32	42.4 x 4.9 CHS	4.53	6.5			X	●	X	
	4.0 CHS	3.79				X	●	X	
	3.2 CHS	3.09				●	●	X	
32	42.2 x 1.65 CHS 6/7		6.5	X	X				
25	33.7 x 4.5 CHS	3.24	6.5			X	●	X	
	4.0 CHS	2.39				X	●	X	
	3.2 CHS	2.41				●	●	X	
25	33.4 x 1.65 CHS 6/7		6.5	X	X				
20	26.9 x 4.0 CHS	2.26	6.5			X	●	X	
	3.2 CHS	1.87				X	●	X	
	2.6 CHS	1.56				●	●	X	
20	26.7 x 1.65 CHS 6/7	1.02	6.5	X	X				
15	21.3 x 3.6 CHS	1.57	6.5			X	●	X	

Key and Notes – Refer to Previous pages.

Availability of DURAGAL Angles, Channels and Flats

The GRADES produced are similar to those of AS 1163 C450LO or C400LO for angles & channels and C400LO or C350LO for flats



ANGLES - Minimum yield 450MPa										CHANNELS - Minimum yield 450 MPa										FLATS - Minimum yield 400 MPa									
Size		Thickness - mm								Size		Thickness - mm								Size		Thickness - mm							
mm	mm	2.5	4.0	5.0	6.0	7.0	8.0			mm	mm	2.5	4.0	5.0	6.0	7.0	8.0			mm	mm	2.5	4.0	5.0	6.0	7.0	8.0		
30 x 30	kg/m	1.06				1	1			75 x 40	kg/m	4.25								50	kg/m	1.49	1.84				x 1	3.14	
40 x 40	kg/m	1.43	2.20							100x 50	kg/m	5.59								65	kg/m	1.94	2.40						
45 x 45	kg/m	1.62	2.50							125 x 65	kg/m	7.23								75	kg/m	2.24	2.77						
50 x 50	kg/m	1.81	2.79	3.42	4.21					150x 75	kg/m	10.5								100	kg/m	2.98	3.69	4.71					
65 x 65	kg/m		3.69	4.52	5.62					180x 75	kg/m	11.6								130	kg/m	3.88	4.80	6.12					
75 x 50	kg/m		3.54	4.34	5.38					200x 75	kg/m	12.4	15.5							150	kg/m	4.47	5.53	7.07					
75 x 75	kg/m		4.29	5.26	6.56	7.59	8.59			230x 75	kg/m	16.9								200	kg/m								
90 x 90	kg/m		5.18	6.37	7.97	9.24	10.5			250x 90	kg/m	19.2								250	kg/m								
100 x 75	kg/m									300x90	kg/m									300	kg/m								
100x 100	kg/m		5.78	7.11	8.92	10.3	11.7																						
125 x 75	kg/m																												
125 x 125	kg/m		7.27	8.95	11.3	13.1	14.9																						
150 x 100	kg/m																												
150 x 150	kg/m																												

Note:

The minimum yield strength of this thickness is 50MPa less than that listed above.

Standard products and finish

Can be made but minimum order quantities may apply

Not available or outside mill capabilities.

●	X	
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THE VICTAULIC MECHANICAL JOINT PIPING SYSTEM

Piping systems for the transmission of fluids and gasses are joined by a variety of methods:

- Threaded and coupled with a range of threaded fittings
- Butt-welded with a range of "butt weld fittings"
- Flanged
- Mechanical joint using a range of Victaulic fittings and couplings

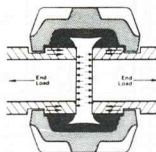
The Victaulic System

The system starts off with a two-piece coupling which is bolted around the pipe and located on pre-grooved or shouldered ends. A liquid/gas tight seal is achieved by using a gasket between the pipe and coupling.



Installed cost savings from 10% to 30%

No special skills required • Minimal equipment investment • Fast assembly in tight places • Clean system ... no pipe dope or welding slag to contaminate pipes • Costs are more predictable ... estimates more accurate.



Proven joint reliability

Full circumferential engagement of housing into groove provides end pull strength • Couplings available for working pressures to 2,500 psi/17,235 kPa ... vacuum service to 29.9" Hg.

An appropriate range of fittings and valves are available to provide a complete Victaulic system for pipe sizes from 50 to 600mm.

The Victaulic system can be used on black and galvanised pipe with light, medium or heavy wall thicknesses. The system is also available for copper and stainless pipe.

Please contact a **BHP SPP** sales office or distributor for more information on the range of piping systems.

PVC PIPES AND FITTINGS

Further information and supplies from:–

- **Vinidex** Sales offices in each state
- Major building and hardware stores and plumbing supply houses

Pressure Pipes

- Standard length – 6m
- Solvent cement joint – nominal size 15 to 300mm
- Polydex rubber ring joint – nominal size 50 to 375mm
- Pipes and fittings manufactured to AS/NZS 1477

Stormwater Drainage Pipes and Fittings

- Sizes available – 90 to 315mm
- Fittings available include Elbows, Tees, Reducers, Y Junctions
- Downpipe Adaptors
- Manufactured to AS 1254

Drain, Waste and Vent Pipe and Fittings

- Sizes available – 32 to 375mm
- Full range of fittings
- Manufactured to AS 1260

Electrical Conduits

- LD and HD Conduits available.
- Sizes 16 to 150mm

Downpipe and Fittings

- Size available – 100 x 50mm rectangular

Polyethylene Pipe and Fittings

- Sizes available – 16 to 1000 mm
- Manufactured to AS 4130

PVC Pressure Pipe – AS/NZS 1477 Series 1

Sizes, Classes and Pressure Ratings at 20°C

Nominal Size	Mean outside diameter mm	PN 4.5			PN 6			PN 9		
		(0.45 MPa) 45m Head			(0.6 MPa) 60m Head			(0.9 MPa) 90m Head		
		Mean bore mm	Mean wall thickness mm	Mass kg/m	Mean bore mm	Mean wall thickness mm	Mass kg/m	Mean bore mm	Mean wall thickness mm	Mass kg/m
25	33.55							30.5	1.55	0.22
32	42.25							38.5	1.90	0.34
40	48.25				45.2	1.55	0.31	44.1	2.10	0.44
50	60.35				56.8	1.80	0.48	55.2	2.80	0.89
65	75.35	72.0	1.70	0.58	71.0	2.20	0.75	68.9	3.25	1.07
80	88.90	84.9	2.00	0.80	83.7	2.60	1.04	81.3	3.80	1.49
100	114.30	109.3	2.50	1.30	107.8	3.25	1.68	104.6	4.85	2.46
125	140.20	134.1	3.05	1.95	132.2	4.00	2.57	128.4	5.90	3.71
150	160.25	153.4	3.45	2.53	151.3	4.50	3.28	146.9	6.70	4.82
195	219.10	209.7	4.70	4.74	206.7	6.20	6.21	200.9	9.12	9.01
200	225.30	215.8	4.85	5.14	212.5	6.40	6.71	206.6	9.35	9.68
225	250.35	239.7	5.35	6.13	236.3	7.05	8.03	229.6	10.40	12.90
250	260.40	268.4	6.00	7.87	264.7	7.85	10.23	257.1	11.65	14.95
300	315.45	302.1	6.70	10.12	297.7	8.90	13.22	289.3	13.10	19.24
375	400.50	385.2	7.65	14.33	380.3	10.10	18.83	370.7	14.90	27.67

PVC Pressure Pipe – AS/NZS 1477 Series 1

Sizes, classes and pressure ratings at 20°C

Nominal Size	Mean outside diameter mm	PN 12			PN 15			PN 18		
		(1.2 MPa) 120m Head			(1.5 MPa) 150m Head			(1.8 MPa) 180m Head		
		Mean bore mm	Mean wall thickness mm	Mass kg/m	Mean bore mm	Mean wall thickness mm	Mass kg/m	Mean bore mm	Mean wall thickness mm	Mass kg/m
25	33.55							30.5	1.55	0.22
15	21.35				18.3	1.55	0.14	17.8	1.55	0.18
20	26.75	23.7	1.55	0.18	23.0	1.90	0.22	22.4	2.20	0.25
25	33.55	29.8	1.90	0.28	29.0	2.30	0.33	28.1	2.75	0.39
32	42.25	37.5	2.40	0.44	36.4	2.95	0.53	35.4	3.45	0.82
40	48.25	42.8	2.75	0.57	41.6	3.35	0.88	40.5	3.90	0.80
50	60.35	53.7	3.35	0.89	52.2	4.10	1.07	50.5	4.95	1.26
65	75.35	67.0	4.20	1.38	65.1	5.15	1.88	63.2	6.10	1.95
80	88.90	79.0	4.95	1.92	76.7	6.10	2.33	74.6	7.15	2.71
100	114.30	101.7	6.30	3.17	98.8	7.75	3.85	96.0	9.15	4.49
125	140.20	124.9	7.65	4.77	121.3	9.45	5.81	117.7	11.25	6.79
150	160.25	142.7	8.80	6.24	138.7	10.80	7.56	134.7	12.80	8.75
195	219.10	195.3	11.90	11.36	189.6	14.77	14.12	184.2	17.48	16.44
200	225.30	200.7	12.30	12.80	194.9	15.20	15.23	189.4	17.95	17.72
225	250.35	223.1	13.85	15.27	216.6	16.90	18.70	210.5	19.95	21.72
250	280.40	249.7	15.35	19.41	242.6	18.90	23.70	235.7	22.35	27.56
300	315.45	281.1	17.20	24.54	273.1	21.20	29.90	265.3	25.10	34.87
375	400.5	361.2	19.65	36.0	352.0	24.25	44.0	343.0	28.75	51.67

FARM FENCING CONSTRUCTION AND HANDLING OF FENCING MATERIALS

Few, if any, capital items on a farm or grazing block improve the general appearance and utilisation of the property more than sturdy, well-constructed boundary and subdivisional fences. The following notes are not designed to describe the exact method of erecting a farm fence, as this will vary from area to area and contractor to contractor, but rather to act as a guide when considering certain features of construction.

The class of fence to be erected depends mainly on the site and material available, and whether the fence is to be rabbit or dog-proof or merely stock-proof.

Fence Posts

Fence posts used in Australia are typically:

- STAR® steel posts
- Local timber (hardwood)
- Chemically impregnated pine
- Precast concrete
- Used materials, such as old railway line

If timber is available close to the fence line, it may be economical to use this, but the easy to handle and light Star steel post is usually used. The method of driving Star posts is by a manually operated tubular driver. There is no need to bore a hole in the ground prior to driving the post. Chemically treated posts are usually round and about 75 to 100mm in diameter. They are driven with a tubular driver into a pilot hole.

Other posts are set in the ground manually with post hole digger, shovel and soil rammer.

On flat ground, posts would be spaced evenly apart (eg. each 5m) but in undulating or hilly country, post spacings need not be regular. A nominal distance apart should be determined but this would be varied to allow for ground undulation. Whether posts are driven at right angles to the ground or perpendicular to the horizon will depend on the fencing conditions, but a perpendicular position is usually chosen because it is much easier to keep the line tidy in appearance.

Strainer Assemblies

The corner post is the anchor of the fence and, as such should be immovable. Considerable loss of tension is experienced for a small amount of movement in a corner. There are two main designs for the construction of strainer assemblies used in Australia. They are a horizontal stayed or a Box assembly, and the Diagonal stayed assembly, both of which can be built using WARATAH® steel strainer assemblies.

WARATAH steel strainer assemblies were developed to provide an economical, quick to erect anchorage capable of withstanding strains up to 30kN(700lb).

Where the ground has poor holding properties, a double horizontal stayed assembly with three vertical and two horizontal posts can be used. Two diagonal braces are made of wire, of the thickness being used in the fence, and are run around four times prior to straining up and tying off. Timber posts should not be bored as this allows moisture into the interior of the post. Also, where the wire passes through the post, it will corrode away more quickly. Boring of holes also increases the possibility of wooden posts burning.

Wire Components in Fencing

The choice of wire is influenced by the cost per kilometre, length of strain, type of stock run and so on. High tensile wires, such as TYEASY® wire, are cheaper per kilometre and are lighter to carry to the site. They can be strained over long distances without fear of losing the wire's elasticity.

Plain fencing wires are suitable for most conventional fencing applications. Being softer, knots can be tied relatively easily. Their disadvantages are the additional cost and weight per km, the need for closer post spacings and difficulty in maintaining tension due to their lower elastic rates of elongation.

This makes it necessary to have strainer posts closer together – 1 for every 1000 metres on flat country compared with every 1500 metres for high tensile wires. Soft wires are not suitable for use in a suspension fence.

The running-out procedure is the same for all types of wire. To run out a wire, it is suggested that certain procedures be observed in order to avoid tangles. A wire spinner makes the running-out of coil easy. The coil is placed on the spinner, with the tip of the coil facing upwards. The four wire ties are then cut off and the starting end is pulled out in the same plane as the coil. A few metres are run slowly to avoid snags and then the coil is ready to run out by pulling on the free end.

The wire should be tied on the Star steel posts with preformed fence post clips or tie wire after the line has been run and strained.

Fabricated Fencing and its Erection

Fabricated fencing has the advantage of being the easiest fence to erect. Because fences should be erected from top to bottom, it is necessary to position posts and any wires run over the top of fabricated fencing first. Then one end of a roll is fixed to the end post and the balance of the roll is run out as near as possible to the line of fencing. It is then tied loosely in position prior to straining-up.

For many years, farmers have been straining fabricated fences by pulling it up with a tractor or four-wheel-drive vehicle. This is a quick method but it generally results in the material being over strained, unless a tension indicator is used.

The WARATAH WEDGELOCK™ clamp is suitable for holding all sizes of field fence.

It is only necessary to tie every second wire of fabricated fence to each fence post.

Horse fences

Horses have difficulty seeing the wire component in fences. WARATAH HORSESIGHTER® wire, coated with PVC, can overcome the problem of horses colliding with fences.

Horsesighter wire has a finished diameter of 5.20mm, a minimum breaking load of 6.1kN and is packaged in 400m coils weighing 43kg.

A horse fence should consist of four or five lines of Horsesighter wire. If other stock are likely to be run in the same paddock, then only two of the top wires should be Horsesighter wire. Horsesighter wire should be strained to 2.0kN and the strain should be greater than 100m. Posts should be spaced at a maximum 5m centres.

Wire netting

Wire netting is erected in a similar manner to fabricated fencing, except that the wire netting should not be tightly strained. Manual tightening is usually sufficient.

The reason netting should not be strained as tightly as other wires is that it may distort under the strain. It is fastened to the fence by means of tie wire or ring fasteners. When the bottom edge is to be buried, the trench should be dug before the netting is run out. The soil is replaced after the fence is erected, and if properly done might help to tighten the netting.

An alternative method of securing netting is to lay the bottom 180mm flat on the ground and secure with rocks every 300 to 500mm. Vegetation will soon grow through the netting and bind it to the ground. Rabbit netting should be placed in the ground at a depth of 180mm, and this can most easily be accomplished by cutting a furrow with a small plough. Rabbit netting should be supported by three plain wires. A wire should run 60mm above the ground to secure the netting, the portion below this being held by being buried in the ground. Another wire should be run along the top edge of the netting and, if using 1050mm wide netting, the third should be 515mm above the ground. Fasten the netting to the top wire with strong tie wire or ring fasteners at intervals of 1200mm, but there should be a tie 300mm on each side of every post. Also fasten the netting to the centre wire.

WARNING

It is absolutely necessary to remove every trace of old netting and the earth in which it was buried when renewing rabbit netting. The trench should be thoroughly cleared out of all old soil, clean virgin soil being used to bury the new netting. It has been found that fragments of old wire or rust spots in the soil will rapidly destroy any new netting.

Barbed wire

To position barbed wire, first fix one end to the corner post, then either run a bar through the reel and walk alongside it as it unwinds, or place it on a WARATAH 3 Way wire spinner.

After straining, barbed wire is tied to fence posts or Star steel posts with either tie wires or preformed fence post clips. Strains not longer than 500m are recommended as longer strains become difficult to handle.

Electric fencing

This can be used for permanent fencing, provide effective temporary fencing solutions, and extend the life of existing fences.

The products in the WARATAH SPITFIRE™ range are state-of-the-art level and designed to maximise the effectiveness of electric fencing.

SPITFIRE mains and battery-powered energisers feature CYCLIC WAVE™ technology, which means they supply a clean, effective pulse under increasing fence loads. The energiser range can handle everything from 1km of wire up to 180km of wire.

SPITFIRE products cover everything from insulators to poly tapes, lightning diverters, earth rods, cut-out switches, voltage testers and the specialist PERMELEC® and TEMPELEC® electric fence wires.

Steel fence post clips and fastening tools

The firm attachment of all fence wire (including plain fence wire) to the outside of the steel post rather than running the wire through the holes is faster and results in less damage to the zinc coating of galvanized wire.

WARATAH clips hold the wire firmly to the post after straining, and fastening is performed by use of a small fastening tool.

WARATAH clips are available in packets of 300, including a fastening tool, or in pails of 1500 containing 5 plastic packs.

Strains for fencing products

The mass of a fence wire limits the practical length of strain. As a general rule, the maximum realistic strains are:–

• 4.00, 3.55 & 3.15mm Fencing Wire	1000m
• 2.50 & 2.80mm HT Wire	1500m
• Barbed Wire	500m
• Fabricated Fencing	400m
• Wire Netting	500m

Tension in wires

When overstrained, wire does not return to its original state but continues to stretch until it breaks. No wires should be strained to more than the following maximum loadings:–

• 4.00mm Fencing Wire	1.8kN
• 3.55mm Fencing Wire	1.3kN
• 3.15mm Fencing Wire	1.2kN
• 2.50mm FLEXABEL®	1.3kN
• 2.50mm TYEASY	1.8kN
• 2.80mm HT Fencing Wire	2.0kN
• 2.50mm Iowa pattern and 1.60mm HT Barbed Wire	1.3kN
• Fabricated Fencing	1.0kN
• Wire Netting	Only until tight

A wire strainer should have smooth jaws or the wire will be damaged causing a weakness at that point. The use of a WARATAH TENSER SENSER™ gauge will ensure correct tensioning of all types of wires and prefabricated field fence.

Waratah HT fence droppers

These fence droppers are made from high tensile galvanized steel so they are fire and rust-resistant. They are attached after the fence posts have been erected and line wires run and strained. They may be used on all fencing wire between 4.00mm and 2.50mm diameter, including barbed wire.

A suggested fence construction would be posts spaced at up to 20 metres apart, with droppers clipped at intervals of two to four metres, depending on the number of line wires and site conditions.

Specifications	Length mm	Mass per Bundle kg	Fastening clips – Included in bundles Sufficient for fences of
HT glavanized steel	635	13	5 wires
fence droppers punched	815	17	6 wires
at 25mm centres complete	940	19	7 wires
with fixing tool, instruction	1070	22	9 wires
sheet & clips	1170	24	9 wires

Note: Packs measure approximately 40 x 150mm x length of dropper. Packs of 250 clips have a mass of 0.5kg.

Waratah steel fence posts

Length mm	Hole Spacings (from top) mm
1350	25, 130, 100, 100, 100, 60, 120, 75, 75, 80, 75
1650	25, 130, 100, 100, 100, 60, 120, 75, 75, 80, 70, 75, 60, 95
1800	25, 130, 100, 100, 100, 60, 120, 75, 75, 80, 70, 75, 60, 95
2400	25, 275, 300, 300, 300, 300, 300.

1 post per 40m = 25 per km

1 post per 20m = 50 per km

1 post per 15m = 67 per km

1 post per 10m = 100 per km

1 post per 7m = 143 per km

1 post per 5m = 200 per km

1 post per 3m = 333 per km

Steel strainer assemblies

Description	Mass kg
Strainer Assembly (single stay)	35
Corner Assembly (two stays)	52
Additional stay, base plate and bolts	17
Vertical Post only	19
Waratah Post Driver	28

Waratah barbed wire

Specification	Reel Type	Wire per reel mm	Gross mass per reel kg	Recommended tension kN
2.50mm Std galv Iowa pattern Blue Reel	Wood	400	45	1.3
2.50mm Hvy galv Iowa pattern Red Reel	Wood	400	46	1.3
1.57mm Hvy galv HT Red Reel	Wood	500	24	1.3
1.80mm Hvy galv HT Unpainted Reel	Wood	500	28	1.3

Galvanized fence wire

Diameter mm	Type	Length per Coil m	Recommended Tension kN
4.00	Standard galv	500	1.8
3.55	Standard galv	600	1.3
3.15	Standard galv	750	1.2
2.80	HT Heavy or std galv	1000	2.0
2.50	HT Std galv Flexabel	1500	1.3
2.50	HT Hvy or std Tyeasy	1500	1.8
2.50	HT Hvy galv Permelec	1000	1.5
1.80	HT Hvy galv	2000	1.0
1.60	HT Hvy galv	3000	0.75
1.60	Tempelec	500	NA

Note: The above represents standard thicknesses regularly produced for fencing purposes.

The main sizes regularly produced are:

Size +	Suggested uses	Coil Length m	Approx mass Per roll kg
30x4x1.4	Reconditioning existing netting fences	100	27
90x4x1.4	Rabbit proof fencing, tree guards, bird cages	100	75
105x4x1.4	Rabbit proof fencing, tennis court fencing	100	87
90x3x0.9	Tree guards, bird cages	50	26
90x5x1.0	Trellising, animal enclosures	50	15
90x5x1.6	Flood gates, tree guards, farm fencing	50	37
180x5x1.6	Feral fencing, poultry and animal enclosures	50	68
180x5x1.0	Poultry enclosures, roof insulation	50	29

Note: +Other sizes available on request

Fence specifications

1500m length of fence	Number of strainer assemblies	Additional stay and base plates (if required)
100m strain	16	14
200m strain	9	7
400m strain	5	3
800m strain	3	1
1500m strain	2	

WARATAH Hinged Joint fencing

Type	Length per roll m/roll	Mass per roll kg/roll	Rolls per kilometre roll/km	Height of roll-nominal mm	Line-wire spacings from top nominal mm	Picket spacing nominal mm
5/67/30	200	64	5	670	200, 180, 150, 140	300
6/70/30	200	73	5	700	180, 150, 140, 130, 115	300
6/90/30	200	79	5	900	230, 200, 180, 150, 140	300
7/90/30	200	88	5	900	200, 180, 150, 140, 130, 115	300
8/80/15	100	63	10	800	150, 140, 130, 115, 100, 90, 75	150
8/90/30	200	97	5	900	180, 150, 140, 130, 115, 100, 90	300
8/115/30	200	104	5	1150	230, 200, 180, 150, 140, 130, 115	300

WARATAH STOCKTITE® fencing

Type	Length per roll m/roll	Mass per roll- kg/roll	Rolls per kilometre roll/km	Height of roll nominal mm	Line-wire spacings from top nominal mm	Picket spacing nominal mm
6/70/30	200	78	5	700	180, 150, 140, 130, 115	300
6/90/30	200	84	5	900	230, 200, 180, 150, 140	300
7/90/30	200	93	5	900	200, 180, 150, 140, 130, 115	300
8/80/15	100	65	10	800	150, 140, 130, 115, 100, 90, 75	150

WARATAH STOCKLOCK® fencing

Type	Length per roll m/roll	Mass per roll kg/roll	Rolls per kilometre roll/km	Height of roll nominal mm	Line-wire spacings from top nominal mm	Picket spacing nominal mm
5/70/30	200	60	5	675	175, 175, 175, 150	300
5/70/45	200	53	5	675	175, 175, 175, 150	450
6/70/30	200	70	5	675	150, 150, 125, 125, 125,	300
6/70/45	200	61	5	675	150, 150, 125, 125, 125,	450
6/90/30	200	74	5	900	200, 175, 175, 175, 175,	300
8/90/15	100	63	10	900	150, 150, 125, 125, 125, 125, 100	150
8/90/30	200	92	5	900	150, 150, 125, 125, 125, 125, 100	300

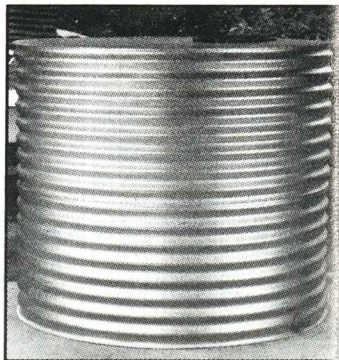
WARATAH SUPA STOCKLOCK® fencing

Type	Length per roll m/roll	Mass per roll kg/roll	Rolls per kilometre roll/km	Height of roll-nominal mm	Line-wire spacings from top nominal mm	Picket spacing nominal mm
SAME TABLE AS ABOVE						
7/90/30	200	88	5	900	200, 175, 150, 125, 125, 125,	300
7/90/60	200	72	5	900	200, 175, 150, 125, 125, 125,	600

WATER TANKS - AQUAPLATE POLYMER COATED STEEL

Introduction

AQUAPLATE polymer coated steel fills the need for a product suitable for the fabrication of reliable water tanks. Specifically developed for the purpose, AQUAPLATE steel is the only BHP product recommended for the storage of potable (drinking), spa, rain, bore or river water from a wide variety of sources. This recommendation supersedes the use of both galvanized and ZINCALUME steel.



Water Tanks

A BHP warranty of 20 years applies to the AQUAPLATE component of tanks complying with BHP's recommended manufacturing practice and usage. This warranty results from several years of successful usage throughout Australia.

The prime features of AQUAPLATE tanks are their tolerance of a wide range of water qualities and catchment materials. **Lead, copper and treated timber catchments are not recommended for the collection of drinking water for health reasons.**

With the strength of steel and the corrugated appearance of traditional Australian water tanks, AQUAPLATE water tanks blend well with the environment. They are available with a galvanized outer surface suitable for post painting or as COLORBOND AQUAPLATE steel.

While from the outside an AQUAPLATE tank looks just like a traditional water tank, its enhanced performance comes from the polymer film lamination within the tank. The tough, abrasion resistant

polymer film is produced to meet Australian Standard 2070, Part 2 – Plastic Materials for Food Contact use”. The film is not UV resistant and must not be exposed to direct sunlight for extended periods.

Tank Walls and Lids

Single-sided AQUAPLATE steel unpainted or COLORBOND AQUAPLATE steel – both with a 200 µm grade polymer film laminated to one side. The film is always positioned within the tank to provide an impervious lining, ensuring water is not in contact with the metal. The zinc-coated, unlaminated side provides corrosion protection from the surrounding atmosphere and is treated with a clear, weatherable water-based lacquer called “GALSEAL”. This treatment minimises early dulling of the outside finish. The Z450 coating class is the same as that for galvanized roofing.

Tank Bottoms

Double sided AQUAPLATE Z275 with a 200 µm grade polymer film. The combination of the two laminated sides provides internal protection while the reverse protects the underside of the tank from contact with concrete or timber on which the tank may rest. This removes the need for a further protective membrane.

Material Specification

Walls

Single sided AQUAPLATE steel 0.60mm ZINCFORM G300 Z450. Available as both 8 and 10.5 x 76.2mm pitch corrugated profile in custom cut lengths.

COLORBOND AQUAPLATE steel 0.60mm ZINCFORM G300 Z275 with COLORBOND prepainted finish. Available as both 8 and 10.5 x 76.2mm pitch corrugated profile in custom cut lengths.

Top

Single-sided AQUAPLATE steel G300 Z450. Available as 1200mm width, coil or 2400mm length sheet.

AQUAPLATE steel tanks must be fitted with a lid to exclude sunlight, which can degrade the film and/or encourage the growth of algae within the tank.

Base

Double sided AQUAPLATE-B steel – 0.60mm ZINCFORM G300 Z275 x 1200mm coil or 2400mm length flat sheet.

Tank Accessories

Inlet strainers

ZINCALUME steel fitted with aluminium mesh. Although some authorities demand bronze or copper gauze in the filters for mosquito control, these metals can cause corrosion so aluminium is the BHP recommended material. ZINCALUME steel must not be continuously immersed in water. Where mosquito protection is not required, a moulded product such as a polythene Capri garden sieve or similar non toxic material may be used.

Strainers should be designed so they are fitted above the water level to avoid continuous immersion, and also to discourage mosquito breeding. An opaque cover should be placed over the filter unit as a means of excluding light from within the tank.

Kerosene is **not** recommended as a means of controlling mosquitos for reasons of health and possible damage to the film.

Overflows

Moulded fittings of PVC, polypropylene or similar materials are very practical items for this purpose. A weir or baffle may be fitted within the horizontal section of the fitting at the tank to raise the water capacity. Aluminium gauze may be necessary to exclude mosquitos.

It is advisable to extend the overflow beyond the tank to avoid water from dripping down the side where it could erode or stain the outer surface coating. In many instances, it makes sense to continue the overflow to ground or a selected area.

Outlets

There are many designs of moulded fittings made from various plastics, with polypropylene being most suitable. Metal alloys such as zinc/aluminium are very suitable under most conditions, however it must be realised that ground water quality can range from benign to extremely aggressive. Ground water quality can change considerably during times of drought. Copper or its alloys **must not** be used.

Fasteners

Stainless steel is not compatible with GALVANIZED steel. It is necessary to supplement the fastener corrosion protection by coating each fastener inside the tank with sealant.

Many tankmakers have invested in sophisticated fastening methods and now employ self-piercing Furma rivetting machines.

Flow controls

Several designs of non-metal taps are available, but copper or its alloys such as brass or bronze **must not** be used.

Edge sealing

Bare steel must not be exposed inside the tank. All internal cut edges and fasteners must be sealed by encapsulating them in sealant.

Close Inspection is Very Important for Best Results

Any surface blemish must be closely inspected and if necessary, repaired to ensure the integrity of the film is maintained.

AQUAPLATE steel provides the means of building a trouble-free tank which will provide many years of service, even in conditions not

usually conducive to reliable metal tank life. The long service life of an AQUAPLATE steel tank is, however, conditional on the metal substrate and fasteners being completely sealed from the water. Any perforation of the film is likely to lead to accelerated localised corrosion of the metal.

The curving and subsequent fabrication involved in producing the tank is the responsibility of the tankmaker.

Recommended Steps for Fabricating an Aquaplate Tank

These recommendations assume that the reader has a knowledge of basic tankmaking.

Preparation

Prior to fabrication, a careful visual inspection of the laminated surface is essential to ensure it is free from damage.

Ensure the curving rolls are clean and free from foreign matter.

Ripping of the corrugations can be caused if the pitch of the rolls doesn't match the pitch of the corrugations.

Curving

AQUAPLATE steel curves very well and should be treated with the same techniques adopted for COLORBOND steel sheets. Sheet ends must meet and nest accurately.

Sealing

Soldering is not an applicable option – Sealants must be used.

The sealant must be non-toxic and approved by the manufacture as suitable for potable water tanks. Neutral cure silicone rubber sealant has proved to be suitable.

Lapping surfaces must be clean and dry. Methylated spirits used with clean cloth or tissue is recommended.

A heavy bead of neutral cure silicone sealant is applied along the centre of the intended lap. The bead must be sufficient to fill the lap and will be about the diameter of a thumb for a 100mm lap.

Post sealing

AQUAPLATE tanks may be post-sealed, ie. sealant may be applied after fabrication. This technique is quite effective as it removes the need for sealants to be used during fabrication and assembly. Technical Bulletin No 3 "THE MANUFACTURE of AQUAPLATE STEEL WATER TANKS" covers the details of fabrication in detail.

Fastening walls

Self-drilling screws such as Streakers are commonly used, while a very sophisticated workshop will use Furma self-piercing rivets.

A fastener at every valley on the inside lap and each crest of the outside lap will pull the joint tight. Those fasteners which will eventually be positioned within the intended girth lap joint should be left out for the time being, and driven after the girth joint is lapped.

Excess sealant on the outside is best removed at this stage using a non-metal spatula, followed by a turps rag. A useful tool for cleaning excess sealant can be made from an empty sealant cartridge by cutting a single nick in the open end and pushing this nick along the lap edge. Sealant will be collected in the open end.

Excess sealant on the inside lap edge can well serve to provide edge sealing. Additional sealant must be provided if necessary to ensure thorough inside sealing. Each fastener must also be individually sealed.

Note: The girth joints require a bead about the size of a small-finger, with a little extra in the area where the vertical seams meet horizontal seams as this is the area most prone to leaking.

Girth joint

The snug assembly of the rings at the girth is essential and can be by means of roping or slipping. Fasteners do not need to be more closely spaced than for soldered tanks, but tightness can best be assured by roping. Fastening should begin on the opposite side from the lap and progress towards it to pull the joint snug.

Flanging

The flanging at the top and bottom can be done with a rubber mallet and dolly but tools such as a Walker Edge Former do the job neatly, quietly and without abrading the film.

Tank bottom

The base segments can be lapped and fastened through sandwiched sealant but lockseaming is preferred. Ensure a clean surface and extrude a bead of sealant (about 2 to 3mm) into the recess of one edge prior to assembly and smooth excess sealant over the joint.

The edges of the base can be flanged by means of a mallet and dolly or a flanging tool such as a Jenny Wheel or Walker Flanging Tool.

Outlet holes

Outlet holes can be cut with small tinsnips but a punch or hole saw is quicker and neater. This should be done prior to fitting the base to avoid swarf (metal debris) retention.

Outlet fittings

If a polythene or polypropylene tank fitting is used, it must be “flame brushed” to ensure a bond with the sealant. This involves a short lick of flame over the plastic surfaces.

Inspection

All drillings, filings and other metal residue (swarf) must be removed and any damaged areas repaired. Surface blemishes can be repaired by cleaning the film with methylated spirits and applying sealant by means of a spatula.

Overflows

Contoured PVC overflows are available and can be shaped by immersing the section to be shaped in heated glycerine, taking care to protect the eyes from splashes.

An alternative is to fit a 100 x 50mm rectangular or 90mm round PVC rainwater fitting. This can be attached by providing a flange at the lower side of the cutout through which to fasten the lower edge of the fitting. The top side can be attached directly to the underside of the lid if the fitting is located flush with the rim. It may be necessary to reinforce the wall of the tank at this point to compensate for cutting the wall at the rim.

Painting

If painting is desirable for appearance - Refer to section on painting of zinc-coated, steel sheet.

Summary of Do's and Don'ts

- DO store AQUAPLATE steel material under cover, sheltered from sunlight
- DO inspect surface before and after fabrication
- DO have a clean working area
- DO ensure clean, smooth curving rolls
- DO closely inspect the finished tank for damage and sealed areas
- DO ensure clean surfaces for sealing
- DO sandwich sealant within laps unless tank is being post sealed
- DO ensure that all internal laps and fasteners are sealed
- DO ensure good light during sealing procedures
- DO wear footwear that cannot cause damage to the inside of the tank
- DO **not** store water in excess of 65° Celsius

Do ensure adequate ventilation at all time when using sealants.



Installation of AQUAPLATE steel tanks

First Fill

As with all water tanks, it is essential that at least a portion of the first fill be drained from the tank. This is advisable for health reasons, as the roof or gutter catchment could have toxic matter on or in it. The tank itself may also have residuals within it as a result of manufacture and transportation.

If the roof is painted, always check the paint is suitable for the collection of drinking water.

Do not collect drinking water from catchments containing lead, copper or copper-treated timber.

Location of Tank

Ideally, the tank should be installed in a shady location away from trees from which leaves and debris could clog the strainer or contaminate the water.

Tank Base

The AQUAPLATE steel tank must be totally supported by a firm, flat, stable platform, the dimensions of which must be larger than the diameter of the tank. As AQUAPLATE steel tanks are supplied with a protective membrane under the base, they may be placed directly onto a concrete or timber base. Tank stands must be engineered to safely support the tank when full of water, bearing in mind that water has a mass of 1 kilogram per litre.

Water Connection

Copper piping must not be connected directly to AQUAPLATE steel tanks. If copper outlet pipes are involved, there must be at least 2 metres of plastic pipe between the tank and the copper. Copper must not be used for recirculating water to an AQUAPLATE steel tank.

Liquids other than Water

AQUAPLATE steel has been developed specifically for the storage of potable water from most sources, and all warranty refer to water. However, its suitability for storing other liquids is recognised. Enquiries should be made to BHP Coated Steel Australia for advice regarding other specific storage needs.

Dimensions

The following table indicates the dimensions of typical round water tanks. These dimensions may vary slightly between tankmakers, who usually produce their own range based on best economy.

Apart from round tanks, there are also elongated designs which allow tanks to be installed alongside homes in restricted width locations. These are usually smaller capacity units for which AQUAPLATE steel is ideal.

BHP Coated Steel Australia, Technical Bulletin TB-3 covers
"The Manufacture of AQUAPLATE Steel Water Tanks."

Dimensions of corrugated water tanks made from AQUAPLATE Steel

Tank capacity in kilolitres	Mean diameter and sheet length required to curve ring from single sheet allowing for 100mm END Lap, mm.					
	Mean dia	Sheet length	Mean dia	Sheet length	Mean dia	Sheet length
	Single sheet rings of 10.5 x 76mm corrugated sheet					
	1 ring, 810mm high		2 rings, 1620mm high		3 rings, 2380mm high*	
0.5	885	2890				
1	1250	4040				
2	1775	5670	1255	4040		
3	2170	6920	1535	4930		
4	2505	7980	1775	5670		
5			1980	6330	1635	5240
6			2170	6920	1790	5730
7			2345	7470	1935	6180
10			2805	8910	2315	7370
14			3315	10520	2735	8700
16			3545	11240	2925	9290
20			3965	12560	3270	10380
	Single sheet rings of 8 x 76mm corrugated sheet					
	1 ring, 620mm high		2 rings, 1230mm high		3 rings, 1840mm high	
0.5	1015	3290				
1	1435	4610	1015	3290		
2	2025	6470	1440	4630		
3	2480	7900	1765	5650		
4	2865	9100	2035	6500	1665	5330
5	3205	10170	2275	7250	1860	5950
6			2495	7940	2040	6510
7			2695	8570	2200	7020
10			3220	10220	2630	8370
14			3810	12070	3115	9890
16			4070	12890	3330	10560
20			4550	14400	3720	11790

*A half corrugation is trimmed off the top of the centre ring of 10.5 corrugation three ring high tanks for slip joint assembly method.

USEFUL INFORMATION-RURAL

Determining the Quantity of Hay in a Stack

Formulae for the exact calculation of the capacity of a haystack are rather complicated for general use. These formulae are used because of the fact that a haystack is irregular in shape and dimensions. However, since the volume of hay per tonne varies greatly with the age of the hay and its degree of settling, formulae which are not so accurate, but are sufficient for practical purposes, are given below. These will enable the farmer to obtain a reasonable estimate of the amount of fodder available in both rectangular and circular stacks.

Cubic Contents of a Rectangular Stack

To determine the volume of a rectangular stack:—

- (a) Multiply length at base in metres by breadth at base in metres
- (b) Multiply together length and breadth at eaves in metres
- (c) Add length at base and length at eaves in metres together and multiply this figure by the sum of the breadth at the base and the breadth at the eaves in metres. Add (a), (b) and (c) together and multiply by the height in metres of the eaves above ground level. Divide this product by six, and the result is the volume of the body of the stack in cubic metres

For the top portion:

- (d) Multiply together the length and breadth in metres at the eaves
 - (e) Multiply the breadth in metres at the eaves by the sum of the length at the eaves and length along the ridge in metres
- Add (d) and (e) together, multiply by the height of the ridge above the eaves in metres and divide by six. This gives the volume of the portion above the eaves which when added to the volume of the body gives the total volume of the stack.

Example: Consider a rectangular stack the dimensions of which are: 12m by 6m at base; 15m by 7m at the eaves; 9m long at the ridge; eaves 3m above the ground; ridge 3m vertically above the eaves.

Cubic Contents of a Rectangular Stack

Volume of base or body =	Volume of portion above eaves =
(a) $12 \times 6 = 72$	(d) $15 \times 7 = 105$
(b) $15 \times 7 = 105$	(e) $7 \times (15 + 9) = 7 \times 24 = 168$
(c) $(12 + 15) \times (6 + 7) = 27 \times 13 = 351$	(d) + (e) = 273
(a) + (b) + (c) = 528	$\frac{273 \times 3}{6} = 136.5$ cubic metres
$\frac{528 \times 3}{6} = 264$ cubic metres	Total volume of stack = 400.5 cubic metres

Cubic Contents of a Circular Stack

To determine the volume of a circular stack:—

- Measure the circumference at both the base and eaves in metres
- Add these together and multiply this figure by itself (ie square it)
- Multiply the circumference at the base by the circumference at the eaves and deduct this from the result of (b)
- Multiply the result of (c) by the height in metres of the eaves above the base and divide the result by thirty-eight. The figure obtained is the volume of the body of the stack in cubic metres

For the top conical portion of the stack, square the circumference in metres at the eaves and multiply the height in metres of the top or peak above the eaves. Divide by thirty eight and the result obtained is the volume in cubic metres of the top portion. By adding the volume of the base and top together, the total content of the stack is obtained.

Example: Consider a circular stack with circumference at ground level 18m, at the eaves 21m and 3m high at the eaves and 2m at the top from the eaves. Applying the formula:

Cubic contents of a circular stack

Volume of body of stack	Volume of conical top
$= [(18 + 21) \times (18 + 21) - (18 \times 21)] \times \frac{3}{38}$ $= (1521 - 378) \times \frac{3}{38}$ $= 1143 \times \frac{3}{38}$ $= 90.2 \text{ cubic metres}$	$= \frac{21 \times 21 \times 2}{38}$ $= \frac{882}{38}$ $= 23 \text{ cubic metres}$ <p>Total volume of stack = 113.2 cubic metres</p>

Approximate Content of Haystack

After a paddock has been cut, the farmer will usually know, either from experience or from rough guides such as the amount of twine used, about how much hay is to be stacked.

The size of the haystack built should be in accordance with the expected yield. Stacks are usually about as high above the eaves as below when built in correct proportions, and the following table gives an idea of the content of various sized stacks.

Mass per stack of hay

Average width m	Average length m	Height to eaves m	Height of ridge m	Mass per stack tonnes
3	6	2.5	1	1.5
3	6	3	1.5	2
4	8.5	3	3	4
5	9	3.5	3	6
6	15	4	3	15

Approximate number of cubic metres per tonne of hay

Period	Oats		Wheat		Lucerne m ³
	Sheaf m ³	Loose m ³	Sheaf m ³	Loose m ³	
Freshly stacked	10	11	11	14	11 – 13
One month after stacking	8.5	10	10	11	10 – 11
One year after stacking	8.5	9	9	10	8.5 – 10

Stock breeding table

Date of Service	Expected Date of Parturition					
	Mares (340 days)*	Cows (283 days)*	Ewes (150 days)*	Does (147 days)*	Sows (116 days)*	Bitches (63 days)*
1 Jan	7 Dec	11 Oct	31 May	28 May	27 Apr	5 Mar
8 "	14 "	18 "	7 "	4 June	4 May	12 "
15 "	21 "	25 "	14 "	11 "	11 "	19 "
22 "	28 "	1 Nov	21 "	18 "	18 "	26 "
29 "	4 Jan	8 "	28 "	25 "	25 "	2 Apr
5 Feb	11 "	15 "	5 July	2 July	1 June	9 "
12 "	18 "	22 "	12 "	9 "	8 "	16 "
19 "	25 "	29 "	19 "	16 "	15 "	23 "
26 "	1 Feb	6 Dec	26 "	23 "	22 "	30 "
5 Mar	8 "	13 "	2 Aug	30 "	29 "	7 May
12 "	15 "	20 "	9 "	6 Aug	6 July	14 "
19 "	22 "	27 "	16 "	13 "	13 "	21 "
26 "	1 Mar	3 Jan	23 "	20 "	20 "	28 "
2 Apr	8 "	10 "	30 "	27 "	27 "	4 June
9 "	15 "	17 "	6 Sep	3 Sep	3 Aug	11 "
16 "	22 "	24 "	13 "	10 "	10 "	18 "
23 "	29 "	31 "	20 "	17 "	17 "	25 "
30 "	5 Apr	7 Feb	27 "	24 "	24 "	2 July
7 May	12 "	14 "	4 Oct	1 Oct	31 "	9 "
14 "	19 "	21 "	11 "	8 "	7 Sep	16 "
21 "	26 "	28 "	18 "	15 "	14 "	23 "
28 "	3 May	7 Mar	25 "	22 "	21 "	30 "
4 June	10 "	14 "	1 Nov	29 "	28 "	6 Aug
11 "	17 "	21 "	8 "	5 Nov	5 Oct	13 "
18 "	24 "	28 "	15 "	12 "	12 "	20 "
25 "	31 "	4 Apr	22 "	19 "	19 "	27 "
2 July	7 June	11 "	29 "	26 "	26 "	3 Sep
9 "	14 "	18 "	6 Dec	3 Dec	2 Nov	10 "
16 "	21 "	25 "	13 "	10 "	9 "	17 "
23 "	28 "	2 May	20 "	17 "	16 "	24 "
30 "	5 July	9 "	27 "	24 "	23 "	1 Oct
6 Aug	12 "	16 "	3 Jan	31 "	30 "	8 "
13 "	19 "	23 "	10 "	7 Jan	7 Dec	15 "
20 "	26 "	30 "	17 "	14 "	14 "	22 "
27 "	2 Aug	6 June	24 "	21 "	21 "	29 "
3 Sep	9 "	13 "	31 "	28 "	28 "	5 Nov
10 "	16 "	20 "	7 Feb	4 Feb	4 Jan	12 "
17 "	23 "	27 "	14 "	11 "	11 "	19 "
24 "	30 "	4 July	21 "	18 "	18 "	26 "
1 Oct	6 Sep	11 "	28 "	25 "	25 "	3 Dec
8 "	13 "	18 "	7 Mar	4 Mar	1 Feb	10 "
15 "	20 "	25 "	14 "	11 "	8 "	17 "
22 "	27 "	1 Aug	21 "	18 "	15 "	24 "
29 "	4 Oct	8 "	28 "	25 "	22 "	31 "
5 Nov	11 "	15 "	4 Apr	1 Apr	1 Mar	7 Jan
12 "	18 "	22 "	11 "	8 "	8 "	14 "
19 "	25 "	29 "	18 "	15 "	15 "	21 "
26 "	1 Nov	5 Sep	25 "	22 "	22 "	28 "
3 Dec	8 "	12 "	2 May	29 "	29 "	4 Feb
10 "	15 "	19 "	9 "	6 May	5 Apr	11 "
17 "	22 "	26 "	16 "	13 "	12 "	18 "
24 "	29 "	3 Oct	23 "	20 "	19 "	25 "
31 "	6 Dec	10 "	30 "	27 "	26 "	4 Mar

*Average length of gestation period; may be subject to slight variation in individual cases

Capacity of Tanks – Calculations

Square or Rectangular Section – All dimensions in metres:–

Length x breadth x depth = capacity in kilolitres.

Circular Capacity in kilolitres given by either of the following rules.

A. Exact formula capacity = $\frac{\pi D^2 h}{4}$

Where capacity is in kilolitres and

B. Approximate formula capacity = $\frac{8C^2 h}{100}$

C. = circumference in metres

D. = diameter in metres

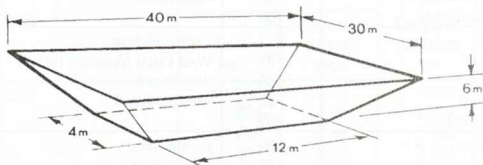
C. Approximate formula capacity = $\frac{4D^2 h}{5}$

h = height in metres

Example: Capacity of a tank with a diameter 2m and height 2m

Approximate capacity = $\frac{4D^2 h}{5} = \frac{4 \times 2^2 \times 2}{5} = 6.4$ kilolitres

How to Measure Dams or Tanks



In order to calculate the amount of excavation required or the capacity of a dam or tank, as illustrated, the following formula should be used.

(a) Length at bottom multiplied by width at bottom

= $12 \times 4 = 48$

(b) Length at top multiplied by width at top

= $40 \times 30 = 1200$

(c) Sum of the lengths multiplied by sum of the widths

= $52 \times 34 = 1768$

(a) + (b) + (c) = $\frac{3016}{6}$

(d) (a) + (b) + (c) multiplied by the depth and divided by six

= $\frac{3016 \times 6}{6} = 3016\text{m}^3$

1 cubic metre is equal to 1 kilolitre.

Average district rainfall throughout Australia

State	District	Annual fall mm	District	Annual fall mm
N S W	Western Far North West	229	Central Tablelands North	642
	Western Lower Darling	253	Central Tablelands South	897
	Western Upper Darling	348	Central Western Slopes North	628
	Western SW Plains	342	Central Western Slopes South	595
	Central Western Plains South	472	Metropolitan East	1137
	Central Western Plains North	467	Metropolitan West	823
	North-west Plains East	582	Illawarra	1098
	North-west Plains West	510	South Coast	932
	North-west Slopes North	670	Southern Tablelands,	
	North-west Slopes South	655	Goulburn, Monaro	664
	Northern Tablelands Western	801	Southern Tablelands,	
	Northern Tablelands Eastern	993	Snowy Mountains	867
	North Coast Upper	1426	South-west Slopes South	815
	North Coast Lower	1469	South-west Slopes North	600
	Manning	1322	Riverina East	467
	Hunter	892	Riverina West	359
V I C	Mallee North	306	East Gippsland	774
	Mallee South	351	West Gippsland	911
	North Wimmera	406	East Central	890
	South Wimmera	502	West Central	611
	Lower North	429	North Central	726
	Upper North	512	Western Plains	626
	Lower North-east	786	West Coast	773
	Upper North-east	1106		
T A S	Northern	973	Central Plateau	1017
	East Coast	791	West Coast Mountain Region	2298
	Midlands	539	King Island	913
	South-east	755	Flinders Island	724
	Derwent Valley	689		
S A	North-west	189	Central West	418
	Far North	186	Central East	588
	Western Agricultural	334	Murray Valley	322
	Upper North	335	Murray Mallee	302
	North-east	215	Upper South-east	423
	Lower North	433	Lower South-east	646
W A	North Kimberley	1014	North Coast	389
	East Kimberley	546	Central Coast	832
	West Kimberley	558	South Coast	890
	De Grey	305	Central North	352
	Fortescue	281	Central South	426
	West Gascoyne	213	Eucla	242
	East Gascoyne	230	South-east	262
	Murchison	232	North-east	233

Average district rainfall throughout Australia

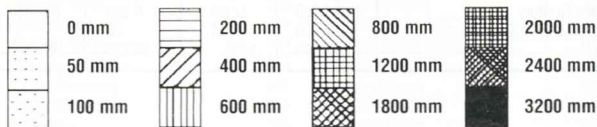
State	District	Annual fall mm	District	Annual fall mm
N T	North Kimberley	1014	North Coast	389
	Arnhem	1195	Barkly	415
	Roper-McArthur	739	Alice Springs	250
Q L D	Peninsula North	1458	Upper West	349
	Peninsula South	945	Lower West	243
	Carpentaria Lower	608	South Coast, Port Curtis	889
	Carpentaria Upper	421	South Coast, Moreton	1144
	North Coast, Barron	1582	Darling Downs East	693
	North Coast, Herbert	1936	Darling Downs West	560
	Central Coast East	978	Maranoa	549
	Central Coast West	600	Warrego	426
	Central Highlands	607	Far South West	295
	Central Lowlands	464		

Information Courtesy Bureau of Meteorology – 1997

Area, coastline, tropical and temperate zones

State or Territory	Estimated area		Length of coastline km	Percentage of total area in	
	Total km ²	Percentage of total area		Tropical zone	Tem- perate zone
New South Wales	801 600	10.43	1 900	–	100
Victoria	227 600	2.96	1 800	–	100
Queensland	1 727 200	22.48	7 400	54	46
South Australia	984 400	12.81	3 700	–	100
Western Australia	2 525 500	32.87	12 500	37	63
Tasmania	67 800	0.88	3 200	–	100
Northern Territory	1 346 200	17.52	6 200	81	19
Australian Capital Territory	2 400	0.03	35	–	100
Australia	7 682 300	100	36 735	39	61

Australian Median Annual Rainfall (mm) January to December



Courtesy – National “CLIMATE” centre, Bureau of Meteorology.

Major Dams and Reservoirs in Australia

(H/E = hydro-electricity, FC = flood control and/or mitigation, WS = water supply, Gigalitres = 1000 megalitres)

Name (Year of Competition)	Location and nearest town	Gross capacity gigalitres	Height of wall m	Purpose
NEW SOUTH WALES				
Eucumbene (1958)	Eucumbene River Cooma	4,798	116	Part of Snowy Mountains H/E Scheme
Hume (1936, 1961)	Murray River, near Albury	3,038	51	Irrigation, water supply, H/E
Warragamba (1960)	Warragamba River,	2,057	142	Water supply Sydney, H/E
Menindee Lakes (1960)	Darling River, near Menindee	1,794	18	Irrigation
Burrendong (1967)	Macquarie River near Wellington	1,677	76	Irrigation, FC
Blowering (1968)	Tumut	1,628	112	H/E, irrigation
Copeton (1976)	Gwydir River, Inverell	1,364	113	Irrigation
Wyangala (1936, 1971)	Lachlan River, Cowra	1,220	85	Irrigation, stock, etc
Burrinjuck (1927, 1956)	Murrumbidgee River, Yass	1,026	79	Irrigation, H/E
Talbingo (1971)	Tumut River, Tumut	921	162	H/E
Jindabyne (1967)	Snowy River, Cooma	688	72	H/E
Lake Victoria (1928)	Murray River, near SA border	680	—	Conserves supply for SA
Keepit (1960)	Namoi River, Tamworth	423	55	Conservation, irrigation H/E
Split Creek (1988)	Manilla River, Namoi Valley, Tamworth	372	66	Irrigation
Windamere (1984)	Cudgegong River, near Mudgee	368	69	Irrigation
Glennies Creek (1983)	Hunter Valley, near Singleton	284	65	Irrigation, industrial, mining, water supply
Glenbawn (1958, 1987)	Hunter River, near Scone	759	100	Conservation, irrigation, FC
Tantangara (1960)	Murrumbidgee River, Cooma	254	45	H/E
Avon (1927)	Avon River, Mittagong	214	72	Water supply for Sydney
Grahamstown (1969)	Grahamstown, near Newcastle	153	12	Industrial, mining, water supply
Lake Brewster (1952)	Lachlan River, near Hillston	150	—	Irrigation
Liddell (1968)	Gardiner Creek, near Muswellbrook	148	43	Cooling water for thermal electricity generation, WS
Tallowa (1976)	Shoalhaven River, near Nowra	115	43	WS for Sydney, H/E
Googong (1979)	Queanbeyan River	125	62	Canberra region

Major Dams and Reservoirs in Australia

H/E = hydro-electricity, FC = flood control and/or mitigation, WS = water supply, Gigalitres = 1000 megalitres

Name (Year of Competition)	Location and nearest Town	Gross capacity gigalitres	Height of wall m	Purpose
VICTORIA				
Dartmouth (1979)	Mitta Mitta River	4000	180	Irrigation, water supply, H/E
Eildon (1927, 1955)	Upper Goulburn River, Alexandra	3390	79	Irrigation, H/E
Thomson (1984)	Thomson River, near Moe	1175	164	Irrigation, water supply
Waranga (1910)	Near Rushworth (Swamp)	411	12	Irrigation
Mokoan (1971)	Winton Swamp, near Benalla	365	10	Irrigation, water supply
Rocklands (1953)	Glenelg River, Hamilton	348	28	Domestic and stock water supply
Eppalock (1964)	Campaspe River, Bendigo	312	45	Irrigation, water supply
Cardinia (1973)	Cardinia Creek, near Emerald	289	86	Water supply for Melbourne
Upper Yarra (1957)	Warburton	207	89	Water supply for Melbourne
Blue Rock (1984)	Tanjil River, near Moe	200	75	Industrial, mining, WS
Glenmaggie (1927, 1958)	Macalister River, Sale	190	37	Irrigation
Cairn Curren (1956)	Loddon River, near Newstead	148	44	Irrigation
Yarrawonga (1939)	Murray River	117	22	Irrigation
Toolondo (1952, 1960)	Natural depression, near Horsham	107	—	Domestic and stock water supply
Winneke (1980)	Sugarloaf Creek, near Melbourne	100	89	Water supply
QUEENSLAND				
Burdekin (1987)	Burdekin River, near Townsville	1860	55	Irrigation, water supply
Fairbairn (1972)	Nogoa River, Central Qld, Emerald	1440	49	Irrigation, industrial
Wivenhoe, (1986)	Brisbane River, near Ipswich	1150	59	H/E, FC, water supply
Somerset (1959)	Stanley River	893	50	WS for Brisbane, H/E
Fred Haigh (1974)	Kolan River, near Gin Gin	586	52	Irrigation
Proserpine Dam (1989)	Proserpine River, near Bowen, Qld	500	51	Water supply, irrigation
Ross River (1974)	Near Townsville	417	35	FC, water supply
Tinaroo Falls (1958)	Barron River, Mareeba	407	47	Irrigation, H/E

Major Dams and Reservoirs in Australia

H/E = hydro-electricity, FC = flood control and/or mitigation, WS = water supply, Gigalitres = 1000 megalitres

Name (Year of Competition)	Location and nearest Town	Gross capacity gigalitres	Height of wall metres	Purpose
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QUEENSLAND (continued)

Awoonga High Dam (1985)	Boyne River, near Gladstone	250	45	Industrial, mining, water supply
Glenlyon (1976)	Pike Creek, near Stanthorpe	261	62	Irrigation
Boondooma (1983)	Boyne River, near Proston	212	64	Irrigation, water supply
North Pine (1975)	North Pine, near Brisbane	205	44	Water supply
Wuruma (1968)	Nogo River, near Eidsvold	194	46	Irrigation
Koombooloomba (1961)	Tully River, Innisfail	212	52	H/E, irrigation
Callide Dam (St. II) (1986)	Callide Creek, near Biloela	127	35	Irrigation, water supply, industrial, mining
Julius (1977)	Leichhardt River, near Mt Isa	127	35	Water supply, mining
Bjelke Petersen (1988)	Barker Creek, near Murgon, Qld	125	43	Irrigation
Leslie Dam (St II) (1985)	Sandy Creek, near Warwick	108	34	Water supply, irrigation
Lake Moondarra (1957)	Leichhardt River, near Mt Isa	107	27	Water supply, mining, industrial
Eungella (1969)	Broken River, Collinsville	131	49	Water supply, irrigation, industrial, mining
Beardmore (1972)	Balonne River	101	15	Water supply, irrigation

TASMANIA

Lakes Gordon and Pedder (1974)	South west (Queenstown)	11316	140	H/E
Gordon				
Scotts Peak (1973)				
Serpentine (1971)				
Edgar (1993)	Great Lake, Launceston	3356	28	Storage for H/E
Miena (1967)				
Lake St Clair (1938)				
Crotty Dam (1990)				
	Central Plateau	est 2000	3	Natural storage for H/E
	King River, near Queenstown, Tas	1091	83	H/E
Mackintosh (1981)	Mackintosh River, near Queenstown		75	H/E
Tullibardine (1981)	Tullibardine River near Queenstown	949	25	H/E
Lake Echo (1956)	Queenstown	725	19	H/E

Major Dams and Reservoirs in Australia

H/E = hydro-electricity, FC = flood control and/or mitigation, WS = water supply, Gigalitres = 1000 megalitres

Name (Year of Competition)	Location and nearest Town	Gross capacity gigalitres	Height of wall metres	Purpose
TASMANIA (continued)				
Lower Pieman (1985)	Pieman River, near Queenstown	641	122	H/E
Lake King William (Clark) (1949, 1966)	Derwent River, Queenstown	541	67	H/E
Arthur's Lake (1965)	Source of Lake River, near Great Lake, Launceston	511	17	H/E
Devils Gate (1969)	Forth River, near Devonport	180	84	H/E
Rowallan (1967)	Mersey River	131	43	H/E
Bastyan (1983)	Pieman River, near Queenstown	124	75	H/E
Cethana (1971)	Forth River, near Devonport	109	110	H/E
NORTHERN TERRITORY				
Darwin River (1972)	Darwin River	259	31	Water supply for Darwin
WESTERN AUSTRALIA				
Lake Argyle (Ord) (1972)	Ord River, near Wyndham	5797	99	Irrigation, FC, H/E
South Dandalup (1973)	Pinjarra	208	43	Water supply for Perth
Wellington (1933, 1944, 1960)	Collie	185	37	Water supply, irrigation, H/E
Serpentine (1961)	Perth	185	55	Water supply for Perth
Harding (1985)	Harding River, Pilbara	114	42	Water supply, industrial, mining

Note:

This information was compiled from the "Register of Dams in Australia", which lists some 260 dams completed between 1857 and 1988. Of these some 132 have a wall height above 40 metres which places them in a significant category. However, due to space restrictions we have listed only those with a reservoir gross capacity above $100,000 \text{ } 10^{(3)} \text{ M}^{(3)}$ (100 gigalitres). We acknowledge the assistance from the "Australian National Committee on Large Dams".

A E R I A L A G R I C U L T U R E

Aircraft are widely used in Australia for top dressing and seeding, for spraying and dusting of crops and pastures, and for pest and vermin extermination. Landing areas for these aircraft are determined by the operator providing they meet the minimum requirements specified by the Civil Aviation Authority Australia.

“Authorised landing areas” ceased to exist when specified amendments to the Civil Aviation Regulations (CARs) came into effect on 9 August 1991. Prior to that time, CAR 89 the then Civil Aviation Authority authorised certain places to be used as aerodromes by issuing general instruments of authorisation for that purpose. These instruments allowed a place to be used as an “authorised landing area” (ALA) if it satisfied the general specifications set out in the instrument.

As from 9 August 1991, aircraft are permitted to take off from, or land at, any place that is suitable for use as an aerodrome. The principal condition on this permission is that, having regard to all the circumstances of the proposed landing or take-off (including prevailing weather conditions), the aircraft can land at, or take off from, the place in safety. The relevant position of the Regulations is paragraph 92(1)(d) is reproduced below.

Use of aerodromes

92. (1) An aircraft shall not land at, or take-off from, any place unless:
- (a) the place is an aerodrome established under the Air Navigation Regulations; or
 - (b) the use of the place as an aerodrome is authorised by a licence granted under regulation 89C; or
 - (c) the place is an aerodrome for which an arrangement under section 20 of the Act is in force and the use of the aerodrome by aircraft engaged in civil air navigation is authorised by CASA under that section; or

(d) the place (not being referred to in paragraph (a), (b) or (c) is suitable for use as an aerodrome for the purposes of the landing and taking-off of aircraft;

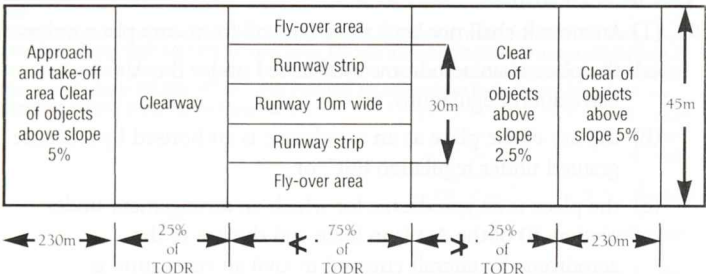
and having regard to all the circumstances of the proposed landing or take-off (including the prevailing weather conditions), the aircraft can land at, or take-off from, the place in safety.

- (2) CASA may, in relation to an aerodrome, issue directions relating to the safety of air navigation.
- (3) A person must not contravene a direction.

Guidelines that may be used to determine the suitability of a place for landing or taking off are contained in Civil Aviation Advisory Publication (CAAP) 92-1(1), which was released in July 1992. Guidelines for the establishment and use of helicopter landing sites are set out in CAAP 92-2(1), which was published in January 1996.

These publications are available from The Civil Aviation Publications Centre, 715 Swanson Street, Carlton, Vic. 3053. Telephone (03) 9342 2000 or 008 331 676.

Dimensions – Agriculture Day Operations Only



Definitions

In these guidelines, unless the contrary is stated:–

- **Clearway** – means an area in which there are no obstacles penetrating the slope of 2.5% rising from the end of the runway over a width of 45m
- **Fly-over area** means a portion of ground adjacent to the runway strip which is free of tree stumps, large rocks or stones, fencing, wire and any other obstacles above ground but may include ditches or drains below ground level
- **Landing area (LA)** – means an area of ground suitable for the conduct of take-off and landing and associated aeroplane operations under specific conditions
- **Lateral transitional slope** – means a desirable area around all LAs which provides greater lateral clearance in the take-off and landing area and may reduce wind-shear when the runway is situated near tall objects such as trees and buildings
- **Obstacle free area** – means there should be no wires or any other form of obstacles above the approach and take-off areas, runways, runway strips, fly-over areas or water channels.
- **Runway** – means that portion of the landing area which is intended to be used for the landing or take-off of aeroplanes
- **Runway strip** – means a portion of ground between the runway and fly-over area which is in a condition that ensures minimal damage to an aeroplane which may run off a runway during take-off or landing;

Which aircraft may use a landing area?

Use of landing areas other than aerodromes is not recommended for aircraft with a MTOW greater than 5700 kg.

Which types of operations may be conducted from a landing area?

Aeroplanes engaged in the following operations may use a landing area:–

- private
- aerial work - excluding student solo flying and student dual flying prior to successful completion of the General Flying Progress Test
- charter

Recommended minimum physical characteristics of landing areas

- **Runway width** – for other than agricultural operations, a minimum width of 15 metres is recommended, although aeroplanes with a MTOW below 2000 kg can be operated safely on runways as narrow as 10 metres provided there is no or only light cross-wind. For agricultural operations, a 10 metre wide runway is the recommended minimum
- **Runway Length** – for agricultural day operations, the minimum runway length is the greater of 75% of the take-off distance specified in the aeroplane's flight manual or approved performance chart for the prevailing conditions with the balance as clearway or the landing distance so specified
- **Longitudinal Slope** – for agricultural operations, the slope should not exceed 12.5% for day and 2% for night operations: where the overall slope exceeds 2% the runway should only be used for one-way operations – downhill for take-off and uphill for landing
- **Transverse Slope** – for agricultural day operations, the transverse slope should not be more than 3% over the runway and 5% over the runway strip

Other factors that should be considered prior to using a landing area

- A pilot should not use a landing area or have an aeroplane engine running unless the aeroplane is clear of all persons, animals, vehicles or other obstructions
- A pilot should not use a landing area without taking all reasonable steps to ensure the physical characteristics and dimensions are satisfactory. For aerial work and charter operations the operator should provide evidence to the pilot on the suitability of a landing area prior to its use
- **Runway lengths** calculated for take-offs and landings should be increased by 50% for agricultural operations on one-way runways at night
- **Geographic Location** – a landing area should not be located:–
 - (a) within the area or in such close proximity as to create a hazard to aircraft conducting a published instrument approach, excluding the holding pattern; or
 - (b) within any area where the density of aircraft movements makes it undesirable; or
 - (c) where take-off or landing involving flight over a populated area creates an unnecessary hazard
- Except in an emergency, the consent of the owner/occupier is required before a landing area may be used
- If the proposed landing area is located near a city, town or populous area or any other area where noise or other environmental considerations make aeroplane operations undesirable, the use of such a landing area may be affected by the provisions of the *Commonwealth Environment Protection (Impact of Proposals) Act 1974* and parallel State legislation as

well as other legislation. It is the responsibility of the pilot and/or operator to conform with these requirements

- A method of determining the surface wind at a landing area is desirable. A wind sock is the preferred method
- The surface of a landing area should be assessed to determine its effect on aeroplane control and performance. For example, soft surfaces or the presence of long grass (over 150mm) will increase take-off distances while moisture, loose gravel or any material that reduces braking effectiveness will increase landing distances

Surface testing of a landing area

- **Rough Surfaces** – the presence of holes, cracks and ruts will degrade aeroplane performance and handling and increase the possibility of structural damage. The smoothness of the runway can be tested by driving a stiffly sprung vehicle along the runway at a speed of at least 75kph. If this is accomplished without discomfort to the occupants, the surface can be considered satisfactory.
- **Soft, Wet Surfaces** – a test vehicle as indicated in the table below should be driven in a zig-zag pattern at a speed not exceeding 15kph along the full length and width of the runway. Particular attention should be paid to suspect areas with possibly three passes over these areas. If tyre imprints exceed the depth of 25mm the surface is not suitable for aircraft operations represented by the test vehicle. Experience may prove that for a certain type of aircraft (eg an aircraft with small wheels or high tyre pressure) operations are unsafe with a lesser imprint. Testing with a crowbar should also be done in several places along the runway to ensure that a dry surface crust does not conceal a wet base

USER AIRCRAFT WEIGHT	SUGGESTED VEHICLE TO BE USED FOR TEST
1. MTOW not exceeding 2000kg	Fully laden utility, Landrover, station sedan
2. MTOW 2001kg to 3400kg	Fully laden 1.5 tonne truck or lightly laden 3 tonne truck
3. MTOW 3401kg to 5700kg	Fully laden 3 tonne truck
Attention should also be given to the remainder of the strip as this area is provided for run-off in the event of an abnormal take-off or landing	

Note: We reiterate these excerpts cover **Agriculture Day Operations** only and acknowledge the assistance of the **Civil Aviation Safety Authority Australia**.

STEEL ROAD SAFETY BARRIERS

“W” Beam Guardfence (Armco Barrier), Thrie Beam and Wire Rope Safety Barriers are systems manufactured from high strength steel and are hot dip galvanized to meet the design life requirements of modern road design specifications.

All safety barrier systems must pass internationally recognised crash testing procedure before being approved for use on Australian roads. An incorrectly designed or located safety barrier can often be a roadside hazard. The choice of an appropriate barrier and its location should be carefully considered using risk analysis techniques developed by the appropriate road authority.

Roadside Safety Barriers are defined as rigid and non-rigid types. These steel and wire rope barriers are non-rigid and by definition require a clear zone between the barrier and the obstacle to allow the barrier adequate room to deflect when impacted. Interfaces with other barrier types should be carefully considered and designed with a gradual transition in height and horizontal stiffness.

Erection practices that do not comply with the appropriate drawings and specifications should not be permitted.

Corrugated Steel Pipe

Pre-engineered and easy to design for any given situation, the pipes are custom produced in diameters ranging from 300mm to 3600mm and in lengths up to 12 metres, making them the ideal solution in a wide variety of applications, such as:

- Road and rail crossings
- Pedestrian, vehicular and livestock underpasses
- Irrigation pipes, dam level overflows and erosion protection
- Urban stormwater detention and retention systems

- Conveyor tunnels, access tunnels and air overcast
- Under-floor fire escape tunnels and service ducts
- Vertical shafts, chimney stacks and aerial conduits

Many factors make galvanized steel pipe the cost effective alternative:

- The high strength-to-weight ratio
- The low initial material cost
- Custom fabricated tee and angle junctions
- Light weight long lengths, allowing easy handling by minimal skilled labour, contributing to a lower installed cost.

AS 1762 details the necessary requirements for culvert installation.

Multi-Plate corrugated structures

Constructed from hot dip galvanized structural plate, Multi-Plate was a further development of corrugated steel pipe in the 1930's to fill the need for larger structures capable of carrying high fills. Assembled in the field, Multi-Plate is available in a range of shapes and sizes from circular pipes and arches up to 8.5 metres in diameter, to elliptical bridge structures spanning 15.0 metres.

The ability to design and manufacture structures to almost any shape and size makes Multi-Plate the ideal solution for a wide range of applications, including:

- Grade separation for road and rail through underpasses for vehicles, pedestrians and fauna
- Mining portals and load-out tunnels
- Conveyor and access tunnels
- Fire escape and service tunnels

Note:- A number of companies in Australia utilise BHP Steel to manufacture a range of "Road Hardware". Call "Steel Direct" for contact details.

CONCRETE

The Cement and Concrete Association of Australia is a national, non-profit organisation sponsored by the cement industry. Publications and information on the making and uses of concrete are available from the Regional Office of the Association in each State.

Specifying Concrete Quality

Concrete should be specified so that it will possess both adequate strength and durability (ie. resistance to environmental agents and wear). The quality of concrete is dependent on the quality of materials used, the standard of workmanship in placing, and the care with which the concrete is compacted, finished and cured.

Required quality (strength and curing period) is specified in AS 3600 "Concrete Structures". This depends on exposure classification and for external members should be determined by a qualified specialist. Appropriate compressive strengths and curing periods for some common cases and cover to reinforcement, are shown in the following table.

Member	Strength grade MPa	Curing period days	Cover mm
Residential slab-on-ground floors, footings in non-aggressive soils, footpaths, and residential driveways.	20	3	20*
Industrial floors (internal) subject to <ul style="list-style-type: none"> • light traffic only • medium traffic 	25 32	3 7	20* 20*
External members <ul style="list-style-type: none"> • within 1km of coast • 1 to 50 km of coast 	40 32	7 7	45 30
Elements in aggressive environments, eg marine conditions.	Obtain specialist advice.		

Note: * Where cover is measured to face against soil, increase the dimension shown by – 10mm if concrete surface protected by damp-proof membrane, or 20mm otherwise.

Concrete Supply and Manufacture

Pre-mixed concrete

The easiest way to obtain good quality concrete is to purchase it from a pre-mixed concrete supplier. Pre-mixed concrete is generally specified as “normal-class”. The purchaser has to nominate:–

- The appropriate strength grade (one of N20, N25, N32, N40 or N50)
- Appropriate slump (one of 20 to 110 in 10mm increments) usually 80mm
- Appropriate maximum nominal size of aggregate (one of 10, 14, or 20mm) usually 20mm
- Method of placement (eg direct from truck, by pump)
- Whether or not project assessment is required to be carried out by the supplier (not usual for small projects)

If required the purchaser may also nominate:–

- An early strength requirement for early stripping of formwork and air-entrainment for freeze-thaw resistance. However, these would normally be specified only where required by special conditions.

Site mixed concrete

This should not normally be used for structural projects. Suggested mixes for some applications are shown in the following table.

Use	Nominal mix proportions by volume cement	Materials required for one cubic metre of concrete			Max added water per bag cement litres
		Cement bags	Sand m ³	Coarse aggregate m ³	
Mass footings, light duty driveways and paths	2:5:8	8	0.5*	1	20
Fence posts, floors and wearing surfaces	2:3:6	10.5	0.5*	1	20

Note: *When ordering sand, allow 15-20% extra to the above figure for losses & bulking of sand.

Materials

Cement

- Type GP (General purpose portland) and Type GB (General purpose blended) can be used. Other types are available but are used for special applications. Masonry cement should not be used to make concrete. Cement is available in multi-layer paper bags:—

1 bag = 40kg

25 bags = 1 tonne

Sand

- Must be clean and free from clay, earth, humus, salt or other deleterious material. A coarse, well-graded (ie from coarse to fine) sand is preferable.

Coarse aggregate

- May be river gravel or crushed stone. Material should be clean, hard, impervious and free from organic matter. For most work a well-graded material 10 to 20mm is suitable.

Water

- Water should be clean and fresh. Generally mains water is satisfactory but bore water should be checked.

Storage of Materials

- Cement must be kept dry, Stack off the ground and away from exterior walls. Cover so as to allow only limited air circulation but preventing condensation. Use on first in/first out basis.
- Aggregates should be stored on firm, hard surfaces and kept separate from each other.

Mixing

Concrete should be mixed in power-operated or hand mixer. Mixers should not be overfilled and should revolve at speeds recommended by the maker. A minimum mixing time of two minutes after the addition of the last ingredients should be allowed.

Proportions should be controlled by mass or volume batching. When volume batching, proportions should be measured in boxes or buckets. Do not use shovelfuls as shovelfuls of cement, sand and coarse aggregate are not equal.

Ingredients should be added to the mixer in the following order:—

- (a) Half to two-thirds of the water,
- (b) Coarse aggregate,
- (c) Sand,
- (d) Cement,
- (e) Final water sparingly added until desired workability is reached.

Higher strengths and better durability are achieved by using as little water as possible.

Concrete Construction

Formwork

The quality and rigidity of the formwork is reflected in the trueness of line and the surface finish exposed after the formwork is stripped. Some of the points to watch are:—

- Formwork should be well braced, and rigid enough to remain true to line and level during the concreting operations
- Joints between boards and at corners should be sealed to prevent loss of cement paste from the concrete, (causes honeycombing)

- Formwork should be treated with a form-release agent to prevent concrete adhering to the form
- Formwork should not be removed until the concrete has gained sufficient strength to carry the imposed loads. This will be longer in cold than in warm weather and will be affected by cement type

Reinforcement

Concrete is strong in compression but needs the addition of steel reinforcing bars to carry the tensile forces resulting from: the dead load of the member, the application of external loads, or from the shrinkage of the concrete as it dries out.

Determination of the amount and position of the reinforcement requires specialist knowledge, we suggest you visit the **BHP Reinforcing Products WEB site** at www.reinforcing.com and use our reinforcement area calculator. Once determined, the steel reinforcement must be accurately placed and firmly supported and tied to prevent displacement during the concreting operations. Tie wires used to bind the reinforcement in place should be trimmed off and bent back away from the concrete surface.

For slabs in slab-on-ground floors, driveways and paths, the reinforcement is used to control the cracking of the concrete surface. It should be located in the top third of the slab but with appropriate cover to protect it against corrosion.

Placing

Concrete should be poured as soon as possible after arriving at the site.

The concrete should be deposited in the forms as close as possible to its final location. Avoid flowing it along the forms, as this can lead to segregation. The concrete should be spread by shovel and worked thoroughly into place, ramming with shovel or rod. Concrete should be compacted preferably by mechanical vibrators. Immersion

vibrators should be used only for sections over 200mm deep and beam/screed vibrators for slabs. On small jobs where these are not available, use tamping with rods and screed boards.

Finishing of horizontal surfaces

Many surface finishes and textures are possible. The type of surface finish should be chosen with regard to its use.

Curing

The action of retaining water in the concrete so that it can react chemically with the cement to bond the aggregates together is known as curing. This process enables concrete to reach its potential strength, ensures the surface is as hard as possible and minimises the tendency for cracking.

Curing is most simply done by covering or encasing the member immediately after finishing with a plastic sheet secured to seal the surface from the atmosphere. This should be kept in place for three to seven days.

Alternatively, the surface of the concrete should be kept continuously wet for three to seven days.

Slab-on-Ground-Floors

Site considerations

Residential Slab-on-ground floors are suitable for use on flat sites or on sites with moderate slopes (up to 1 in 5) by using cut-and-fill techniques. For more steeply sloping sites, split level or suspended floors formed with Bondek structural decking should be considered.

Foundation material should be checked. Stable materials (eg. rock, sand, sandy clay) pose no constraints but expansive soils (eg. heavy plastic clays) and soils with low bearing capacity (eg. soft alluvial clays, peaty soils) may cause problems for all footing systems and should be investigated by a specialist consultant. Properly designed slabs are

suitable for use on expansive soils and those with low bearing capacity, and are covered in AS 2870.

It is important to check the site drainage and the position of water courses during heavy rain. Low-lying sites should be avoided or built up to avoid flooding. Dish drains and sloped paving should be used to keep surface run-off away from a slab-on-ground floor and foundation under it.

Construction considerations

The construction area should be cleared of all vegetable matter and the associated layer of topsoil.

In a cut-and-fill situation, any fill should be well compacted in shallow layers using hand-operated vibrating rollers or mechanical tampers. To prevent water vapour rising through the slab, a polyethylene sheet vapour barrier should be laid immediately under the slab and any beams or thickenings. The sheet should be purpose-made concrete underlay polyethylene of minimum thickness 0.2mm. Penetrations would be sealed with pressure sensitive tape. Joints should be lapped 200mm.

- Design of the slab and reinforcement details must conform to local building regulations and should follow AS 2870 “Residential Slabs and Footings – constructions”. In most areas it is desirable to minimise the risk of termites gaining entry to the building by following the recommendations of AS 3660.1.
- Slab-on-ground construction should follow the preceding recommendations for concrete construction in general.

Landscaping

- Large trees should not be planted close to any building. Where gardens are adjacent to the walls they should **be kept well below the damp-proof course or the floor level**. The ground in a one metre wide strip out from the walls should fall at least 25 mm away from the walls.

Deformed steel reinforcing bars for concrete

All details for Steel Reinforcing Bars for Concrete are contained in AS 1302.

Standard reinforcing bars

Bar size mm	Calculated mass per unit length kg/m	Nominal area mm ²	Calculated area mm ²
10†	0.616	80	78.5
12	0.888	110	113.1
16	1.578	200	201.1
20	2.466	310	314.2
24	3.551	450	452.4
28	4.834	620	615.8
32	6.313	800	804.2
36	7.990	1020	1017.9
40*	9.864	1260	1256.6
50*	15.413	1960	1963.5

* Available on Request

Note: It is anticipated that a new joint Australian and New Zealand reinforcement code will be published in 1999. This code will cover both reinforcement and fabric in strength grades of 250 and 500 MPa yield strength, and as applicable in ductility classes L (Low), N (Normal) and E.

Reinforcing Fabric for Concrete

- Reinforcing fabric is manufactured in accordance with AS 1304 from hard-drawn steel wire conforming with AS 1303. Standard sheets are cut flush at the sides and have equal overhangs at the ends.

BHP Ribbed Reinforcing Mesh (Grade 500)

Product Code	Mesh Specification					Approx. Mass of 2.4m x 6m sheets		Nominal cross-sectional area					
	Longitudinal Wires			Cross Wires									
	No	x	size mm	@	pitch mm	No	x	size mm	@	pitch mm	area kg/m ²	sheet kg	Longitudinal mm ² /m

Rectangular Meshes

RF1218	25	x	11.90	@	100	30	x	7.60	@	200	10.5	156	1112	227
RF1118	25	x	10.65	@	100	30	x	7.60	@	200	8.8	130	891	227
RF1018	25	x	9.50	@	100	30	x	7.60	@	200	7.3	109	709	227
RF918	25	x	8.55	@	100	30	x	7.60	@	200	6.3	93	574	227
RF818	25	x	7.60	@	100	30	x	7.60	@	200	5.3	79	454	227
RF718	25	x	6.75	@	100	30	x	7.60	@	200	4.6	67	358	227

Square Meshes (with edge lapping wires)

RF102	10	x	9.50	@	200	30	x	9.50	@	200	5.5	80	354	354
	+4	x	6.75	@	100									
RF92	10	x	8.55	@	200	30	x	8.55	@	200	4.5	65	287	287
	+4	x	6.00	@	100									
RF82	10	x	7.60	@	200	30	x	7.60	@	200	3.6	52	227	227
	+4	x	5.50	@	100									
RF72	10	x	6.75	@	200	30	x	6.75	@	200	2.8	40	179	179
	+4	x	4.75	@	100									
RF62	10	x	6.00	@	200	30	x	6.00	@	200	2.2	32	141	141
	+4	x	4.00	@	100									
RF52	10	x	4.75	@	200	30	x	4.75	@	200	1.4	21	89	89
	+4	x	4.00	@	100									
RF63	6	x	6.00	@	300	20	x	6.00	@	300	1.5	21	94	94
WA only	+4	x	4.00	@	100						(2.3m sheet width)			
RF53	6	x	4.75	@	300	20	x	4.75	@	300	1.0	14	59	59
WA only	+4	x	4.00	@	100						(2.3m sheet width)			

Square Meshes

RF81	25	x	7.60	@	100	60	x	7.60	@	100	7.1	105	454	454
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Trench meshes (strip widths 200mm, 300mm, 400mm)

RF12TM	3,4 or 5	x	11.90	@	100	-	4.75	@	300				
RF11TM	3,4 or 5	x	10.65	@	100	-	4.75	@	300				
RF8TM	3,4 or 5	x	7.60	@	100	-	4.00	@	300				

Note: Not all products available in all states

MASONRY-BRICKWORK AND BLOCKWORK

Masonry walls are commonly built using clay bricks, calcium silicate bricks or concrete bricks and blocks. In addition to the more routine uses, masonry walls offer properties such as high sound absorption coefficients, high sound transmission loss, and good thermal insulation and fire resistance.

Information is available from the Clay Brick and Paver Institute (most States) and the Concrete Masonry Association of Australia (most States).

Design

The design of masonry structures is regulated by Australian Codes and Standards and Building Regulations of State Governments. As with any other structure, design should be entrusted to a competent person experienced in such work and in the requirements of the applicable Codes, Standards and Regulations.

Points requiring special attention in design include the provision of control joints and other movement and crack control measures, the design of lintels over wall openings, and proper lateral support of loadbearing elements.

Specification for Building Walls

Modular planning

To achieve economy in construction, walls should be dimensioned to suit brick or block sizes.

Dimensions

Manufacturing dimension of bricks and blocks are 10mm less than nominal dimensions to allow for a standard 10mm mortar joint.

Laying

All manufacturers recommend that bricks and blocks should be laid as dry as possible. They should never be wetted to control suction prior to application of mortar. Keep units as dry as possible on the site. At the stoppage of work, the tops of the walls should be covered to prevent moisture entering cores.

All joints are to be fully bedded except in the special situation where blockwork is face-shell bedded to prevent entry of water.

Support of walls during construction

All walls must be braced during construction against lateral loads, especially wind loads, to ensure that adverse or unsafe conditions do not arise in the wall.

The height of unbraced free-standing walls should be limited during construction to the heights specified in the appropriate State Building Regulations.

Damp-proof courses

Damp-proof courses should be provided in accordance with recognised practice.

External finish

If single-leaf clay or concrete block external walls are to be constructed they should be coated with an approved waterproofing film such as acrylic paint and protected by wide eaves overhangs.

Mortar Mix

Mortar for brickwork and blockwork is made up from a mixture of cement, lime and sand, with sufficient water to provide a workable consistency. Material proportions are varied to suit the job, the most commonly used being:—

1 Cement : 1 lime : 6 sand

Where higher strength or impermeability is required, mortars richer in cement can be used. Lime-rich mortars should only be used where strength is not important.

If cement other than portland cement is used, the mix proportions will need to be varied. For example, if a blended cement is used the common mix should be:—

1 blended cement: 1 lime: 5 sand

For calcium silicate bricks and concrete masonry, the manufacturers recommend the use of a particular mortar consisting of one part cement to five parts sand with the addition of Calsil Mortarbond to provide workability and water retention.

Quantities

To lay 2000 standard size bricks use, approximately one cubic metre of mortar. To make the quantity requires six bags cement, six bags lime and one cubic metre of sand for the 1:1:6 mix.

Wall Ties

Normal cavity walls are tied with wall ties spaced 600mm apart, both vertically and horizontally. Some situations, however, do require special tying. For information refer to the appropriate SAA Code.

BRICKWORK DIMENSIONS FOR MODULAR BRICKS

Modular brick dimensions are in even 100mm increments, therefore all dimensions can be extrapolated from the following table:—

Modular Brick

Size: 290 x 90 x 90mm

No. of bricks per course	Wall length mm	Opening size mm	Height mm
1	290	310	100
1 $\frac{1}{3}$	390	410	200
1 $\frac{2}{3}$	490	510	300
2	590	610	400
	etc	etc	etc

Note: Wall panels are 10mm shorter and openings 10mm longer than figures below.

Blockwork Dimensions

Blocks, like modular bricks, are in dimensions which follow a simple arithmetic progression; therefore all dimensions required can be extrapolated from the following table:—

No. of blocks	Length, mm (based on 400mm long units)				Height, mm (based on 200mm high units)	
	Full blocks	+ Fractional blocks			No. of courses	Height
		1/4	1/2	3/4		
1	400	500	600	700	1	200
2	800	900	1000	1100	2	400
3	1200	1300	1400	1500	3	600

Brickwork Dimensions

Metric Standard Brick: 230 x 110 x 76mm

Joints: 10mm Vertical Gauge: 7 courses = 600mm

No. of Bricks	Length	Opening	Height	No. of Bricks	Length	Opening	Height
1	230	250	86	26	6230		2229
1.5	350	370		26.5	6350		
2	470	490	172	27	6470		2314
2.5	590	610		27.5	6590		
3	710	730	257	28	6710		2400
3.5	830	850		28.5	6830		
4	950	970	343	29	6950		2486
4.5	1070	1090		29.5	7070		
5	1190	1210	429	30	7190		2572
5.5	1310	1330		30.5	7310		
6	1430	1450	514	31	7430		2657
6.5	1550	1570		31.5	7550		
7	1670	1690	600	32	7670		2743
7.5	1790	1810		32.5	7790		
8	1910	1930	686	33	7910		2829
8.5	2030	2050		33.5	8030		
9	2150	2170	772	34	8150		2914
9.5	2270	2290		34.5	8270		
10	2390	2410	857	35	8390		3000
10.5	2510	2530		35.5	8510		
11	2630	2650	943	36	8630		3086
11.5	2750	2770		36.5	8750		
12	2870	2890	1029	37	8870		3172
12.5	2990	3010		37.5	8990		
13	3110	3130	1114	38	9110		3257
13.5	3230	3250		38.5	9230		
14	3350	3370	1200	39	9350		3343
14.5	3470	3490		39.5	9470		
15	3590	3610	1286	40	9590		3429
15.5	3710	3730		40.5	9710		
16	3830	3850	1372	41	9830		3514
16.5	3950	3970		41.5	9950		
17	4070	4090	1457	42	10070		3600
17.5	4190	4210		42.5	10190		
18	4310	4330	1543	43	10310		3686
18.5	4430	4450		43.5	10430		
19	4550	4570	1629	44	10550		3772
19.5	4670	4690		44.5	10670		
20	4790	4810	1714	45	10790		3857
20.5	4910	4930		45.5	10910		
21	5030	5050	1800	46	11030		3943
21.5	5150	5170		46.5	11150		
22	5270	5290	1886	47	11270		4029
22.5	5390	5410		47.5	11390		
23	5510	5530	1972	48	11510		4114

ELECTRICITY

Fundamental units

Ampere is the unit in which electric current flow is measured.

Ohm is the unit in which resistance to the flow to of an electric current is measured.

Volt is the unit of electric pressure. A pressure of 1 volt is required to force a current of 1 ampere through a resistance of 1 ohm.

Watt is the unit of power or rate of doing work.

watts = volts x amperes

Kilowatt hour For commercial purposes electrical energy is charged in units of 1000 watt hours, and is called the kilowatt hour.

$$\text{kW.h} = \frac{\text{volts} \times \text{amperes} \times \text{hours}}{1000} \quad \text{or} \quad \frac{\text{watts} \times \text{hours}}{1000}$$

Example: To find the cost of burning five 60 -watt lamps for ten hours, assuming the cost per unit to be seven cents:

$$\text{Cost} = \frac{60 \times 5 \times 10 \times 7c}{1000} = \$0.21$$

The normal voltage for household appliances is 240; for 3-phases motors, etc., it is 415.

Safety precautions

One of the main advantages of electricity is that there is nothing complicated about its use. It is a good servant, but this does not mean you can abuse it.

Fortunately, fatal electrical accidents have been few compared with fatal accidents from other causes. But a few is still too many and these can be avoided by the observance of simple safety precautions.

Flexible cord core colours

In the past, the requirements concerning the identification of the conductors of flexible cords have provided that the colour green shall be used to identify the earthing conductor and that current – carrying conductors shall not be green. A new system of colour coding is now used in conformity with overseas practice and the earthing conductor is now coloured green/yellow.

The colours of the cores of the old and new flexible cords are:

Old Cords	New Cords
Red	Brown
Black	Blue
Green or green/yellow	Green/yellow

In three-pin plugs and cord extension sockets, the green/yellow earthing core must be connected to the earth terminal (or the green core in old cords). This earth terminal is marked either E, EARTH or $\perp$. In modern plugs the earth terminal is also marked with the GREEN and a green colour. No other conductor may be connected to this terminal.

The electrical installation

It is illegal for any person other than a licensed electrical person or a person in the employment of and under the supervision of a licensed electrical person to carry out any electrical wiring work, including the installation, repair or replacement of power points, dimmers, light fittings, etc.

- **DO NOT** interfere with the fixed wiring in your home. If you do, you not only break the law, you run the risk of serious accident.
- **DO** have your installation checked by a licensed electrical person if signs of wear and tear appear. Your local electricity supply authority will also inspect the installation if you suspect it is faulty.
- **DO** inspect the main earth wire connection regularly. The earth wire should be connected to a rod driven directly into the ground and also to the water pipe system, except that in older installations it might

be connected to the water pipe system only. Remember that an effective main earthing system is essential for personal safety.

- **DO** arrange to have electrical repairs carried out by an electrical contractor as a matter of urgency if the earth wire or its connection is found to be damaged or disconnected.
- **DO** arrange for an electrical contractor to modify the main earthing system, if it is not connected to a driven rod, prior to any work being carried out on the water pipe system involving the use of non-metallic pipes or fittings.

Flexible cords

Every year flexible cords are involved in electrical fatalities.

- **DO** consider replacing old or damaged cord extension sockets with new shrouded types that help prevent accidental contact with the plug pins.
- **DO** make sure that all flexible cords are correctly connected. If in even the slightest doubt, consult an electrician. Incorrect connection of the earthing core in flexible cords has accounted for almost half of the domestic fatalities associated with flexible cords.
- **DO** treat extension cords with respect. As they are often subjected to rough treatment and are used in awkward work situations, they should be inspected regularly.

Either buy ready-made extension cord or have them made up by an electrician. The do-it-yourself approach might have fatal consequences.

- **DO** read and follow the instructions carefully when using a flexible cord wound on a reeling or coiling device. If used coiled up it may overheat and melt the insulation.
- **DO NOT** dismantle, repair, or attempt to adjust contacts on cord fittings while the cord is switched on or plugged in. There is a golden rule which says switch off the electricity then pull the plug out. Every year someone makes the fatal mistake of disregarding this simple rule.

- **DO NOT** join cords by twisting and taping. Makeshift joints are dangerous. If it is necessary to join two lengths of cord a correctly attached three-pin plug and shrouded cord extension socket should be used.
- **DO NOT** use cord which are frayed, badly worn, or perished or which have chipped, cracked or broken fittings. Replace them now, later may be too late.
- **DO** make sure that any cord you use is suitable in type and size for the job it has to do.

NEVER assemble extension cords from two-core cables. Even if intended for use with a double insulated appliance, it is certain that the extension cord will be used inadvertently to supply single insulated equipment which must be earthed by a three-core cord for safety.

Equipment required to be earthed

All equipment that is not double insulated is required to be earthed. All equipment that is double insulated is required to be marked with the symbol  or with the words DOUBLE INSULATED.

- **DO** make sure that all electrical appliances and other equipment that are not double insulated are fitted with three-core supply flexible cord and three-pin plug.

Overseas type plugs

Two-pin parallel pin overseas type plugs are not suitable for connection to electricity supply in Australia, because they have a small resistance between pins and the edge of the plug body, and are considered to be dangerous.

- **DO** replace overseas type plugs with Australian approved plugs.
- **DO NOT** bend or twist pins of two-pin overseas type plugs to fit Australian power points.

Portable appliances in earthed situations

Portable appliances commonly used in earthed situations include electric tools and welders, washing, polishing and ironing machines, mixers, blenders, kettles, toasters, irons, room heaters and any other appliances used in the kitchen, bathroom or laundry, or out-of-doors.

- **DO** use a portable safety switch to guarantee against serious electric shock.
- **DO** find out from a licensed electrician whether the power point to which you normally connect these appliances is effectively earthed.
- **DO** make sure the flexible cord is properly connected.
- **DO NOT** under any circumstances connect the appliance to a two-pin power point or a lampholder.
- **DO NOT** use portable electric tools outdoors while barefooted. Bare feet, minimum clothing and wet skin lower body resistance, thus increasing the amount of shock current if an accident should occur.

The growing use of light metal ladders around the home gives cause for some further safety reminders. Remember when working from metal ladders that you are in metallic contact with the ground or wall (ie, earthed). Therefore even simple operations such as changing a lamp should be performed with care. Also keep well clear of overhead wires when moving metal ladders.

Outside the home

- **DO** take immediate action should you see overhead wires which have sagged or fallen. Keep well clear. Stand guard to warn others of the danger. Send somebody to inform the police or the electricity supply authority. Make sure somebody remains on guard until the supply authority's repair people arrive. In particular, remember that both ends of a broken wire may be alive and need to be guarded.
- **DO** take extreme care when climbing on a roof, ladder, tree, etc., near overhead electrical wires. Touching these wires may mean death. Be careful when painting or carrying out repairs near electric wires.

- **DO** take extreme care when operating mobile cranes, tip trucks or tall agricultural machinery, or when upending long pipes, boatmasts or erecting aerials or lengths of guttering in the vicinity of overhead power lines.

Maintenance

- **DO NOT** expect that electrical equipment you use every day will last forever.
- **DO** arrange for your electrical equipment to be regularly checked by the manufacturer or a qualified electrical person.
- **DO NOT** use any electrical equipment if there is any doubt about its safe condition.
- **DO NOT** dismantle or attempt to repair or adjust internal parts of any electrical equipment or flexible cord while it is plugged into a power outlet. Each year someone makes the fatal mistake of disregarding this rule.
- **DO** ensure that all repairs of electrical equipment are carried out by electrical persons.

Danger signals

- **DO** act immediately if the following danger signals appear. Call your electricity supply authority or a licensed electrical person without delay.
 - An electric shock, however slight, is a warning that something is wrong with the installation or appliance. If you do not have it fixed the next shock may be fatal.
 - When a fuse blows or circuit breaker trips repeatedly there is a fault somewhere...in the permanent wiring, an appliance, or the flexible cord.
 - Sparking, spluttering or overheating at the fittings of a flexible cord or at the power point show that the cord connections or the power point are faulty. These symptoms are frequently accompanied by a crackling noise in the radio and interference lines on a TV screen.

LIQUEFIED PETROLEUM GAS (LP GAS)

When used properly and handled with appropriate care, LP gas is a safe, clean, efficient and convenient source of energy. It is used for domestic, leisure, commercial, industrial, and agricultural applications and as an automotive fuel.

Information about LP gas and appliances and equipment is available from the Australian Liquefied Petroleum Gas Association, 30 George Street, Redfern, NSW 2016.

Liquefied Petroleum Gas (LP gas) is composed predominantly of the following hydrocarbons or a mixture of all or any of them: – propane, butane or propylene. The main supply sources of LP gas are extractions from natural gas or a by-product from oil refineries.

When compressed moderately at normal temperature it becomes a liquid. When gas is withdrawn, the pressure drops and the liquid reverts to a gas. This means it can be stored and transported as a liquid and burnt as gas.

As the expansion ratio of gas from liquid is 270:1, LP gas has a significant advantage in that a large quantity of liquid may be transported in a small space.

LP gas is odourised with a distinctive smell (like rotting cabbage) to assist in the detection of leaks.

Cylinders and tanks are never filled to capacity; and ullage (vapour space) of approx. 15% of the container volume is necessary for the expansion of the liquid gas under possible temperature increases. The vapour pressure is dependent on the ambient temperature; for instance, commercial propane exerts a pressure at 15 degrees Celsius of approximately 760 kPa. As gas is drawn from a container, the pressure in the vapour space is reduced and more liquid boils off and will

continue to do so until the cylinder is empty or the withdrawal is discontinued. This re-establishes an equilibrium condition with the LP gas exerting a vapour pressure related to its temperature.

Tanks and cylinders are fitted with a relief device. It is important that the containers always be stored or transported in a vertical position so that the relief valve connects to the gas space, not to the liquid space in the vessel.

Various standards and codes for the safe and efficient use of LP gas are published by Standards Australia and the ALPGA. State governments also have regulations controlling LP gas matters, either gazetting the codes of the SAA or ALPGA or including the requirements for these codes in their respective LP gas regulations. If in doubt on the requirements of any Standard or Code, contact ALPGA.

All LP gas cylinders shall be stamped to indicate they have been checked at a test station. Reinspection and restamping at a test station shall be carried out every ten years. 3T88 stamped on a cylinder means it was tested March 1988 and by March 1998 it must be retested and restamped. It is illegal to fill a cylinder outside of the ten-year period since its last test.

Adequate ventilation with gas burning appliances is essential, particularly in caravans and marine craft where the free volume is limited.

All installation and repair work shall be carried out and checked by an authorised or licensed LP gas installer to the requirements of Gas Installations Code AG601.

Some Additional Safety Hints:–

- All appliances and equipment must be maintained in a serviceable condition and the overall installation must be checked regularly for leaks – with a detergent or soap solution, not with a naked flame
- All appliances should meet LP gas industry approval requirements
- The uses of unflued water heaters or space heaters in caravans and marine craft is prohibited
- Cylinder valves shall be kept closed when the installation is not in use. This is of particular importance during the refuelling of caravans and marine craft. Never use any gas appliance including refrigerator in a moving vehicle
- In the event of accidental gas leaks or fire, close cylinder valves(s) until hazard is removed
- Close valves and fit gas tight sealing plug to all spare cylinders whether full or empty
- Valves on caravan cylinders must be closed during transit

GAS Hand Cutting Nozzles

Standard nozzle

Plate thickness, mm	Nozzle size	Pressure		Speed Acet & LP Gas mm/min
		Oxygen, kPa	Acet & LP Gas kPa	
6	8	200	100	450
12	12	200	100	380
20	12	250	100	340
25	15	220	100	320
40	15	350	100	270
50	15	400	100	240
75	15	450	100	180
100	20	400	100	150
125	20	450	100	150
150	20	520	100	130

Mass densities of materials

Mass densities shown in this selective list may vary, depending on material composition. Where calculations need to be precise, exact density factors should be obtained from manufacturers or other appropriate sources.

Material	kg/m ³	Material	kg/m ³
Aluminium, rolled	2710	Nails, wire, bags	1201
Bitumen, prepared	1362	Paper: printing, reels	897
Bolts and nuts, bags	1201	writing	961
Brass, cast	8330	Petrol	689-769
Bricks (common burnt clay)		Pine: Kauri, Qld	481
stacked	1602-1920	New Zealand	609
brickwork	1920	Oregon	529
Cement: bags	1281	Pipes: cast iron; stacked	961-1281
slurry	1442	earthenware, loose	320
Coal, loose lumps	897	wrought iron, 9.5mm stacked	3204
slurry	993	Plywood	481-641
Coke:	481-561	Pulp, wood: dry	561
Concrete, reinforced:		Rubber: processed sheet	1121
2 per cent steel	2420	sponge	48-160
Copper, drawn or sheet	8938	Sand: saturated	1922
Cyprus wood	593	undisturbed dry	1682
Douglas fir	529	Sawdust	208
Earth: dry, loose	1280	Screws, iron, packs	1602
moist, loose	1440-1600	Slag wool	224-288
Galvanized steel, sheet, bundles	897	Snow: fresh	96
Glass, plate	2787	wet compact	320
Grain: wheat	770	Steel, low carbon	7850
barley	625	Straw, compressed bales	304
oats	416	Sulphate of ammonia, bags	641
rye	721	Tyres, rubber	176-256
Gypsum, plaster	737	Waste paper	352
Ice	913	Water: fresh	1001
Iron, cast	7208	salt	1009-1201
Lead, cast or rolled	11325	Wire: iron, coils	1185
Lime, hydrate, gables	513	rod, coils	801
Lime mortar: dry	1650	rope, coils	1442
wet	1748	Wool: compressed bales	769
Magnesite	3044	uncompressed	208
Maple: Canadian	737	Zinc: cast	6804
English	689	rolled	7192

Areas and circumferences of circles

Diameter	Area	Circumference	Diameter	Area	Circumference
1	0.7854	3.1416	51	2042.8	160.22
2	3.1416	6.2832	52	2123.7	163.36
3	7.6086	9.4248	53	2206.2	166.50
4	12.566	12.566	54	2290.2	169.65
5	19.635	15.708	55	2375.8	172.79
6	28.274	18.850	56	2463.0	175.93
7	38.485	21.991	57	2551.8	179.07
8	50.266	25.133	58	2642.1	182.21
9	63.617	28.274	59	2734.0	185.35
10	78.540	31.416	60	2827.4	188.50
11	95.003	34.558	61	2922.5	191.64
12	113.10	37.699	62	3019.1	194.78
13	132.73	40.841	63	3117.3	197.92
14	153.94	43.982	64	3217.0	201.06
15	176.72	47.124	65	3318.3	204.20
16	201.06	50.266	66	3421.2	207.35
17	226.98	53.407	67	3525.7	210.49
18	254.47	56.549	68	3631.7	213.63
19	283.53	56.690	69	3739.3	216.77
20	314.66	62.832	70	3848.5	219.91
21	346.36	65.974	71	3959.2	223.05
22	380.13	69.115	72	4071.5	226.20
23	415.48	72.257	73	4185.4	229.34
24	452.39	75.398	74	4300.9	232.48
25	490.88	78.540	75	4417.9	235.62
26	530.93	81.682	76	4536.5	238.76
27	572.56	84.823	77	4656.6	241.90
28	615.75	87.965	78	4778.4	245.04
29	660.52	91.106	79	4901.7	248.19
30	706.86	94.247	80	5026.5	251.33
31	764.77	97.390	81	5153.0	254.47
32	804.25	100.53	82	5281.0	257.61
33	855.30	103.67	83	5410.6	260.75
34	907.92	106.81	84	5541.8	263.89
35	962.12	109.96	85	5674.5	267.04
36	1017.9	113.10	86	5808.8	270.18
37	1075.2	116.24	87	5944.7	273.32
38	1134.1	119.38	88	6082.1	276.46
39	1194.6	122.52	89	6221.2	279.60
40	1256.6	125.66	90	6361.7	282.74
41	1320.3	128.81	91	6503.9	285.89
42	1385.4	131.95	92	6647.6	289.03
43	1452.2	135.09	93	6792.9	292.17
44	1520.5	138.23	94	6939.8	285.31
45	1590.4	141.37	95	7088.2	298.45
46	1661.9	144.51	96	7238.2	301.59
47	1734.9	147.66	97	7389.8	304.74
48	1809.6	150.80	98	7543.0	307.88
49	1885.7	153.94	99	7697.7	311.02
50	1963.5	157.08	100	7854.0	314.16

Squares, cubes, square roots and cube roots

n	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	n	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$
					50	2 500	125 000	7.071	3.684
1	1	1	1.000	1.000	51	2 601	132 651	7.141	3.708
2	4	8	1.414	1.260	52	2 704	140 608	7.211	3.733
3	9	27	1.732	1.442	53	2 809	148 877	7.280	3.756
4	16	64	2.000	1.587	54	2 916	157 464	7.348	3.780
5	25	125	2.236	1.710	55	3 025	166 375	7.416	3.803
6	36	216	2.449	1.817	56	3 136	175 616	7.483	3.826
7	49	343	2.646	1.913	57	3 249	185 193	7.550	3.849
8	64	512	2.828	2.000	58	3 364	195 112	7.616	3.871
9	81	729	3.000	2.080	59	3 481	205 379	7.681	3.893
10	100	1 000	3.162	2.154	60	3 600	216 000	7.746	3.915
11	121	1 331	3.317	2.224	61	3 721	226 981	7.810	3.936
12	144	1 728	3.464	2.289	62	3 844	238 328	7.874	3.958
13	169	2 197	3.606	2.351	63	3 969	250 047	7.937	3.979
14	196	2 744	3.742	2.410	64	4 096	262 144	8.000	4.000
15	225	3 375	3.873	2.466	65	4 225	274 625	8.062	4.021
16	256	4 096	4.000	2.520	66	4 356	287 496	8.124	4.041
17	289	4 913	4.123	2.571	67	4 489	300 373	8.185	4.062
18	324	5 832	4.243	2.621	68	4 624	314 432	8.246	4.082
19	361	6 859	4.359	2.668	69	4 761	328 509	8.307	4.102
20	400	8 000	4.472	2.714	70	4 900	343 000	8.367	4.121
21	441	9 261	4.583	2.759	71	5 041	357 911	8.426	4.141
22	484	10 648	4.690	2.802	72	5 184	373 248	8.485	4.160
23	529	12 167	4.796	2.844	73	5 329	389 017	8.544	4.179
24	576	13 824	4.899	2.884	74	5 476	405 224	8.602	4.198
25	625	15 625	5.000	2.924	75	5 625	421 875	8.660	4.217
26	676	17 576	5.099	2.962	76	5 776	438 976	8.718	4.236
27	729	19 683	5.196	3.000	77	5 929	456 533	8.775	4.254
28	784	21 952	5.292	3.037	78	6 084	474 552	8.832	4.273
29	841	24 389	5.385	3.072	79	6 241	493 039	8.888	4.291
30	900	27 000	5.477	3.107	80	6 400	512 000	8.944	4.309
31	961	29 791	5.568	3.141	81	6 561	531 441	9.000	4.327
32	1 024	32 768	5.657	3.175	82	6 724	551 368	9.055	4.344
33	1 089	35 937	5.745	3.208	83	6 889	571 787	9.110	4.362
34	1 156	39 304	5.831	3.240	84	7 056	592 704	9.165	4.380
35	1 225	42 875	5.916	3.271	85	7 225	614 125	9.220	4.397
36	1 296	46 656	6.000	3.302	86	7 396	636 056	9.274	4.414
37	1 369	50 653	6.083	3.332	87	7 569	658 503	9.327	4.431
38	1 444	54 872	6.164	3.362	88	7 744	681 472	9.381	4.448
39	1 521	59 319	6.245	3.391	89	7 921	704 969	9.434	4.465
40	1 600	64 000	6.325	3.420	90	8 100	729 000	9.487	4.481
41	1 681	68 921	6.403	3.448	91	8 281	753 571	9.539	4.498
42	1 764	74 088	6.481	3.476	92	8 464	778 688	9.592	4.514
43	1 849	79 507	6.557	3.503	93	8 649	804 357	9.644	4.531
44	1 936	85 184	6.633	3.5320	94	8 836	830 584	9.695	4.547
45	2 025	91 125	6.708	3.557	95	9 025	857 375	9.747	4.563
46	2 116	97 336	6.782	3.583	96	9 216	884 736	9.798	4.579
47	2 209	103 823	6.856	3.609	97	9 409	912 673	9.849	4.595
48	2 304	110 592	6.928	3.634	98	9 604	941 192	9.899	4.610
49	2 401	117 649	7.000	3.659	99	9 801	970 299	9.950	4.626
					100	10 000	1 000 000	10.00	4.642

Trigonometrical ratios

Degrees	Angle		Chord	Sine	Tangent	Co-tangent	Cosine	1.414	1.5708	90°
	0	Radians								
0°	0		0	0	0	∞	1	1.414	1.5708	90°
1	0.0175		0.017	0.0175	0.0175	57.2900	0.9998	1.402	1.5533	89
2	0.0349		0.035	0.0349	0.0349	28.6363	0.9994	1.389	1.5359	88
3	0.0524		0.052	0.0523	0.0524	19.0811	0.9986	1.377	1.5184	87
4	0.0698		0.070	0.0698	0.0699	14.3007	0.9976	1.364	1.5010	86
5	0.0873		0.087	0.0872	0.0875	11.4301	0.9962	1.351	1.4835	85
6	0.1047		0.105	0.1045	0.1051	9.5144	0.9945	1.338	1.4661	84
7	0.1222		0.122	0.1219	0.1228	8.1443	0.9925	1.325	1.4486	83
8	0.1396		0.140	0.1392	0.1405	7.1154	0.9903	1.312	1.4312	82
9	0.1571		0.157	0.1564	0.1584	6.3138	0.9877	1.299	1.4137	81
10	0.1745		0.174	0.1736	0.1763	5.6713	0.9848	1.286	1.3963	80
11	0.1920		0.192	0.1908	0.1944	5.1446	0.9816	1.272	1.3788	79
12	0.2094		0.209	0.2079	0.2126	4.7046	0.9781	1.259	1.3614	79
13	0.2269		0.226	0.2250	0.2309	4.3315	0.9744	1.245	1.3439	77
14	0.2443		0.244	0.2419	0.2493	4.0108	0.9703	1.231	1.3265	76
15	0.2618		0.261	0.2588	0.2679	3.7321	0.6959	1.218	1.3090	75
16	0.2793		0.278	0.2756	0.2867	3.3874	0.9613	1.204	1.2915	74
17	0.2967		0.296	0.2924	0.3057	3.2709	0.9563	1.190	1.2741	73
18	0.3142		0.313	0.3090	0.3249	3.0777	0.9511	1.176	1.2566	72
19	0.3316		0.330	0.3256	0.3443	2.9042	0.9455	1.161	1.2392	71
20	0.3491		0.347	0.3420	0.3640	2.7475	0.9397	1.147	1.2217	70
21	0.3665		0.364	0.3584	0.3839	2.6051	0.9336	1.133	1.2043	69

General Information

Conversion factors

Factors listed are based on Australian Standard 1376 "Conversion Factors" and where not exact have been rounded to six significant figure. Exact values printed in bold type.

To convert from	Convert to	Multiply by
acre	hectare	0.404 686
acre foot	cubic metre	1 233.48
atmosphere	millibar	1 013.25
atmosphere	pascal	101 325
barrel	litre	159.113
barrel (US)	litre	158.987
barrel, dry (US)	cubic metre	0.115 627
British thermal unit	joule	1 055.06
British thermal unit	kilowatt. hour	0.000 293
British thermal unit	megajoule	0.001 055
Btu per cubic foot	kilojoule per cubic metre	37.258 9
Btu per gallon	kilojoule per litre	0.232 080
Btu per hour	watt	0.293 071
Btu per pound	kilojoule per kilogram	2.326
Btu per square foot hour F	watt per square metre. kelvin	5.678 26
bushel	litre	36.368 7
bushel (US)	litre	35.239 1
cubic foot	cubic metre	0.028 317
cubic foot per second	cubic metre per second	0.028 317
cubic inch	cubic centimetre	16.387 064
cubic inch	cubic millimetre	16387.1
cubic yard	cubic metre	0.764 555
fathom	metre	1.828 8
fluid ounce	millilitre	28.413 1
foot	metre	0.304 8
foot per minute	metre per minute	0.304 8
foot per minute	metre per second	0.005 08
foot per second	metre per second	0.304 8
foot pound force	joule	1.355 82
foot pound force per second	watt	1.355 82
furlong	metre	201.168
gallon	litre	4.546 09
gallon (US)	litre	3.785 41
gravity (standard)	metre per second per second	9.806 65
horse-power	kilowatt	0.745 700
hundredweight	kilogram	50.802 3
inch	metre	0.025
inch	micrometre	25400.00
inch	millimetre	25.4
inch mercury	kilopascal	3.386 38
inch water gauge	kilopascal	0.248 642

To convert from	Convert to	Multiply by
kilowatt hour	megajoule	3.6
knot (international)	kilometre per hour	1.852
mile	kilometre	1.609 344
mile per gallon	litre per 100 kilometre	divide 2.28481 by mile per gallon
mile per hour	kilometre per hour	1.609 344
millimetre mercury	kilopascal	0.133 322
millimetre water gauge	pascal	9.789 04
ounce	gram	28.349 5
ounce per square foot	gram per square metre	305.152
ounce per square yard	gram per square metre	33.905 7
pint	litre	0.568 261
pound	kilogram	0.453 592 37
pound force	newton	4.448 22
pound force foot	newton.metre	1.355 82
pound force inch	newton.metre	0.112 985
pound force per square inch	kilopascal	6.894 76
pound force per square inch	megapascal	0.006 895
pound force per square inch	pascal	6 894.76
pound per acre	kilogram per hectare	1.120 85
pound per cubic foot	kilogram per cubic metre	16.018 5
pound per foot	kilogram per metre	1.488 16
pound per gallon	kilogram per litre	0.099 776
pound per square foot	kilogram per square metre	4.882 43
square foot	square metre	0.092 903
square foot per gallon	square metre per litre	0.020 436
square foot per ton	square metre per tonne	0.091 436
square inch	square centimetre	645.16
square inch	square millimetre	645.16
square mile	square kilometre	2.5899 99
square yard	square metre	0.836 127
superficial foot	cubic metre	0.002 360
ton	tonne	1.016 .5
ton, freight (40ft ³)	cubic metre	1.132 67
ton, register (100 ft ³)	cubic metre	2.831 68
ton force foot	kilonewton metre	3.037 03
ton force per square inch	megapascal	15.444 3
ton per cubic yard	tonne per cubic metre	1.328 94
yard	kilometre	0.000 914

GEOMETRY AND MENSURATION

Circle Circumference = diameter $\times \frac{22}{7}$ (or 3.1416)

Area = diameter² $\times 0.7854$

Area of sector of circle = length of arc $\times$ half radius.

Area of segment of circle = area of sector, less area of triangle

Side of square of area equal to circle = 0.862 diameter of circle

Diameter of circle equal in area to square = 1.1284 side of square

Sphere Surface area = 3.1416 $\times$ diameter²

Volume = 0.5236 diameter³

Areas generally.

Square, rectangle, rhombus or rhomboid = base $\times$ height

Triangle = half base $\times$ perpendicular height

Trapezoid = half sum of two parallel sides $\times$ height

Area of any figure of four or more unequal sides is found by dividing it into triangles, finding areas of each, and adding together

Regular polygon (inscribed circle) = half radius of circle $\times$ length of one side $\times$ number of sides

Parabola = base $\times$ height $\times \frac{2}{3}$

Ellipse = long axis $\times$ short axis $\times 0.7854$

Cubes a = length of one side, volume = a^3 , surface area = $6a^2$.

Rectangular Prism Volume = area of base $\times$ height = $\frac{bl \times h}{2}$

Total surface area = $2(bl + lh + bh)$

Regular Prism Volume = $\frac{1}{2} n \times r \times a \times h$, where n = number of sides, r = radius of inscribed circle, a = length of side

Cylinder (Right Circular) Volume = 0.7854 $\times$ diameter² $\times$ height. Lateral surface area = 3.1416 $\times$ diameter $\times$ height

Total surface area = 3.1416 (diameter $\times$ height) + 1.5708 diameter²

Any Prism or Cylinder Volume = $h \times$ area of base. Lateral surface area = length of cylinder $\times$ perimeter of normal section

Regular Pyramid or Cone Volume = $\frac{1}{3}$ (area of base $\times$ height). Lateral surface area of regular figure $\frac{1}{3}$ = (perimeter of base $\times$ slant height)

Any Pyramid or Cone Volume = $\frac{1}{3}$ (area of base $\times$ distance from vertex to plane of base)

Frustum of any Pyramid or Cone Volume = $\frac{h}{3} (A_1 + A_2 + \sqrt{A_1 A_2})$, where A_1 and A_2 are the areas of bases made by parallel planes.

Tables and Statistics – Overseas trade:

Australia, 1825–1835 to 1996

Year	Exports \$m (FOB)	Imports \$m	Excess of exports (+) or imports (–) \$m
1826-1835	0.8	1.6	– 0.8
1836-1845	2.5	3.8	– 1.3
1846-1855	13.7	13.0	+ 0.7
1856-1865	34.7	35.4	– 0.7
1866-1875	43.7	37.0	+ 6.7
1876-1885	51.8	54.1	– 2.3
1886-1895	60.3	56.4	+ 3.9
1896-1905	92.3	66.4	+ 25.9
1906-1915	143.8	113.6	+ 30.2
1916-1925	249.6	216.0	+ 33.6
1926-1935	252.3	193.1	+ 59.2
1936-1945	325.8	393.7	– 67.9
1946-1955	1,246	1,104	+ 142
1956-1965	2,036	1,950	+ 86
1966	2755	– 2826	– 171
1967	2954	– 2841	+ 113
1968	2968	– 3164	– 196
1969	3242	– 3207	+ 35
1970	3998	– 3561	+ 437
1971	4244	– 3806	+ 438
1972	4746	– 3814	+ 932
1973	6027	– 37817	+ 2210
1974	6754	– 5767	+ 987
1975	8512	– 7665	+ 847
1976	9476	– 7930	+1546
1977	11446	– 10350	+1096
1978	12006	– 11149	+ 857
1979	14072	– 13385	+ 687
1980	18589	– 15831	+ 2758
1981	18718	– 19177	– 459
1982	19376	– 22389	– 3013
1983	20930	– 21725	– 795
1984	23661	– 23475	+ 186
1985	29730	– 30080	– 350
1986	32148	– 35691	– 3543
1987	36038	– 37152	– 1114
1988	41515	– 40386	+1129
1989	43894	– 47012	– 3118
1990	48564	– 50992	2428
1991	52155	– 49244	+ 2911
1992	54874	– 51077	+ 3797
1993	60022	– 59431	+ 591
1994	63822	– 64411	– 589
1995	66446	– 74715	– 8269
1996	75306	– 77104	– 1798

Information courtesy Australian Bureau of Statistics

Population, rate of increase, birth and death rates, surface area and density for the world, macro regions and regions: selected years

Macro Regions and Regions	Mid-year estimates (millions)								Annual rate of increase %	Birth rate	Death rate	Surface area km ²	Density ¹
	1950	1960	1970	1975	1980	1985	1990	1993					
	1950	1960	1970	1975	1980	1985	1990	1993	1990-1995			1993	1993
World Total	2 520	3 021	3 697	4 077	4 444	4 846	5 285	5 544	1.6	25	9	135641	41
Africa	224	282	364	414	476	549	633	689	2.8	42	14	30306	23
Eastern Africa	66	83	110	125	145	168	196	214	3.0	46	16	6 356	34
Middle Africa	26	32	40	45	52	61	70	77	3.1	46	15	6 613	12
Northern Africa	53	67	85	96	110	126	143	154	2.3	31	9	8 525	18
Southern Africa	16	20	25	29	33	38	42	45	2.3	32	9	2 675	17
Western Africa	63	80	104	118	135	156	181	198	3.0	46	16	6 138	32
Latin America	166	217	283	320	358	398	440	465	1.8	26	7	20533	23
Caribbean	17	20	25	27	29	31	34	35	1.3	24	8	235	149
Central America	37	49	67	78	89	101	113	121	2.2	30	6	2 480	49
South America	112	147	191	214	240	267	293	300	1.7	25	7	17819	17
Northern America ²	166	199	226	239	252	265	278	287	1.0	16	9	21517	13
Asia ³	1 403	1 703	2 147	2 406	2 642	2 904	3 186	3 350	16	25	8	31764	105
Eastern Asia	671	792	987	1 097	1 179	1 259	1 352	1 397	1.0	18	7	11762	119

(TABLE CONTINUED)

South Central Asia	499	621	788	886	990	1 113	1 243	1 325	2.1	31	10	10776	123
South Eastern Asia	182	225	287	324	360	401	442	467	1.8	27	8	4 495	104
Western Asia ³	50	66	86	99	113	131	149	160	2.4	32	7	4 731	34
Europe³	549	605	656	676	693	706	722	726	0.2	12	11	22986	32
Eastern Europe	221	254	276	286	295	303	310	310	-0.1	12	12	18813	16
Northern Europe	78	82	87	89	90	91	92	93	0.3	14	11	1 749	53
Southern Europe	109	118	128	132	138	141	143	144	0.1	11	10	1 316	109
Western Europe	141	152	165	169	170	172	176	179	0.6	12	11	1 107	162
OCEANIA²	12.6	15.7	19.3	21.4	22.7	24.5	26.4	27.7	1.5	19	8	8 537	3
Australia and New Zealand	10.1	12.6	15.4	17.0	17.7	18.9	20.2	21.1	1.4	15	8	7 984	3
Melanesia	2.1	2.6	3.3	3.7	4.2	4.7	5.2	5.6	2.2	32	9	541	10
Micronesia	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	2.3	33	6	3	167
Polynesia	0.2	0.3	0.4	0.4	0.5	0.5	0.5	0.6	1.5	31	6	9	67

General Notes

Unless otherwise specified all figures are estimates of the order of magnitude and are subject to a substantial margin of error.

Footnotes

1. Population per square kilometre of surface area. Figures are merely the quotients of population divided by surface area and are not to be considered as either reflecting density in the urban sense or as indicating the supporting power of a territory's land and resources.
2. Hawaii, a state of the United States of America, is included in Northern America rather than Oceania.
3. The European portion of Turkey is included in Western Asia rather than Europe.

A U S T R A L I A

Australia comprises a land area of 7,682,300 square kilometres. The land lies between latitudes 10°41' south (Cape York) and 43°39' south (South East Cape, Tasmania) and between longitudes 113°09' east (Steep Point) and 153°39' east (Cape Byron).

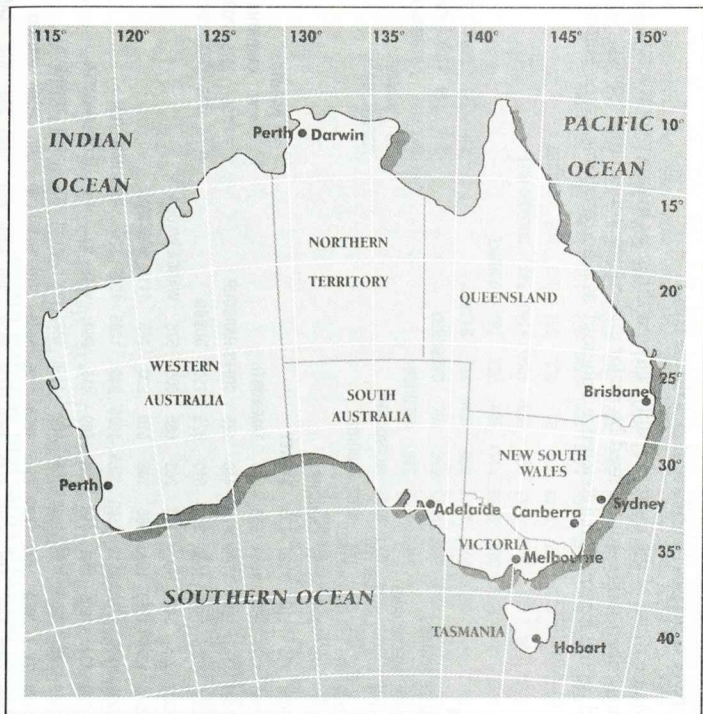
The area of Australia is almost as great as that of the United States of America (excluding Alaska), about 50 per cent greater than Europe (excluding former USSR) and 32 times greater than the United Kingdom.

Australia is composed of six states – New South Wales, Victoria, Queensland, Western Australia, South Australia, Tasmania and two Territories: Northern Territory and Australian Capital Territory.

The longest river in Australia is the Murray River, 2,520 kilometres, which forms a natural border between the States of New South Wales and Victoria. The highest mountain in Australia is Mount Kosciusko, 2,230 metres, which is situated in New South Wales.

State/ Territory	Area 000km ²	Length of Coastline Km	Estimated resident population June '93 '000	Capital City	Estimated resident population of city June '93 '000
NSW	802	1 900	5 998	Sydney	3 714
Vic.	228	1 800	4 465	Melbourne	3 189
Qld.	1 727	7 400	3 116	Brisbane	1 422
SA	984	3 700	1 463	Adelaide	1 071
WA	2 526	12 500	1 676	Perth	1 221
Tas.	68	3 200	471	Hobart	193
NT	1 346	6 200	169	Darwin	78
ACT	(a)2	(b)35	(b)299	Canberra	(b)299
Aust.	7 682	36 735	(b)17 657	Canberra	(b)11187

Note: (a) Excludes Jervis Bay Territory. (b) Includes Jervis Bay Territory.
Information courtesy Australian Bureau of Statistics



Distances between airports (nearest 5 kilometres)

Distances shown are those of the most probably selected direct or indirect commercial flights following the prescribed airline routes used by major and commuter airlines. Source: 'Great Circle Distances based on the International Reference Spheroid' as made available to the editor by Ansett Airlines of Australia.

PERTH																
2120	ADELAIDE	2120	DARWIN	2885	2610	1300	ALICE SPRINGS	2705	645	3255	1955	MELBOURNE	3175	1055	3665	2370
3435	1315	1300	ALICE SPRINGS	2705	645	3255	1955	MELBOURNE	3175	1055	3665	2370	475	LAUNCESTON	3320	1260
2705	645	3255	1955	MELBOURNE	3175	1055	3665	2370	475	LAUNCESTON	3320	1260	3870	2570	615	145
3175	1055	3665	2370	475	LAUNCESTON	3320	1260	3870	2570	615	145	HOBART	3090	970	3585	2285
3320	1260	3870	2570	615	145	HOBART	3090	970	3585	2285	470	945	1085	CANBERRA	3285	1165
3090	970	3585	2285	470	945	1085	CANBERRA	3285	1165	3220	2020	705	1180	1320	235	SYDNEY
3285	1165	3220	2020	705	1180	1320	235	SYDNEY	3600	1485	3540	2340	1025	1500	1640	555
3600	1485	3540	2340	1025	1500	1640	555	320	TAMWORTH	3725	1605	3660	2460	1145	1620	1765
3725	1605	3660	2460	1145	1620	1765	675	440	185	COFFS HARBOUR	3595	1475	3530	2330	1015	1490
3595	1475	3530	2330	1015	1490	1630	545	310	625	750	DUBBO	3070	1005	3620	2320	365
3070	1005	3620	2320	365	840	980	160	365	685	805	675	WAGGA WAGGA	4030	1910	2850	2245
4030	1910	2850	2245	1375	1850	1990	980	745	510	320	765	1110	BRISBANE	4550	2430	3370
4550	2430	3370	2335	1895	2370	2510	1500	1265	1025	840	1285	1630	520	ROCKHAMPTON	3960	1845
3960	1845	2940	2700	1330	1805	1945	915	680	600	415	860	1045	90	610	COOLANGATTA	4970
4970	2850	2020	1450	2485	2960	3100	1920	1685	1620	1435	1880	2050	1110	600	1205	TOWNSVILLE
4825	2710	2350	1780	2170	2650	2790	1780	1545	1305	1120	1565	1910	800	280	890	320
5420	330	1680	1455	2765	3240	3380	2370	2135	1900	1715	2155	2500	1390	880	1480	285
																615
																CAIRNS

Distances shown are by the shortest practical route between centres but do not necessarily represent distances by normally recommended roads. Main sealed roads formed the basis for most calculations. Information courtesy of NRMA.

[illegible]

GLOSSARY OF TERMS - PART I

METALLURGICAL TERMS

AGEING - Changes in the properties of steel occurring with the passage of time affecting the mechanical properties of a metal or alloy. Usually accelerated by an increase in temperature, and so may be natural or artificial.

ABRASION RESISTANCE - Resistance to frictional rubbing, as distinct from resistance to knocks and impacts.

ACCELERATED WEATHERING - Laboratory tests designed to simulate, but at the same time intensify and accelerate, the destructive action of natural weathering.

ANNEALING - A process involving heating and cooling, applied usually to induce softening. The term annealing is also used to cover treatments to:-

- Remove stresses,
- Alter mechanical or physical properties,
- Produce a definite microstructure, and
- Remove dissolved gases.

BACKING COAT - See "wash coat".

BEND TEST - A test of ductility where (at ordinary temperature), a test piece must withstand, without fracture, bending through a specified angle around a specified diameter, eg:

- 0t - flat bend on itself
- 1t - bend around thickness of sheet.

BRAZING - Joining metals by fusion of a non-ferrous filler metal with a melting point above approximately 450 degrees Celsius, but lower than those of the metals being joined. The filler metal flows by capillary action between the surfaces to be joined.

BRONZE WELDING - Similar to brazing but the joint is characterised by a substantial external fillet of filler metal.

CAMBER - The deviation of a side edge of metal sheet or strip from a straight line. The measurement is taken on the concave side using a straight edge.

CARBON STEEL - A steel, free from intentionally added alloying elements, depending for its properties substantially upon its carbon content alone. Manganese up to 1% is not regarded as removing the steel from this designation.

CENTRE BUCKLE - (full centre) An out-of-flat condition caused by selective elongation of part of the strip width so that the centre of the sheet is longer than the edges.

CHALKING - A chalk-line formation on the surface of an organic coating caused by the breakdown of the surface layer of resin, releasing pigment particles and fillers normally bound by the resin. This normally occurs after long term exposure to sunlight.

CHATTER - A transverse series of marks or lines in either the metal surface of the paint film caused by vibration or eccentric rolls in processing equipment.

COATING CLASS - Coating Class is designated by the specified coating type and the minimum mass of coating on both sides of the sheet measured by the triple spot test as detailed in Australia Standard 1397, eg AZ150, aluminium/zinc coating with a minimum coating of 150 g/m².

COATING MASS - The ability of a metallic-coated sheet and strip product to withstand corrosion in a particular environment is a function of the amount (and type) of coating on the surface of the steel base. This is quantified as the "coating mass" and is the mass of coating on both sides of the steel base expressed in grams per square metre (g/m²).

COIL - A rolled up length of strip. This word was previously used to describe strip itself.

COIL SET - A tendency of a length of strip to maintain the curved shape of the coil from which it was cut.

COLD ROLLING - Is the reduction of hot-rolled pickled steel strip to a specified thickness, using a series of stands of rolls reducing the thickness progressively. This distorts the grain structure of the steel significantly and therefore a loss of ductility results.

CONVERSION COATING - A chemical treatment which, by reaction with the surface of the strip, converts it to a non-metallic and non-conductive surface for improved paint adhesion and corrosion resistance. See also "chromating" and "phosphating".

CORROSION - Destruction of a metal by electro-chemical reaction with its environment.

CUPPING TEST - A test of the ductility of metal sheet or strip obtained by measuring the depth of bulge which can be formed before fracture.

DECARBURIZATION - In steel, partial or complete loss of carbon by chemical reaction.

DEEP DRAWING - Forming cup-shaped articles, shells or deeply recessed parts by using a punch to force sheet metal into or through a die.

DRY FILM THICKNESS - The thickness of the dried paint film on the surface of primer under the top coat. It is measured in micrometers (um).

DUCTILITY - Relative ability of a metal to deform from a flat condition into a more complex shape without fracture, formability, workability.

ELASTICITY - That property of a material which causes it to resume its original form after removal of a load.

ELASTIC LIMIT - The maximum stress to which a material may be subjected without any permanent strain remaining upon complete release of stress.

ELONGATION - In tensile testing, the increase in the gauge length measured after fracture of the test specimen within the gauge length, usually expressed as a percentage of the original gauge length.

FABRICATING PERFORMANCE - Is the end-use performance of a BHP product for application requiring bending, drawing, pressing, welding or painting. Note the numbering system is arbitrary and only compares BHP products against each other.

FATIGUE - A condition in metals resulting from fluctuating stresses, leading to failure at a stress substantially below the normal tensile strength of the material. Fatigue failures invariably manifest themselves in the progressive development of a crack, generally undetected until after complete failure has taken place, since they occur without prior visible strain. Fatigue cracks commonly originate at some point of local and predominantly tensile stress concentration, either at the surface (sharp re-entrant corners, tool marks, scratches, etc) or in the interior (flakes, forging bursts, or inclusions) of the stressed component.

Where cracks develop under the combined effect of fluctuating stress and corrosive environment, the subsequent failure is termed corrosion fatigue.

FINISH - Finish refers to the degree of smoothness of lustre of the sheet.

FLATNESS - Flatness of sheet metal may be best defined as the absence of any waviness or buckles. The out-of-flatness of a sheet is the measured height of the buckles from a flat surface on which the sheet is lying.

FLUTING - The tendency to form a series of near parallel kinks or creases in sheet metal during curving or bending. The creases occur at right angles to the direction of curving and are associated with non-uniform yielding of metal causing localised deformation.

FORMABILITY - The relative ease with which a metal can be shaped through plastic deformation.

FREQUENCY - The number of complete cycles of current per second taken by alternating current.

GALVANIZING - The process of applying a coating of zinc to a surface of iron or steel to provide a corrosion resistant surface.

Zinc coating may be applied by hot-dipped or electroplating. Solid state diffusion (sherardizing) or spraying are not usually termed galvanizing.

From hot-dip galvanizing there developed a process for producing a zinc/aluminium alloy-coated steel. This process is used to produce ZINCALUME steel.

GLOSS - The degree to which a painted surface possesses the property of reflecting light in a mirror-like (specular) manner. COLORBOND steel surfaces are produced in 10%, 25% and 80% gloss. Building materials are all 25% gloss (semi-gloss).

GRADE-OF:-

- Of BHP steel from which steel products are produced.
- Of product within the BHP product range to distinguish base types, eg. Hot-Rolled "Formable Grade".

HARDNESS - The resistance offered by a metallic material to plastic deformation by indentation or penetration. The above defines hardness as it is commonly measured in metals. Quantitatively it has no absolute significance, but serves for purposes of comparison between materials of similar type (in particular, of similar elastic properties). It is more specifically referred to as indentation hardness or penetration hardness.

HEAT TREATMENT - An operation or combination of operations involving the heating or cooling of a metal or alloy in the solid state for the purpose of obtaining

certain desired conditions or properties.

Heating for the sole purpose of hot working is excluded from the meaning of this definition.

HYDROGEN EMBRITTLEMENT - Brittleness induced in steel due to absorption of hydrogen. This commonly occurs in pickling and electroplating operations. In the heat affected zones of welds, it can lead to cracking. Hydrogen embrittlement is particularly detrimental in steels of high hardness, and may be removed by annealing in the range 200 to 750 degrees Celsius.

HUNTERLAB - Is a colour difference meter which gives an accurate numerical measurement of colour differences between the painted steel sheet under test and an approved colour standard. The meter measures colour as seen in normal daylight similar to how the human eye responds to colour. The units are AE.

INDUCED CURRENT - The electric current produced by moving a conductor in a magnetic field.

KILLED STEEL - A steel with deoxidants such as aluminium or silicon added before casting molten steel to remove oxygen and so prevent evolution of carbon monoxide and chemical segregation during cooling.

LOCK-FORMING - The forming of two adjacent edges prior to interlocking.

LOCK-SEAMING - The closing of a tight seam of lock-formed edges of sheet metal, for example Pittsburgh lock-seam, grooved single lock-seam, Snap Lockseam.

LUSTRE - Lustre finish is a smooth finish for electroplating achieved by using specially prepared rolls. Some surface preparation by the plater may be necessary.

MATT - Cold-rolled products are available with either matt or lustre finish. The matt finish is produced by rolling with mechanically roughened rolls. This finish is preferred for lacquer or paint finishes and is beneficial during drawing operations when used with a lubricant. This finish can be assumed when no surface is specified.

MECHANICAL PROPERTIES - Properties relating to the behaviour of materials under load in conventional mechanical tests, such as elastic moduli, tensile strength, elongation, hardness.

MINIMISED SPANGLE - The formation of normal zinc spangle is inhibited in cooling or by bath control. Skin-passing metallic-coated steel sheet and strip will smooth the surface, and is often done in conjunction with minimised spangle treatment.

NORMALIZING - Heating steel to, and if necessary holding at, a suitable temperature above the transformation range, followed by cooling in a still atmosphere to ambient temperature, in order to produce a medium-to-fine pearlite microstructure.

The effect of normalizing is generally to refine the grain size, render the structure more uniform, and improve the mechanical properties.

PASSIVATION - A surface treatment to give greater resistance to storage corrosion in which the protection is afforded by conversion coatings and films.

PHOSPHATING - Phosphating treatments produce adherent non-metallic conversion coatings which convert the galvanized surface to an insoluble complex, thick enough

to provide good adhesion for subsequent paint films.

PICKLING - Removal of oxide films from metal by immersion in an acid. The process is applied particularly to scale removal from metal prior to operations such as cold rolling, wire drawing and electroplating, and in general is carried out in dilute solutions of the mineral acids, often with additions of organic material (inhibitors) to restrain the rate of attack on the metal. Absorption of hydrogen may occur in pickling of steel causing embrittlement of hard steels, and necessitating low temperature annealing for its removal.

PRESSING - Is a metal working process in which a flat blank, constrained between two surfaces, is forced by a punch to take a required shape.

PRIMER - The first coat of a painting system applied to an unpainted surface. It normally has very good adhesion and corrosion inhibitive properties.

PROOF STRESS - That stress at which a material exhibits a specific limiting permanent set. The proof stress of a material is found by observing, usually from a stress-strain diagram, the stress at which the predetermined permissible elongation (usually of the order of 0.1% or 0.2%) occurs.

RECRYSTALLATION - The reformation to "round" ferrite grains flattened during rolling. This occurs at temperatures above 725°C, either immediately after hot rolling or during annealing after cold reduction.

RESQUARED - This term describes a sheet which has been sheared to accurate dimensional limits as a last operation in its production. The name is derived from early guillotining operations necessary to achieve the required tolerance.

ROLLING DIRECTION - The main direction in which strip has been rolled.

Associated terms used are:-

- Longitudinal - in the rolling direction
- Transverse - right angles to the rolling direction

ROLL-FORMING - Process by which metal is unwound from coiled strip and passed through a number of pairs of metal profile rolls.

Each roll pair is designed to progressively develop a profile by predetermined increments

SCALE - Layers of iron oxide formed on the surface of hot steel when oxygen in the air combines with iron from the steel.

SHEET - A flat rolled BHP product of any width and thickness cut into lengths and stored in a flat condition. Previously the official designation was "cut lengths". Note - this is not to be confused with plate.

SKIN-PASSING - A light cold rolling operation (about 1-2 per cent of cold work) which removes the yield point in steel which otherwise causes coil break, fluting or stretcher strain in subsequent operations. It can also be used to:-

- Modify surface, for example, by reducing surface roughness for bright (lustre) qualities or by specially controlled roughening for matt finish for drawing qualities, and
- Flatten strip being rolled.

SOLDERING - Joining of metals by fusion with alloys that have relatively low melting points, most commonly lead and/or tin base alloys, which are known as soft solders.

Joining with higher melting point alloys, sometimes termed hard solders at temperatures over 450 degrees Celsius, is generally termed brazing.

SPANGLE - Grain or crystal of zinc, or zinc/aluminium as appearing on hot-dip metallic coated steel.

STRAIN AGEING - Ageing which occurs subsequently to the cold working of an alloy. Strain ageing in steel predominantly due to uncombined nitrogen, and results in a marked decrease in ductility.

STRESS RELIEVING - Heating a metal to, and if necessary holding at some temperature generally below the recrystallization range, followed by uniform cooling, for the sole purpose of removing internal stresses.

STRETCHER STRAIN MARKINGS - Characteristic surface markings, usually of a parallel sided diagonal pattern, which appear during the early stages of the plastic deformation of mild steel and certain copper-base alloys. Their production is associated with sudden extension at the yield point. In steel, they are alternatively called Luders Lines.

STRETCHER LEVELLED - Stretcher levelled, as applied to sheets, indicates a standard of flatness. The term originated from an early method of obtaining flatness. This was by gripping the ends of the sheet and stretching it to remove surface waves and buckles.

STRIP - A continuously rolled flat product of any width and thickness, supplied rolled up into and stored in coil form. Previously, the official designation was "coil" used for both the strip and the rolled-up product.

TEMPER - To modify hardness of metals.

- Adjustment of hardness of heat treated articles by controlled heating after quenching.
- Increase of hardness by cold rolling. The degree of cold rolling is variable depending on the required hardness and is more than that of skin-passing.

TEMPER ROLLING - Is a cold-rolling operation which adjusts the metallurgical properties of cold rolled strip and at the same time enhances surface texture and flatness.

TENSILE STRENGTH OR ULTIMATE TENSILE STRENGTH - If a prepared sample of steel is strained in a tensile testing machine until it breaks, then the ultimate tensile strength of the material is obtained by dividing the maximum observed load by the original cross-sectional area of the sample.

TENSILE TEST - A standard sample of material is placed between two jaws and drawn apart in a tensile testing machine until fracture.

TERNE - Refer Metallic coated.

VITREOUS ENAMELLING - Refer Cold-Rolled General Information page.

WASH COAT - The coating applied to the back or unexposed side of the painted strip. There are standard wash coat colours for COLORBOND steel products.

YIELD POINT - The stress at which a material permanently deforms.

YIELD STRENGTH - Strength at which steel first exhibits plastic strain.

GLOSSARY OF TERMS - PART 2

BUILDING & ENGINEERING TERMS

ACCESSORIES - Gutters, ridge capping, ventilators, flashings, downpipes, brackets and their fixings.

ANGLE BRACE - A brace that goes from corner to corner in framing. A tie to strengthen the angles of framing.

APRON FLASHING - Sheet used to prevent water from percolating through where a vertical surface pierces a roof.

AS - Australian Standard published by Standards Australia.

ASTRAGAL - A small moulding with a semi-circular section projecting above the surface, similar to a bead but raised above the surface. A metal strap used to fasten downpipes to walls.

BACKING - The dihedral angle of a hip. Shaping the top of a hip to conform to the roof planes.

BALUSTRADE - A series of balusters in the one flight or along a landing.

BARGE BOARD, VERGE OR GABLE BOARDS - The inclined timbers on the gable ends which are fixed to the rafters and cover the ends of the roof timbers.

BARGE CAPPING - A protective timber or metal capping for a bargeboard.

BARGE FLASHING - A flashing used between a bargeboard or barge capping and the roofing material to prevent the ingress of moisture.

BASE METAL THICKNESS - (B.M.T.) The metal thickness before any subsequent coating.

BT - Boundary trap.

BATTENS - Narrow pieces fixed to walls to receive sheeting or on roofs to receive tiles, slates, etc.

BEARERS - Members supporting the joists in steel, timber framed or brick dwellings.

BEARING - That part of the beam resting on the supports.

BEARING PLATE - A stone or metal plate carrying the weight of a beam, etc.

BELL ROOF - A roof shaped like a bell by fixing false feet to the foot of the rafters.

BOX GUTTER - A gutter formed in the shape of a trough. It is formed between a roof surface and a parapet wall or between two roof surfaces.

BRACKET - The ornamental return piece fixed to the face of the string in a stair. A right angle support with angle brace; usually used to support a shelf, etc.

BRIDGING - The use of stiffening members between deep floor joists and purlins to limit lateral deflection.

BRICK VENEER - A brick facing applied to the outside of a timber structure.

BUILDING PAPER - A waterproof paper used in construction work for insulation or

as an undercover for roofs as a protection against weather.

BUILD-UP RIB - A rib or member that is built up of several thicknesses, usually in brick bond.

BULLNOSE - The edge of a piece of timber, shaped to a quarter circle. A small metal plane with its cutter close to the fore end, used for cleaning up rebates.

CAMBER - To fix a horizontal structural member with a rise at its centre to counteract sagging.

CANT - To incline on an angle other than a right angel.

CANTILEVER - Beams that are supported at one end only as for a shop awning.

CAPILLARY WATER - Water drawn upwards into soil pores and held by surface tension.

CAT LADDER - A ladder fixed vertically to a wall.

CEILING BATTEN - A light timber or steel member fixed to ceiling joists to which the ceiling lining is then fixed.

CEILING JOIST - Light member across a room to carry the ceiling sheeting.

CELLAR - An underground room in a basement used for storage.

CHALK LINE - A long line or string used for setting out long straight lines. When coated with chalk, the ends are held taut, while the centre is lifted away from the surface and allowed to spring back, thus leaving a chalked line on the surface.

CHAMFER - A 45 degree bevel cut on the arris of timber, sometimes stopped before reaching the end of the timber. When the amount removed is unequal on each face it is called a splay or bevel.

CHORD - The horizontal member in a bowstring truss. A straight line drawn across a circle with each end touching the circumference.

CLADDING - The outer non-loadbearing covering of the external walls of a framed building or structure, applied for weatherproofing and sometimes decorative purposes. Also called 'External cladding' or 'wall cladding'.

CLEAR SPAN - The clear horizontal distance or space between faces of the supports of an arch, beam, truss or roof structure. It is always less than the effective span.

COMPOSITE - A type of construction made up of different materials or of different members in conjunction to improve strength or resistance to stresses.

COMPUTER-AIDED DESIGN (CAD) - The application of computer technology to the design of products, including buildings and structures, using interactive programs.

CONCEALED GUTTER - A gutter which is hidden from view except from above. Also called 'hidden gutter' or 'Secret gutter'.

CONDENSATION GROOVE - A groove formed for the purpose of collecting condensation on the inside of sashes to allow the moisture to escape to the outside, as in the bottom rail of a skylight.

CORNICE - The mould at the junction between the wall and the ceiling.

CORRUGATED - Sheet shaped into a sinusoidal, or circular curve.

COVER - The width of the profile less the lap.

CRAMPING-UP - The act of tightening up the joints in framing by means of cramps.

CREEP - Increasing deformation under constant load.

CREST - The top surface of a rib.

DAR - Dressed all round.

DECK - Predominantly flat profile roofing or cladding, also referred to as tray.

DEFORMED SHANK NAIL - Includes nails with annular, spiral or otherwise deformed shanks.

DE-INDEXING - The releasing of interlocking profiled sheets.

DISTRIBUTED LOAD - A design load, not necessarily uniform, which is spread over an area of surface, expressed in kilograms per square metre (kg/m^2); or along a length of a structural member, expressed in kilograms per metre run (kg/m). See also: Uniformly distributed load.

DOMe - A curved roof, semi-circular in elevation over a square, hexagonal, octagonal, or other shaped plan.

DORMER - A window projecting from a roof surface.

DOWNPIPE (DP) - A metal or plastic pipe for conveying rainwater, either externally or internally, from a roof or gutter to a stormwater drain, sump, tank, ground level, or another part of a building. Downpipes are manufactured in 'rectangular' or 'round' cross-sections and are usually installed externally, but sometimes internally or in concealed positions. Also called 'Downspout' or 'Rainwater pipe'.

DOWNTURN - That part of the trough of a sheet turned down into a gutter.

DUTCH GABLE - A roof frame type that is partially hipped but which terminates as a gable.

EAVES - The lower edge of a roof slope.

EAVES GUTTER - An external gutter at the lower edge of a roof - also known as spouting.

ELASTIC LIMIT - The stage at which a noticeable permanent set occurs when the material is loaded.

ELEVATION - The part of a drawing which shows the front view giving length and height.

END LAP - In roofing, the distance by which the upper sheet, tile or other unit of roofing overlaps the top end of the one immediately below it to provide weatherproofing. See also: side lap.

END SPAN - A span which is part of a continuous roof, beam or slab only at its interior support. Therefore, an end span is often shorter and more heavily reinforced than interior spans.

FACTOR OF SAFETY - An arranged increase in size or strength of the member above that at which it is known to fail.

FALL - The slope (pitch) of a flat or low slope surface, such as a roof, gutter, or paving.

FASCIA - The upright board fixed to the feet of the rafters to carry the guttering. Any wide board fixed on edge. (Timber or steel)

FASTENER - A nail, screw or rivet used to fasten metal roofing or cladding to the structure.

FIBRE CEMENT - A building board composed of cellulose fibres and cement.

FIXING - The device used to fix or clip metal roof flashings.

FLASHINGS - Galvanized steel, lead, zinc sheet, etc. used to prevent water seeping through to an interior surface. Lead, however, should not be used with ZINCALUME steel sheet.

FOOTING - The lowest part of a building, an enlargement at the base of a wall to distribute the load over a greater area.

FOUNDATION - The soil or strata which supports the lowest part of a building - ie. the footings.

GABLE - The triangular end of a building above the plate line with the rafters meeting the apex at the ridge.

GABLE ROOF - A roof having two slopes only with a gable at each end.

GALVANIZING - The process in which steel is coated to prevent corrosion by dipping it into a molten zinc bath.

GCI - Galvanized corrugated iron, the old term for zinc-coated corrugated steel sheet and now usually but inaccurately used for corrugated ZINCALUME zinc/aluminium alloy-coated steel.

GIRT - Horizontal members in a wall used to support wall sheeting.

GRADE - The mechanical strength of a metal expressed in yield strength and measured in MPa.

GUTTER - The spouting, or valley gutter, a channel formed to collect and carry away rain water off a roof.

GYPSUM BOARD - A wallboard made from plaster of paris and covered with a stiff paper.

HAMMER BEAM - The lower cantilever member in the roof truss of the same name.

HIP - The external angle formed on a roof where two inclined surfaces meet.

HIPPED ROOF - A roof with its ends inclined as well as its sides.

HIP RAFTER - The inclined member at the intersection of two roof surfaces.

JACK RAFTER - The rafters running from a wall plate to the end of a ridge (sometimes called crown end rafters).

JAMBS - The vertical sides of openings or the vertical timbers fixed to the jambs of

JOISTS - A horizontal structural member of timber or steel, spanning a room either to carry the floor or the ceiling.

KING POST - The central vertical member of a roof truss, that from the centre of the tie beam to the apex of the roof.

KNEE - A curve in a handrail, convex on top and shaped in the form of a human knee.

LAP (OVERLAP) - The length by which one material overlaps another for structural or functional purposes. See also: End lap; Side lap.

LEAN-TO OR SKILLION - A roof with only one slope, formerly when used against another building, but now applied to any roof with a single slope.

LEEWARD SIDE - The side facing away from the prevailing wind.

LINTEL - A horizontal member, timber, steel or concrete, across an opening, usually to carry the wall above.

LIMIT STATE:

SERVICEABILITY LIMIT STATE - The condition when a building becomes unfit for its intended use due to deformation or deflection.

ULTIMATE LIMIT STATE - The condition when a building is permanently deformed or becomes unstable.

LIVE LOAD - A moving or variable load on a floor or beam.

LONG-RUN - Roofing and cladding in one length without transverse laps.

MANSARD ROOF - A form of roof having a break in the slope, the lower part being steeper than the upper.

MONOSLOPE ROOF (Monopitch roof) - A planar roof with a constant slope and without ridge. Also called 'Single pitch(ed) roof'. See also: Lean-to roof; Skillion roof.

MULLION - The vertical dividing member in a window or door frame.

NOBLE METAL - A metal that is less active or likely to corrode when compared to others.

NOGGING - Horizontal pieces fixed between studs for bracing and to which plaster sheeting, skirting, etc. can be fixed.

OIL CANNING - Distortion in the form of waviness of centre fullness in a profiled sheet.

PAN - The flat portion between the ribs in a profiled metal sheet.

PARAPET GUTTER - A gutter or water channel formed against a parapet wall at the bottom of a roof slope.

PARTY WALL - A wall between two adjoining properties, built half on one and half on the other; a wall separating one house from another.

PENETRATION - A projection through a roof or wall, eg. vent pipe or air-conditioning unit.

PERMEABLE MEMBRANE - A building paper or other sheet material that allows the passage of water vapour, also known as 'breather type'.

PITCHED ROOF - A common type of roof with two sloping surfaces of more than 10° of angle meeting at a central ridge.

PLASTERBOARD - A wall board made of plaster and covered on both sides with heavy paper.

PLATE - A horizontal member in structural framework, a level piece that carries the vertical pieces.

PLUMB - To make perpendicular; in a perpendicular position.

PORTAL FRAME - A structural frame of steel, reinforced concrete or timber constructed with rigid joints for stability without diagonal bracing. It has either two upright members rigidly connected at the top to a straight, sloping or curved third member, or a pair of rigidly jointed vertical columns and sloping roof members, jointed at the apex.

PONDING - Undrained water retained on a roof surface due to permanent deflection or deformation of a roof.

PRE-PAINTED - Base metal strip or sheet painted on, or laminated with a film, added to give protection or aesthetic appeal prior to subsequent forming or shaping.

PROFILED SHEETING - Metal sheeting produced with corrugations or ribs to increase its strength.

PURLIN - A horizontal member placed at right angles to and spanning across rafters or roof trusses to which the sheet roof covering or cladding is attached.

RAFTERS - The inclined members of a roof between the plate and the ridge which support the roof covering.

RAINWATER HEAD - An external box capable of collecting rainwater from a gutter. (Also called Rain Head)

RAINWATER PIPE (RWP) - See downpipe.

RETURN PERIOD - The average number of years within which a given wind gust or rainfall is expected to be equalled or exceeded.

RIB - A longitudinal upstand produced by roll-forming folding or crimping.

RIDGE (Roof ridge) - The highest part (or apex) of a pitched roof, usually forming a horizontal line. See also: Ridgeboard.

RIDGE CAPPING - A covering over the ridge to provide a continuous cover and effective weather seal between the two slopes. For sheet roofing shaped metal is used.

RISE - The vertical distance through which an element rises, such as the rise of a roof, arch, stair, or step.

ROOF TRUSS - A framed construction in a roof.

SACRIFICIAL PROTECTION - The coupling of two metals so that one is sacrificed by electrolytic corrosion in order to protect the other.

SARKING - A layer of timber boarding, covering the rafters underneath roofing tiles or slates of a pitched roof, to provide a moisture and thermal barrier.

SARKING MEMBRANE - A pliable, water-resistant membrane for use beneath the external roof or wall covering to collect and discharge any water that may penetrate, or water vapour that may form. Now often combined with reflective foil to provide thermal insulation benefits. Commonly abbreviated to 'Sarking'.

SAW TOOTH ROOF - A roof that in profile is the shape of the teeth of a saw. A trussed construction.

SCISSORS TRUSS - A roof truss so named because of its resemblance to a pair of scissors.

SECRET FIXING - The fixing of joinery in such a manner that on completion the method of fixing is not visible on the face.

SIDE LAP - In roofing, the distance by which the upper sheet, tile or other unit of roofing overlaps the side of the one immediately below it to provide weatherproofing.

SKEW - At an angle or out of square.

SKEW NAILING - Nails driven in at an angle to the surface to give greater holding power.

SKILLION ROOF (SKILLION) - A monoslope (single pitched) roof without a ridge or peak, providing the main roof or part of a roof.

SKIRTING - The moulded baseboard around a room.

SPAN - The horizontal distance between two supports as the springing points in an arch.

SPIGOT - The plain or specially formed end of a pipe for insertion into a socket or coupling to form a joint.

SPOUTING - See Guttering.

SPREADER - A piece of perforated horizontal piping connected to the foot of a downpipe from a higher roof to evenly spread rainwater over a lower roof.

STANCHION - A vertical steel or iron support for a beam

TAPER(ED) FLANGE BEAM - A rolled structural I-section with flanges that are tapered and rounded at the ends.

TIE ROD - A structural member in tension, such as a metal rod or bar serving as a tie, often threaded to enable on-site adjustment of tension.

TILE BATTEN (TILING BATTEN) - A light steel or timber member fixed to the tops of rafters or trusses to which the roofing materials may be fastened.

TILTING BATTEN - A batten cut diagonally from a 75mm x 38mm timber and used at the eaves to tilt the bottom cause of tiles so that the ones immediately above will have a firm seating.

TRANSOM - The horizontal dividing member in a window or door frame.

TRUSS - A triangulated frame for carrying a roof over a large span.

TRUSSED BEAM - A beam formed of two timbers with triangulated strutting between, formed to distribute the load.

TUDOR ROOF - A steeply pitched roof with dormers on one or both sides.

UB - Universal beam.

UC - Universal column.

UNIFORMLY DISTRIBUTED LOAD (UDL) - A superimposed design load which is assumed to be distributed evenly over an area of surface or a length of structural member.

VALLEY - The angle formed by two internal slopes of a roof.

VALLEY BOARDS - Boards nailed to the surface of the roof at the internal intersection of two roof surfaces.

VALLEY RAFTER - The inclined member in a roof at the internal intersection of two roof surfaces.

VERGE - The overhanging edge of the roof covering at a gable.

WEB - The vertical portion of a rolled steel section, extruded section, girder or truss which connects the top and bottom flanges or the top and bottom chords. A web may be a solid plate, a perforated plate, or a lattice.

WEB HOLE - Joints in brickwork left free of mortar or a small hole bored through a trench in a window sill to allow the escape of water.

WIND LOAD - The forces on a building or structure due to wind pressure.

ZED-PURLIN - A pressed metal purlin with a cross-section in the shape of the letter Z. Also spelled 'Z-purlin'.

Special Note:

The "Terms" listed are an abridged version of those more commonly used within the steel, building and engineering industry as applied to this booklet. A complete "Glossary of Building Terms" published jointly by Standards Australia and Suppliers Index can be purchased from the Standards Association.

The Editor.

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