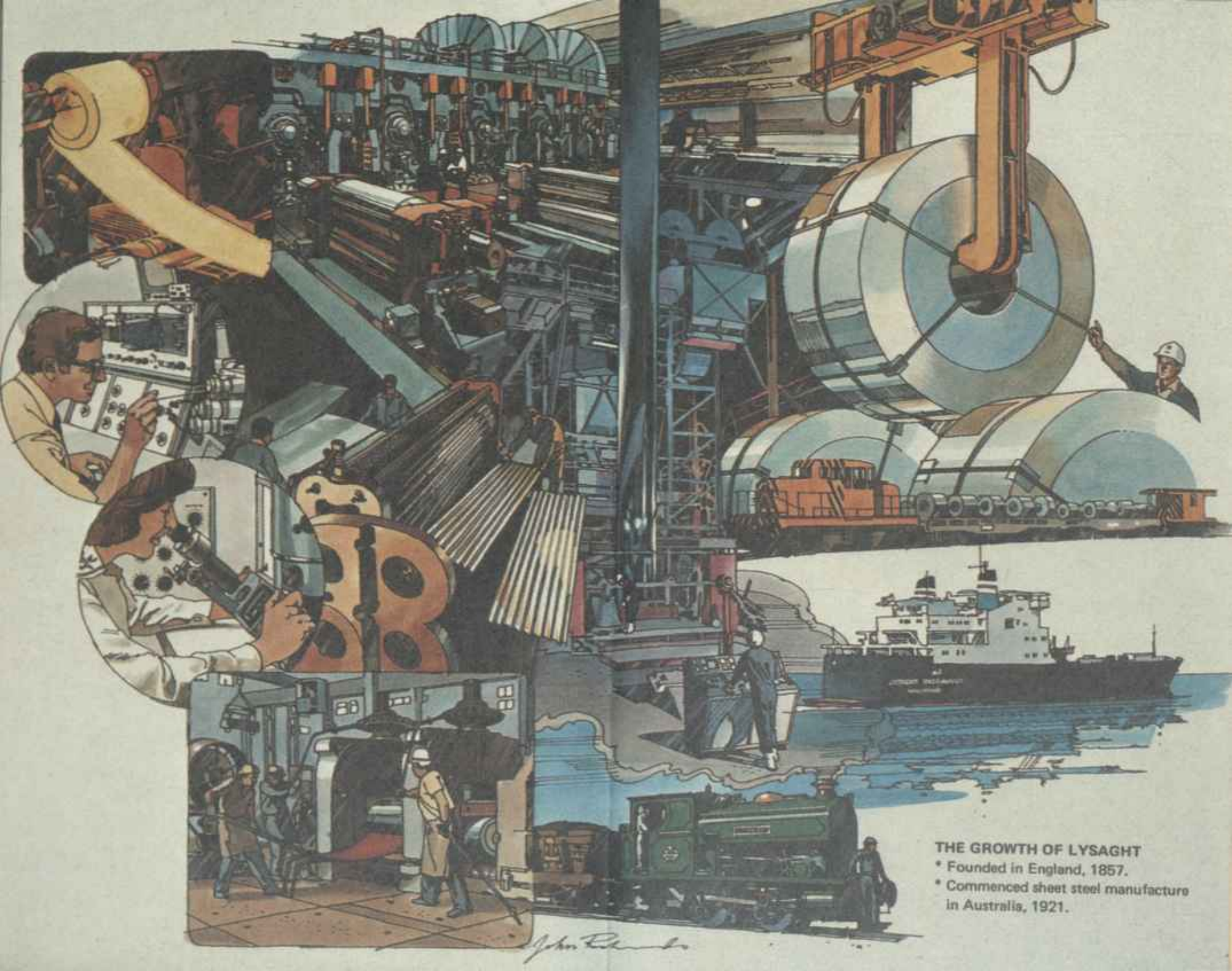
LYSAGHT REFEREE

26th EDITION

A HANDBOOK OF USEFUL INFORMATION



THE GROWTH OF LYSAGHT

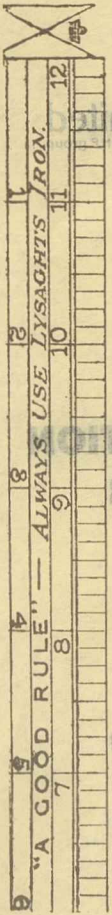
* Founded in England, 1857.
* Commenced sheet steel manufacture in Australia, 1921.

John Lysaght (Australia) Limited

A member of the BHP group

A DIAMOND JUBILEE CELEBRATION SOUVENIR

Selected pages of interest
reproduced from early editions of the
Lysaght Referee
(First Edition published in 1897)



A . . .

SOUVENIR OF THE . . . .

. . . DIAMOND JUBILEE.

The Metal Trades' Referee and Storekeepers' Guide

Being a Table of Weights, Measurements, and Other . . . . Useful Information.

COPYRIGHT.

Troedel & Co. Print.

1837 A Diamond Jubilee 1897

IT may not be generally known that the introduction of GALVANISED IRON—now so important a feature of modern civilization—dates back only to 1837: the present year being in effect its **Diamond Jubilee.**

Earlier in the century various attempts had been made with a view to coating metals—chiefly by a galvanic process—which appear to have met with no commercial success. It is from these earlier methods that the term "Galvanised," as applied to Iron, has come down to the present day.

In 1837, Mr. Henry Crawford, a commander in the R.N., obtained a patent for a method of coating metals with zinc, for preventing oxidation — thus paving the way for the introduction of what is now known as Galvanised Iron.

Amongst the more prominent workers in this field of invention were Messrs. Morewood & Rogers, of Birmingham, by whom various patents were obtained, and at the date of the great Exhibition, 1851, they had so far perfected their methods as to exhibit a Galvanised Plain Sheet, 8ft. x 3ft., for which they received a gold medal. Another firm also exhibited, at the same Exhibition, a more or less crude form of Corrugated Iron, of which no notice appears to have been taken in the awards. Shortly afterwards, Morewood & Rogers introduced a Patent Galvanised Tile, known as "Morewood's Tile," some of which, on older buildings, are extant to the present day.

The application of steam to the process of Corrugating by machinery—for which a patent was taken out in 1854—appears to have given a great stimulus to the trade, rendering possible (owing to the strength

WAGES TABLE

Per Week of Six Days.	IS FOR				
	5 days.	4 days.	3 days.	2 days.	1 day.
1s.	0s. 10d.	0s. 8d.	0s. 6d.	0s. 4d.	0s. 2d.
2	1 8	1 4	1 0	0 8	0 4
3	2 6	2 0	1 6	1 0	0 6
4	3 4	2 8	2 0	1 4	0 8
5	4 2	3 4	2 6	1 8	0 10
6	5 0	4 0	3 0	2 0	1 0
7	5 10	4 8	3 6	2 4	1 2
8	6 8	5 4	4 0	2 8	1 4
9	7 6	6 0	4 6	3 0	1 6
10	8 4	6 8	5 0	3 4	1 8
11	9 2	7 4	5 6	3 8	1 10
12	10 0	8 0	6 0	4 0	2 0
13	10 10	8 8	6 6	4 4	2 2
14	11 8	9 4	7 0	4 8	2 4
15	12 6	10 0	7 6	5 0	2 6
16	13 4	10 8	8 0	5 4	2 8
17	14 2	11 4	8 6	5 8	2 10
18	15 0	12 0	9 0	6 0	3 0
19	15 10	12 8	9 6	6 4	3 2
20	16 8	13 4	10 0	6 8	3 4
30	25 0	20 0	15 0	10 0	5 0
40	33 4	26 8	20 0	13 4	6 8
50	41 8	33 4	25 0	16 8	8 4
60	50 0	40 0	30 0	20 0	10 0
70	58 4	46 8	35 0	23 4	11 8
80	66 8	53 4	40 0	26 8	13 4
90	75 0	60 0	45 0	30 0	15 0
100	83 4	66 8	50 0	33 4	16 8

BICYCLE GEAR TABLES.

26-in. Driving Wheel.

No. Teeth on Crank Wheel	No. of Teeth on Hub 8	9	10
18	58½	52	46 4-5
19	61⅜	54 8-9	49 2-5
20	65	57 7-9	52
21	68¼	60 3-9	54 3-5
22	71½	63 5-9	57 1-5
23	74⅝	66 4-9	59 4-5
24	78	69 3-9	62 2-5
25	81¼	72 2-9	65
26	84½	75 1-9	67 3-5
27	87¾	78	70 1-5
28	91	80 8-9	72 4-5
29	94¼	83	75 2-5
30	97½	86 2-3	78

28-in. Driving Wheel.

No. Teeth on Crank Wheel	No. of Teeth on Hub 7	8	9	10
18	72	63	56	50 2-5
19	76	66½	59 8-9	53 1-5
20	80	70	62	56
21	84	73½	65 3-9	58 1-5
22	88	77	68 4-9	61 3-5
23	92	80½	71 5-9	64 2-5
24	96	84	74 6-9	67 1-5
25	100	87½	77 7-9	70
26	—	91	80 8-9	72 4-5
27	—	94½	84	75 3-5
28	—	98	87 1-9	78 2-5
29	—	101½	90 2-9	81 1-5
30	—	105	93 3-9	84

LYSAGHT'S "ORB" IRON is unrivalled for

Hints for Reckoning.

TO FIND THE SUPERFICIAL MEASUREMENT OF TIMBER.

Multiply the breadth by the thickness in inches, divide by 12, then multiply product by the length.

TO FIND THE VALUE OF A GIVEN WEIGHT AT A GIVEN PRICE PER TON.

EXAMPLE.—

Tons	cwt.	qr.	lbs.	
2	10	1	18	@ £5/10/- per ton.

Reckon the tons as pounds; cwts. as shillings; each qr. 3d. and for every 9 lbs. 1d., equals

£2 10 5 multiplied by the price per ton = 5½ pounds sterling.

£12	12	1
1	5	2½
£13	17	3½ Answer.

TO FIND THE PREMIUM OR DISCOUNT OF ANY SUM.

EXAMPLE:—£24/10/6 @ 3½ %.

Multiply the sum named by double the rate per cent. and point off the product one to the right.

	£24	10	6
double 3½ =			7
£17	1	13	6 Answer 17 1/10th of a shilling say 17/2.

ANOTHER SIMPLE CALCULATION is to divide the discount rate by 5; and multiply the amount to be dealt with by the quotient; then by reading the pounds as shillings, and the shillings in equal proportion, the result will be the amount of discount or premium, as the case may require.

EXAMPLE:—£9 10 0 @ 40 %.

Divide 40 by 5 leaves 8; multiply

	£9	10	0
by			8
£76	0	0	Answer 76 shillings.

IN issuing this 10th Edition of the "Metal Trades' Referee", John Lysaght, Limited, wish to express the extreme regret they feel, that their friends, the distributors and users of galvanized iron throughout Australia, should have been put to serious inconvenience owing to the scarcity of supplies.

It need hardly be stated that this scarcity is entirely due to the War. Steel is now so urgently required in England for munition and other military and naval purposes, that its export has been prohibited except under very exceptional circumstances.

The different works of John Lysaght, Limited, have, in common with all the other steel works in England, been for some time controlled by the Ministry of Munitions, and the large quantity of steel turned out by them, which was previously rolled into sheets and exported to Australia and other parts of the world, is now being supplied to the Government for the manufacture of shells and ship plates, and for the many other purposes for which steel is required in connection with the War.

John Lysaght, Limited, take this opportunity of assuring all those interested, that the moment the War is over and they are again in a position to control their output, the needs of Australia will receive their first and most earnest consideration, and no efforts on their part will be spared to relieve, with all possible speed, the present unsatisfactory position.

Lysaght's Trade Marks

"ORB" Galvanized

Corrugated Iron is favorably known and used throughout the world. Its uniformly reliable character is recognised by consumers everywhere. There are many imitations, but to those who compare its covering capacity with other nominally cheaper brands, its superiority in all respects is at once apparent.

"REDCLIFFE"

Corrugated Iron—A brand of well-established repute and in large demand, occupying a premier position in those markets in which price is a primary consideration.

"WEIGHT BEARING"

Iron. Lysaght's "**ORB**" brand used for building purposes, maintains the maker's reputation, and may be specified by Architects and Engineers in the full confidence that it will justify their preference for British Manufactur s.

Lysaght's Trade Marks

"ORB" Tenax Flat Sheet

Iron, for working up, is of the finest possible quality, suitable for special high-class work, and is, in many instances used as a substitute for copper.

"QUEEN'S HEAD"

Galvanized Tinned Special Flat Sheets.

This brand will stand the severest tests, and commands the confidence of iron-workers everywhere.

"QUEEN'S HEAD"

"BLACK SHEETS"

of the same brand are extensively used by manufacturers of ventilating and other Pipes, Trunks, Stoves, Fender Bottoms, Ovens, Stamping, Perforating, &c., and the many other purposes where a reliable quality is necessary.

"FLEUR-DE-LIS"

Galvanized Tinned Flat Sheets enter largely into consumption in the lighter gauges, for that class of work in which a somewhat cheaper sheet is asked for. It will be found equal to all such requirements.

"FLEUR-DE-LIS"

LYSAGHT'S AUSTRALIAN WORKS

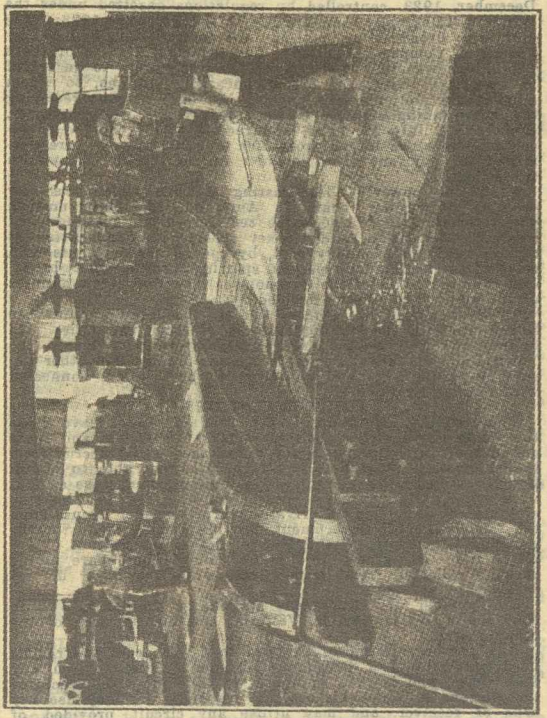
NEWCASTLE, N.S.W.

A NEW era in the history of LYSAGHT'S GALVANIZED IRON has now been entered upon.

Operations on an extensive scale have been commenced at Lysaght's Newcastle Works, and the sheets produced, both Black and Galvanized, have already won the highest approval of discriminating judges.

Illustrations in this edition will give some idea of the modern methods and machinery that are employed, and permission to inspect the works will be granted to approved applicants, if made to the Head Office, 8 Spring Street, Sydney.

Lysaght's Newcastle Works.



"SHEET SHEARING"

(with view of Rolling Mills in background.)

A skilled operator by means of this machine will trim sheets to required size with a remarkable degree of exactness.

BROADCASTING.

AUSTRALIAN WIRELESS REGULATIONS.

Wireless Broadcasting commenced officially in Australia in December, 1923, controlled by regulations gazetted under the Wireless Telegraphy Act, 1905-1919, on July 25, 1923. The first big broadcasting station was erected at Sydney by Farmer & Company, Limited. The principal feature of those regulations was that wireless receiving sets were to be sealed to the wave lengths of the broadcasting stations, to whom annual subscriptions were payable by those persons receiving the broadcasting services. These regulations were, however, amended on July 17, 1924, and receiving sets capable of receiving any wave length from 200 to 2,000 metres were permitted on payment of a common fee to the Commonwealth Government.

From the powerful broadcasting stations which are now working at regular hours in Australia, high-class musical entertainments, news and cable services, stock exchange and weather information, and market reports are transmitted at certain hours of each day, and, by special arrangements with some of the leading newspapers, sporting information is broadcast over the whole of the Commonwealth within a few minutes of the main events being decided.

In Sydney and Melbourne, two of the large stations are linked up with the leading theatres of those two cities. In Sydney the New South Wales Conservatorium of Music, the Town Hall, the Royal Society's Lecture Rooms and other important public halls and churches in the city are connected with Farmer's service.

THE REGULATIONS.

The wireless regulations issued in July, 1924, have made the whole broadcasting position remarkably simple, and those desirous of participating in the advantages which accrue from the supporting of such a movement are now able to obtain licenses and pay the necessary fees with the same ease as that with which they purchase postal notes. The broadcasting stations are conducted by private enterprise under license from the Commonwealth Government, provision being made for the granting of licenses enabling two classes of stations, "A" grade and "B" grade, to operate. The former share in the revenue collected from license fees, while the latter do not receive any revenue.

The number of "A" grade stations is limited to two in New South Wales, two in Victoria, and one in each of the other States.

Any person wishing to listen-in to a broadcast programme need only obtain a Broadcast Listener's License from any Post Office, and is then at liberty to tune in to the whole of the stations to which his set will respond. He may use any type of receiver, and may utilise any circuit, provided, of course, that, by mishandling a receiver, he does not cause a disturbance in the ether surrounding his station, and so interfere with others who may be listening in.

The fees payable for licenses vary according to the district in which the prospective listener resides.

BURNS.—Place the part in a natural position, and apply cloths soaked in oil.

COLIC AND DIARRHOEA.—Give 20 drops of chlorodyne in a little brandy and water.

DYSENTERY.—A small teaspoonful of Ipecacuanha, and a powder every two hours.

DELIRIUM TREMENS.—Act on the bowels, beef-tea every half-hour, 20 grains of chloral in water as a sleeping draught.

DROWNING—Also for **Mild Asphyxiation, Electric Shock, etc.** (Supplied by the Royal Life-Saving Society, N.S.W. Head Centre).—SEND FOR MEDICAL ASSISTANCE, IF POSSIBLE. Place the patient face downward, with left side of the face resting on the ground or floor. If no blanket or mat available, put a piece of paper under the face near mouth and nose. Examine the mouth for, and remove any foreign substance. Extend the arms sideways and upwards. Kneel beside and close to the thighs, place the hands just above the small of the back, little finger on lowest rib, others spread out, thumbs an inch apart parallel to one another and pointing to the head. Carry the body steadily forward until its weight is on both hands, thus compressing the patient's body towards the floor, then carry the body back again, releasing the pressure, but not removing the hands. Continue the movement fifteen times to the minute, or once every four seconds for an hour or two, or until the patient starts to breathe. Then remove any wet clothing, cover with blankets and apply warmth by rubbing the body and insides of limbs, always towards the heart. Place hot-water bottles or bricks to soles of feet, inside thighs or armpits. Watch carefully for any cessation of breathing, and if such occur proceed as before.

EMETICS.—Substances which cause vomiting. A tablespoonful of salt, or mustard and water; an ounce of Ipecacuanha wine; 15 grains of sulphate of zinc in water.

FAINTING.—From loss of blood, weakness, or shock. Keep the body in the lying position, undo the dress, give plenty of air, sprinkle the face and chest with cold water; smelling salts to nostrils.

FITS.—Loosen the clothing about the neck; fresh air, and prevent patient from injuring himself.

MENINGITIS.—Violent headache, unusual irritability or drowsiness, frequent vomiting, tendency to curl up in bed on side, resisting interference, feverish tendencies. Keep in dark room until doctor comes.

POISONS.—1. Give an emetic in the case of poisons which do not stain the mouth, such as Arsenic, Phosphorus, Strychnine, Prussic Acid, Belladonna, and also in the case of Ptomaine Poisoning, Alcoholic Poisoning, Opium, Morphia, Laudanum, Paregoric, Chlorodyne, Syrup of Poppies, etc. (See Emetics above.)

The Evolution of Galvanized Iron

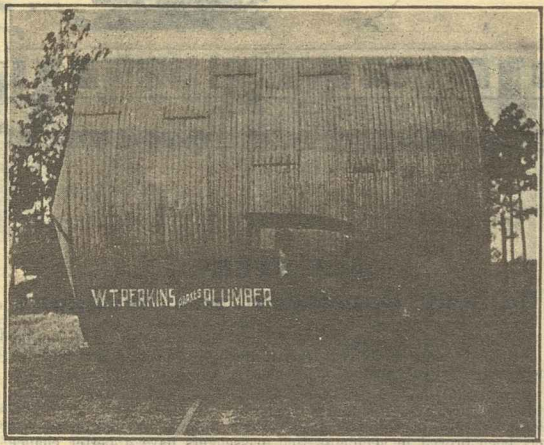
IT is interesting to note at the present day, when the use of Galvanized Iron has become so widely extended, that its introduction dates back only to 1837. Although a plain sheet was exhibited at the Great Exhibition in 1851, it was not until the application of steam power for the purpose of corrugating was brought about in 1854, that Galvanized Iron really came into practical use.

In 1857 the celebrated "ORB" Brand was first manufactured by Mr. JOHN LYSAGHT.

During the seventy years that have since elapsed, greatly improved methods for its production, and extreme care displayed in its manufacture, have secured for **LYSAGHT'S GALVANIZED IRON** an unrivalled reputation throughout the world, and so universally has it been adopted to meet the needs of modern civilization, that it may with truth be said that the sun is always shining on "ORB" IRON.

We are pleased to record that the major portion of the heavy sheets of "Elephant Iron," and the more familiar corrugated curved sheets so extensively used for roofing Hutments and Dug-outs on the Western and other Fronts during the Great War were manufactured by Messrs. John Lysaght Limited, of Bristol, Newport and Scunthorpe (Eng.).

All Australian



This huge tank is made from

18 Gauge Orb

Manufactured at

LYSAGHT'S NEWCASTLE (N.S.W.) WORKS

Dimensions :—

HEIGHT OVERALL	... ...	22 feet
(Wall 18 ft. 6 in., Cone 3 ft. 6 in.)		
CIRCUMFERENCE	... ...	50 feet
DIAMETER	... ...	15 feet 6 ins.
CAPACITY { WATER	...	24,000 gallons
CAPACITY { WHEAT	...	8,000 bushells
WEIGHT (approx.)	... ...	2 tons

QUEEN'S HEAD'' IRON is branded and guaranteed.

ALL STEEL
Railway Carriages and Waggons

In all the progressive countries of the world it is becoming increasingly noticeable that the Railway Authorities are building new rolling stock entirely of steel.

Every collision or accident points to the fact that wooden railway carriages are most dangerous to passengers, from the point of view of splintering and their liability to ignite, and it has been proved in accidents that passengers have a better chance of escape from injury or death in all-steel vehicles than in the old-fashioned wooden carriages.

For years past, John Lysaght Limited, of Newport (Eng.), have specialized in the manufacture of steel panelling for carriages, and steel sheeting for waggons, all qualities being prepared dead flat, square, and exact to any specified size.

Thousands of tons of such panels are in use in various countries.

Railway engineers in Australia are profiting from the experiments made overseas, and the local construction of all-steel carriages for both rail and tramway purposes is proceeding rapidly.

The illustration above is the first of 200 all-steel tramcars built to the design and order of the N.S.W. Government. The whole of the panels and steel sheeting in these cars was rolled at

LYSAGHT'S NEWCASTLE WORKS.

29

To Fix Selling Price of Goods

Useful Information for Small Traders and others whose business does not justify the installation of a Special Costing System.

The Costing of goods upon a scientific basis is highly necessary in any business, large or small, and many instances have been known of business failure through lack of knowledge upon this vital point.

In fixing price to be charged for the goods sold, the first step to be taken is to ascertain the overhead expenses (i.e., rent, rates and taxes, wages, salaries and all expenses, except the cost of the goods), and when this amount has been ascertained see what percentage it bears to the annual turnover, then add to this the amount of nett profit desired to be made and the combined total is the gross profit on sales that should be secured.

Take, for instance, the case of a Country Storekeeper who has a capital of £6,000 invested in a business, with a turnover of £30,000 per annum. If, for instance, he desires to make 20 per cent. on his capital, say £1,200 per annum, and has overhead expenses amounting to £3,000 per annum, he requires to make a gross profit of £4,200 per annum upon a turnover of £30,000 to provide all his expenses and to give the desired return upon his capital.

The proportion that £4,200 bears to turnover £30,000 is exactly 14 per cent., which is the required amount of gross profit to be made on sales.

The amount, however, to be added to the cost price of the goods is **not 14 per cent., but 16⅔ per cent.**, i.e.,

fo example:—

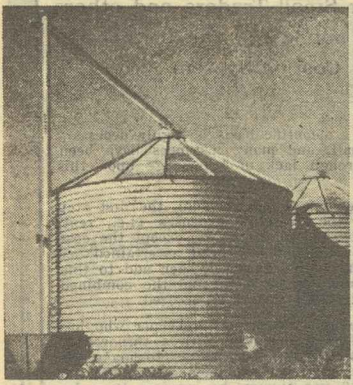
Adding 14 per cent.				Adding 16⅔ per cent.			
Cost price ..	£100	0	0	Cost price ..	£100	0	0
Add 14 per cent.	14	0	0	Add 16⅔ per cent.	16	6	8
Selling price ..	£114	0	0	Selling price ..	£116	6	8
Deduct cost ..	100	0	0	Deduct cost ..	100	0	0
Gross profit ..	£14	0	0	Gross profit ..	£16	6	8

£14 profit on selling price £114 gives gross profit of 12.29 per cent., but £16/6/8 profit on selling price £116/6/8 gives gross profit 14.01 per cent.

LYSAGHT SPECIAL PRODUCTS

GRAIN SILOS AND GENERAL STORAGE BINS

(For Farm or Industrial Uses)



Lysaght Grain Silos are produced in capacities ranging from 200 to 8,500 bushels.

A comprehensive range of Lysaght Augers (Spiral Conveyors) is available for filling and emptying.

11,500-bushel Grain Sheds and large steel Storage Silos to 50,000-bushel capacity are available in ready to assemble form.

For further details and agents' names, write to Lysaght's Works Pty. Limited, Newcastle, or John Lysaght (Aust.) Pty. Limited, capital cities.

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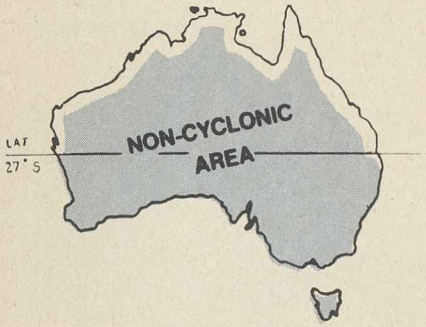
A HANDBOOK OF USEFUL INFORMATION

JOHN LYSAGHT (Australia) LIMITED
Head Office
50 Young Street, Sydney
GPO Box 196 Sydney, NSW 2001



NON-CYCLONIC AREAS

In the Lysaght Referee where information is provided for steel roofing and walling, design and fastening recommendations apply for normal weather conditions in non-cyclonic areas.

A non-cyclonic area is defined as one in which a tropical cyclone is unlikely to occur – ie, areas other than a 50 km coastal strip and offshore islands, north of latitude 27° south.

Design and fastening data for cyclonic areas are available from LBI Offices listed at the front of the Referee.

FOREWORD

LYSAGHT REFEREE—DIAMOND JUBILEE EDITION

This 26th edition of the Lysaght Referee, published in 1981, commemorates 60 years of sheet steel production in Australia—a Diamond Jubilee. Although the origin of the Lysaght organisation dates back to 1857 when the original John Lysaght acquired a galvanizing business in Bristol, England, leading to the export of galvanized sheets to Australia, the actual **Australian production** of steel commenced at Lysaght's Newcastle Works, New South Wales, in 1921.

The Referee itself was first published by Lysaght in 1897. It was printed in Melbourne, Victoria with the title *The Metal Trades' Referee and Storekeepers' Guide*. A first edition in its own right, that particular handbook was at the same time "A souvenir of the Diamond Jubilee" (Queen Victoria's).

In the Introduction to that first edition there is mention of yet another Diamond Jubilee; galvanized iron was first introduced in 1837, so the galvanizing process was then 60 years old.

To browse through all the early editions of the Referee is to take a journey through the history of a company and a country, as well as learn something of the various trades and citizens catered for by the handbook. One sees reference to old brand names, prices, terms, how to detect signs of or treat ague, apoplexy, delirium tremens, rupture, snake bite, sore feet or sunstroke.

It is interesting to record that similar handbooks have appeared for short periods from time to time. Some seem to have emulated the style of the Referee, but it is thought

that the *continued* publication of the Lysaght Referee 84 years after its introduction must be unique.

Judging by the popular demand for, and the enthusiasm expressed to possess a Referee handbook not only in Australia but in other parts of the world, the Lysaght organisation concludes that publication should continue.

Information in the Referee is prepared from data and tables provided by recognized authorities. While great care has been taken to ensure their accuracy, no responsibility can be accepted for any errors which may have escaped the attention of the editors.

This edition is issued gratis with the compliments of the Company, and it is hoped that it will be as useful as the previous issues of the Referee have been over the years.

JOHN LYSAGHT (Australia) LIMITED
50 YOUNG STREET, SYDNEY

LYSAGHT – 60 YEARS OF CONTINUAL GROWTH IN AUSTRALIA

In 1981, 125 years after its foundation, John Lysaght (Australia) Limited celebrates 60 uninterrupted years of production in Australia.

The Lysaght story started in England when that country, as the leader of the industrial revolution, was pioneering new ways of making and using iron and steel.

In 1857 a young Irishman, John Lysaght, acquired a small business, galvanizing buckets, at Bristol, and immediately turned his attention to the galvanizing and corrugating of sheet iron and steel.

Not long after, he began exporting galvanized iron and steel for the booming rural and building markets in Australia. It was upon this trade that the fledgling company grew and prospered.

The high strength to mass ratio of galvanized corrugated sheet steel, its ease of transport and the protection against the elements provided by the heavy zinc coating made the product ideal for building in Australia. By 1900 Australia provided three-quarters of the total market for this English company's corrugated steel.

In 1921 Lysaght formalized its Australian ties with the establishment of a mill in Newcastle, NSW, for the rolling and galvanizing of sheet steel with bar from the nearby recently completed BHP plant. This started a long and mutually supporting relationship between the two companies.

Since that time Lysaght has undergone a steady process of expansion.

In the mid 1930's Lysaght started its second works, at Port Kembla, NSW, utilizing AIS (BHP) feed, and in the immediate post-war years, embarked upon a major expansion programme.

With the installation of a four-stand cold reduction mill, later enlarged to five stands, capacity was lifted to one million tonnes of steel coil per annum by the early 1970's. In addition, three continuous galvanizing lines, commissioned during the 1960's made Port Kembla one of the largest galvanizing works in the world, certainly the biggest under one roof.

The company acquired from Armco in 1946, remaining shares of the nearby Commonwealth Rolling Mills. This is still the location for producing all its internationally acclaimed electrical steel and some of its Colorbond pre-painted steel sheet.

In 1972 Lysaght opened a new plant in Westernport, Victoria. The plant, including a wide cold strip mill, 1500 mm galvanizing and coil painting lines, was established to meet the growing domestic market and to provide capacity for significant production surplus to take up export opportunities.

In 1978 the Lysaght five-stand hot strip mill commenced operations at Westernport. The hot strip mill attracted great overseas interest because of the incorporation of the world's first operational coil box which conserved heat in the transfer bar. The installation of the coil box has meant a much shorter mill than is the case with older style mills, two fewer finishing stands than otherwise would be needed, and substantial economies in the use of power and cooling services.

At around the same time, a considerable programme of expansion was undertaken at Port Kembla.

In 1976 Lysaght introduced a new product, Zincalume steel, which was to have a dramatic effect on its traditional markets. Zincalume is sheet steel coated with an alloy of 45% zinc and 55% aluminium, which imparts greater protection than the traditional zinc coating on galvanized steel.

Lysaght has achieved great success in launching this product as a replacement for galvanized steel in many traditional applications. This success was hailed as one of the great marketing achievements staged in Australia, winning for the company the coveted Hoover Marketing Award in 1979.

Export and International Business

Lysaght has also been successful on the export front. The company has always been an exporter but extra productive capacity arising from the commissioning of Westernport led to a concerted export drive. Export now absorbs more than 30% of production. The value of exports

increased fivefold in the four years up to 1981. Lysaght is also a significant exporter of technology, having designed and helped to install and run continuous galvanizing lines in Malaysia, the Philippines and Indonesia.

In recognition of this outstanding effort, Lysaght won, in 1980, an award for Outstanding Export Achievement conferred jointly by the Department of Trade and Resources and the Confederation of Australian Industry. In addition the company was the top recipient under the Commonwealth Government's Export Expansion Grants Act for the period 1977/79. To help secure and hold overseas markets, Lysaght has developed a network of overseas subsidiary and associated companies. This strategy has proved so successful in helping develop the export trade that it won for the Company a second Hoover Marketing Award in 1980.

Today the International Business Division consists of more than 30 associate and subsidiary companies in 9 countries: Hong Kong, Malaysia, Philippines, Indonesia, Singapore, Papua New Guinea, United States of America, New Caledonia and Fiji.

Brownbuilt

The Brownbuilt name has long been famous for steel shelving, filing systems, steel office furniture and Compactus systems. Founded by E. J. Brown as Brownbuilt in Melbourne in 1885, the company was purchased by Lysaght in 1968, and the Brownbuilt name was retained.

Lysaght Brownbuilt Industries

Lysaght Brownbuilt Industries is the building and industrial products division of the Lysaght group. Brownbuilt, in 1949, introduced Australia's first continuous cold roll-forming process for making profiled metal sections. The company's growing involvement with this aspect of steel fabrication resulted in its product range being extended to include an increasing number of steel building products, including steel roofing and walling. In 1971 these products were merged with the range of similar Lysaght products,

and became produced and marketed by the then newly formed Lysaght Brownbuilt Industries.

Today, Lysaght Brownbuilt Industries (LBI), a separate division of John Lysaght (Australia) Limited, continues the Brownbuilt and Lysaght traditions, manufacturing and marketing products made from sheet and coil steel produced by the parent company, Lysaght.

Lysaght Brownbuilt Industries caters for a wide variety of steel building and industrial needs with an extremely diverse product range which is constantly being refined and expanded. The current range includes Australia's most popular steel roofing and walling profiles, guttering and capping, structural steel products, expanded metal meshes, structural decking and more. Widespread acceptance in a discerning and quality conscious market is a genuine tribute to the way in which LBI maintains product quality, holding improvement and innovation as its major goals.

The Lysaght Group

At the beginning of its sixth decade of Australian operations John Lysaght (Australia) Limited, a member of the BHP group, has grown to become:

- The world's number one producer of Zincalume type steel, with one million tonnes being produced by February 1981.
- The world's third largest galvanizer and coil painter.
- One of the world's technological and marketing leaders in its field.

The company is well poised to meet the challenges of the latter part of the century with modern manufacturing plants, a decentralised distribution and service centre network spread over 22 population centres and with the most advanced products.

Lysaght faces the future with optimism, determination and the willingness to change any aspect of its mode of operations which may be necessary to secure an expanding position in the industrial base of Australia and to make an increasing contribution to national prosperity.

EXPORT ENQUIRIES

BHP International Marketing (Iron and Steel)
140 William Street, Melbourne, Victoria, 3000
GPO Box 86A Melbourne, Victoria, 3001

STEEL SERVICE AND SALES

JOHN LYSAGHT (Australia) LIMITED SHEET AND COIL DIVISION

Sydney, New South Wales
Anzac Street, Chullora — State Office and
PO Box 144 Greenacre 2190 — Steel Service Centre

Melbourne, Victoria
492 St Kilda Road, Melbourne — State Office
GPO Box 2776Y Melbourne 3001
2 St. Albans Road, Sunshine — Steel Service Centre
PO Box 145 Sunshine 3020

Adelaide, South Australia
Wingfield Road, Wingfield — State Office and
PO Box 59 Rosewater East 5013 — Steel Service Centre

Brisbane, Queensland
Lysaght Street, Acacia Ridge — State Office and
PO Box 7 Sunnybank 4109 — Steel Service Centre

Perth, Western Australia
Cnr Norma Rd and McCoy St, Myaree — State Office and
PO Box 46 Applecross 6153 — Steel Service Centre

Hobart, Tasmania
97a Grove Road, Glenorchy — State Office and
PO Box 164 Glenorchy 7010 — Steel Service Centre

Darwin, Northern Territory
Cnr. Coonawarra and Bombing Roads, Winnellie — State Office and
PO Box 39466 Winnellie 5789 — Steel Service Centre

STEEL MANUFACTURING PLANTS

JOHN LYSAGHT (Australia) LIMITED SHEET AND COIL DIVISION

Port Kembla, New South Wales

Springhill Works
Springhill Road, Wollongong
PO Box 77 Port Kembla 2505

CRM Works
Port Kembla Road, Port Kembla
PO Box 77 Port Kembla 2505

Westernport, Victoria

Westernport Works
Bayview Road, Hastings
Private Bag 1 Hastings 3915

INTERNATIONAL

FIJI

John Lysaght (South Pacific) Limited

Lysaght Brownbuilt Industries (Fiji) Limited

FIDC Sheet Steel Limited

Suva
Lakeba Street, Samabula, Suva
GPO Box 91 Suva

Lautoka
Vouwalu Street, Lautoka
PO Box 702 Lautoka

MALAYSIA

John Lysaght (Malaysia) Sdn Bhd

Besikayu (M) Sdn Bhd

Selangor
2/9 Jalan Gudang,
Shah Alam Industrial Estate, Selangor
PO Box 51 Shah Alam, Selangor

Lysaght Corrugated Pipe Sdn Bhd

Lysaght Galvanizing Services Sdn Bhd

Perak
Tasek Square, Tasek Industrial Estate, Ipoh, Perak
PO Box 334 Ipoh, Perak

Kuala Lumpur
7th Floor, Bangunan Yee Sang
15 Jalan Rajah Chulan, Kuala Lumpur
PO Box 2435 Kuala Lumpur

Lysaght Corrugated Pipe (Sarawak) Sdn Bhd

Sarawak
c/– UE Building, 1½ mile Jalan Tun Hj Openg,
Kuching, Sarawak
PO Box 596 Kuching, Sarawak

Lysaght (Sarawak) Sdn Bhd

Sarawak
Lot 17, Section 66
Pending Industrial Area, Kuching, Sarawak
PO Box 1007 Kuching, Sarawak

John Lysaght (Sabah) Sdn Bhd

Sabah
Jalan Simpanan off 5½ miles, Jalan Tuaran,
Likas Industrial Estate, Kota Kinabalu, Sabah
PO Box 2152 Kota Kinabalu, Sabah

SINGAPORE

John Lysaght (SE Asia) Pte Limited

Lysaght Roofing Services Pte Limited

350 Jalan Boon Lay, Jurong Town, Singapore 2261
PO Box 3 Jurong Town Post Office, Singapore 9161

Lysaght Corrugated Pipe (S) Pte Ltd

Room 5603, 5th Floor, Woh Hup Complex,
Golden Mile, Beach Road, Singapore 7

Lysams Pte Limited

c/– Shook Lin & Bok,
Malayan Bank Chambers, Fullerton Square, Singapore
PO Box 250B Singapore

John Lysaght Singapore Pte Limited

Room 606, 6th Floor, Shing Kwan House,
4 Shenton Way, Singapore 1

INDONESIA

P.T. BRC-Lysaght Indonesia

Jakarta Timur
Jalan Rawaterate 1 No 1
Pulogadung Industrial Estate, Jakarta, Timur

PAPUA NEW GUINEA

John Lysaght (PNG) Pty Limited

Sheet Metal Industries (PNG) Pty Limited

Lae
Montoro Street, Lae
PO Box 872 Lae

Port Moresby
Gabaka Street, Gordons, Port Moresby
PO Box 5455 Boroko, Port Moresby

Moresby Metal Industries Pty Limited

Port Moresby
Saraga Street, 6 mile, Port Moresby
PO Box 1 Port Moresby

John Lysaght (Rabaul) Pty Limited

Rabaul Metal Industries Pty Limited

Rabaul
Malaguna Road, Rabaul
PO Box 62 Rabaul

Kieta
Toniva, Kieta
PO Box 301 Kieta

New Britain Engineering Pty Limited

Rabaul
Blanch Street, Rabaul
PO Box 163 Rabaul

Stones Automotive & Diesel Pty Limited

Kieta
Toniva, Kieta
PO Box 301 Kieta

NEW CALADONIA

SICOTEC

Noumea
Perimetre Ducos, Baie De Numbo, Noumea
Boite Postale 3424 Noumea

HONG KONG

John Lysaght International Holdings SA

John Lysaght Hong King Limited

16th Floor, Wang Kee Building,
Connaught Road, Hong Kong Central
GPO Box 103 Hong Kong

UNITED STATES OF AMERICA

ASC Pacific Incorporated

Washington
2141 Milwaukee Way, Tacoma, Washington 98421

California
2110 Enterprise Boulevard
West Sacramento, California 95691

5333 Slauson
Commerce City, California 90040

PHILIPPINES

Philippine Steel Coating Corporation

Manila
Ground Floor, New Solid Building,
357 Beundia Avenue Extension, Makati, Metro Manila

STEEL BUILDING AND INDUSTRIAL PRODUCTS

LYSAGHT BROWNBUILT INDUSTRIES

NEW SOUTH WALES

Sydney
6 Brunker Road, Chullora
PO Box 103 Greenacre 2190

Newcastle
Abdon Close, Bennetts Green 2290
PO Box 342 Charlestown 2290

Dubbo
Cobbora Road, Dubbo 2830

Tamworth
6 Hargrave Street, Tamworth 2340

Albury
111 Union Road, North Albury 2640

AUSTRALIAN CAPITAL TERRITORY

Canberra
Cnr Townsville and Gladstone Streets,
PO Box 268 Fyshwick 2609

VICTORIA

Melbourne
Norcal Road, Nunawading 3131

Geelong
St Georges Road, Norlane 3214
PO Box 210 Corio Village 3214

Horsham
Hamilton Road, Horsham 3400
PO Box 738 Horsham 3400

Portland
Darts Road, North Portland 3305

Gippsland
Cnr Rocla and Southern Roads, Traralgon 3844

Bendigo
Cnr Howard and Station Streets, Epsom 3551

QUEENSLAND

Brisbane
Lysaght Street, Acacia Ridge 4110
PO Box 7 Sunnybank 4109

Townsville
Ingham Road, Garbutt 4814
PO Box 857 Townsville 4810

Rockhampton
99 Stanley Street, Rockhampton 4700
PO Box 822 Rockhampton 4700

Cairns
310 Spence Street, Bungalow 4870

Mackay
Peak Downs Highway, Ooralea 4740
PO Box 1269 Mackay 4740

Maroochydore
2nd Floor, Wilson House
13 Aerodrome Road, Maroochydore 4558

SOUTH AUSTRALIA

Adelaide
Wingfield Road, Wingfield 5013
PO Box 59 Rosewater East 5013

WESTERN AUSTRALIA

Perth
Cnr Norma Road and McCoy Street, Myaree 6154
PO Box 46 Applecross 6153

TASMANIA

Hobart
97a Grove Road, Glenorchy 7010
PO Box 164 Glenorchy 7010

Devonport
Off Kelsey's Tier Road, Spreyton 7310
PO Box 593 Devonport 7310

NORTHERN TERRITORY

Darwin
Cnr Coonawarra and Bombing Roads, Winnellie 5789
PO Box 39466 Winnellie 5789

STEEL FURNITURE AND EQUIPMENT

BROWNBUILT

Sydney, New South Wales
Cnr Bath Road and Waratah Street, Sutherland 2232
Private Bag PO Sutherland 2232

Melbourne Victoria
Head Office
260 Darebin Road, Thornbury 3071
PO Box 150, Fairfield 3078

Brisbane, Queensland
120 Assembly Street, Salisbury North 4107
PO Box 67 Salisbury North 4107

Canberra, A.C.T.
88 Townsville Street, Fyshwick 2609
PO Box 176 Manuka 2603

Adelaide, South Australia
120 Daws Road, Edwardstown 5039
PO Box 120 Clarence Gardens 5039

Perth, Western Australia
Brownbuilt Metalux Industries Limited
24 Collingwood Street, Osborne Park 6017
PO Box 75 Mt. Hawthorn 6016

Fiji
Lysaght Brownbuilt Industries (Fiji) Limited
169–171 Lakeba Street, Samabula, Suva

Papua New Guinea
Sheet Metal Industries (PNG) Pty Limited
Gabaka Street, Port Moresby

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LYSAGHT TRADE MARKS

With its origin dating back well over a century it is understandable that John Lysaght (Australia) Limited has manufactured and marketed countless flat and formed sheet steel products. These products have been identified by various trade marks and devices (logos) familiar in many parts of the world.

Perhaps one of the best known trade marks would be the *Orb* series. A great deal of interest has been indicated by independent researchers tracing the early history of 'corrugated iron' in colonial and later days, and it is significant that trade marks, still identifiable on very old sheets, have been the means of determining where and when the sheet was made. Books and theses have been written on this interesting subject.

The following list is by no means complete but shows some of the John Lysaght (Australia) Limited trade marks familiar to steel users in Australia, and likely to be mentioned in the Referee. The formed product trade marks are mainly associated with Lysaght Brownbuilt Industries.

FLAT PRODUCTS

ZINCALUME
ZINC-HI-TEN
ZINCFORM
GALVABOND
GALVASPAN
ZINCSEAL
ZINCANNEAL
LY-TEN
LYNAMEL
LY-CORE
COLORBOND
MARVIPLATE
KORARMA
COOLCLAD

FORMED PRODUCTS

Cladding, Guttering and Fencing

CUSTOM ORB
CUSTOM BLUE ORB
ZINCALUME CUSTOM BLUE ORB
BLUE ORB
KLIP-LOK
SPANDEK
BROWNBUILT 305 & 406
PANELRIB
TRIMDEK HI-TEN
V-CRIMP
V-CRIMP HI-TEN
WALL-CLAD
EASYCLAD
SHEERLINE
TRIMLINE
STREAMLINE
COLORSCREEN

Structural and Industrial

BONDEK
TRI-LOK
INTERLOK
LYTGAL
HOOK-LOK

Expanded Metals

ORNAMESH
GRIDMESH
METALATH
MULTIMESH

JLA PREFERRED STEEL SHEET DIMENSIONS

JLA PREFERRED THICKNESS — millimetres

AS 2338		JLA
First Choice	Second Choice	Third Choice
0.25		
	0.28	
0.30		
		0.32
	0.35	
		0.38
0.40		
		0.42
	0.45	
		0.48
0.50		
	0.55	
0.60		
		0.65
	0.70	
		0.75
0.80		
		0.85
	0.90	
		0.95
1.0		
	1.1	
1.2		
		1.3
	1.4	
		1.5
1.6		
		1.7
	1.8	
		1.9
2.0		
	2.2	
2.5		
	2.8	
3.0		
		3.2

PREFERRED WIDTHS AND LENGTHS

First preference	**Second preference**
Increments of 100 mm	Increments of 5 mm

Width and length increments less than 5 mm are subject to special negotiation.

Stock products are produced to selected first preference widths and lengths, second preferences being available to meet the needs of manufacturers.

COATINGS ON STEEL SHEET

Coatings have been successfully applied to steel sheet for over a century, the main purpose being to protect the steel against its natural tendency to form oxides of iron. Sometimes the purpose is 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 notes are included under the heading *Atmospheric Exposure Conditions* (refer to index).

In general terms the coated steels produced on continuous coil coating lines by John Lysaght (Australia) Limited are:

- Hot dip zinc-coated and zinc/aluminium–coated (AS 1397)
- Electro-zinc-coated
- Hot-dip lead/tin-coated
- Paint coated
- Organic film laminated

Hot-dip zinc-coated qualities include Galvabond (ductile grades), Zincform (structural grades) and Zinc-Hi-Ten (high strength grades) in various coating classes and finishes. Zincanneal, a ductile grade, has a surface modified in production by a post galvanizing heat treatment.

Hot-dip zinc/aluminium quality is Zincalume in structural and high strength grades in two coating classes.

Electro-zinc-coated quality is Zincseal in ductile grades.

Hot-dip lead/tin-coated quality is Terne in ductile grades.

Paint coated qualities are the many variations of Colorbond. Colorbond has a Zincalume base for exterior applications. For interior use the base may be Galvabond, Zincseal or plain cold rolled steel in ductile grades.

Organic film laminated qualities are Marviplate and Korarma. For exterior use organic films are laminated to Zincalume steel. Marviplate for interior use has an electro-galvanized steel base in ductile grades.

DIMENSIONS OF LYSAGHT HOT-DIP ZINC-COATED AND ZINC/ALUMINIUM-COATED FLAT STEEL SHEET QUALITIES – Typical only

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

Maximum sheet length 4880 m.

Grade	ZINC-COATED		ZINC/ALUMINIUM-COATED	
	Typical thickness, mm	Maximum width, mm	Typical thickness, mm	Maximum width, mm
Formable				
Commercial	0.25 – 3.2	1525		
Deep drawing	0.40 – 3.2	1525		
Structural				
G250	1.0 – 3.2	1350		
G300	0.25 – 3.2	1525	0.35 – 1.6	1245
G350	0.30 – 1.5	1350		
High strength				
G450	1.5 – 2.5	1350	1.5 – 1.6	1100
G500	1.0 – 1.4	1350	1.1 – 1.4	1100
G550	0.40 – 0.95	1300	0.35 – 1.0	1245

ZINC OR ALUMINIUM/ZINC COATING CLASSES: AS 1397

AS 1397 coating classes are designated by the prefix letter Z, ZF or AZ, as appropriate, followed by a three-digit number representing the minimum coating mass as determined by the triple spot test defined in AS 1397. Coating classes listed are:

Zinc		Zinc/Iron alloy	Aluminium/Zinc alloy
Z100	Z430	ZF100	AZ150
Z200	Z550		AZ200
Z300			

HOT DIP ZINC-COATED AND ZINC/ALUMINIUM-COATED STEEL SHEET

Lysaght manufactures hot-dip zinc-coated and zinc/aluminium-coated (Zincalume) steels to AS 1397. Ductile grades are designated GC and GD. Structural grades are designated G250, G300, G350, G450, G500 and G550 according to minimum yield stress in MPa. Grades G450, G500 and G550 are also known as high strength grades.

In addition to the qualities described here, other zinc-coated steels with enhanced ductility are available. Enquiries should be made to Lysaght Offices.

Ductile Steel Grades

GALVABOND GC, GD (AS 1397)

Galvabond is a general purpose zinc-coated flat quality and is the most widely used of the Lysaght zinc-coated qualities. 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 base grade GC with regular coating class Z300 will permit severe forming (including lock-forming) and many drawing operations. For the more critical drawing or spinning operations base grade GD with regular coating class Z200 (for internal applications) is manufactured.

Coatings heavier than coating class Z300, while giving excellent protection against corrosive conditions, are not guaranteed for close forming. In Z430 coating class if resistance to fluting is of prime importance Galvabond NF should be specified (not guaranteed for lock-forming).

The coating with its characteristic spangled pattern, has excellent adherence and will permit a wide range of forming operations without peeling or flaking. Galvabond M has a minimum spangle surface to suit special applications and may be specified where required. 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 Lysaght State Office. Where higher standards of paint finish are required, alternative qualities are available.

Typical Applications

Galvabond is recommended for:

Bus body framework
Cable ladders
Metal signs
Meter boxes
Motor housings
Ducting
Expanded metal
Fascias and trims
Containers
Door channels
Garage doors
Garbage cans
Poultry feeding equipment
Washing machine components
Wheelbarrows
Swimming pool surrounds

ZINCANNEAL GC (AS 1397)

Modification by a post galvanizing heat treatment, which converts the coating into a zinc/iron alloy, gives Zincanneal 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 produced 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 must be painted for external applications.

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

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

Typical Applications

Zincanneal is recommended for:

- Signs & number plates
- Door frames
- Van & bus doors
- Garage doors
- Hot water tank jackets
- Air conditioners
- Commercial refrigerators & freezers
- Coolroom panels
- Domestic & industrial louvres
- Acoustic ceiling tiles (internal only)

Structural Steel Grades

ZINCFORM G250, G300, G350 (AS 1397)

Zincform is produced to meet the minimum strength requirements of AS 1397 base grades G250, G300 and G350. 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 is not suitable for applications where springback or fluting are critical (eg, Rima machines) or for drawing, pressing or lock-forming.

Zincform 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 is recommended for:

Coating Class	
Z200 (Internal applications only)	Building sections – studs, plates, wall frames, purlins Ceiling hangers Fittings General roll-formed sections
Z300	General roll-forming Vertical walling Purlins Painted wall and roof cladding

Z430	Roof decking Gutters and downpipes Ridge capping and valleys Rain-water goods and accessories
Z550	Corrugated tank walls General items exposed to severe corrosion conditions

ZINCALUME G300 (AS 1397)

Zincalume provides significantly improved corrosion resistance under the same atmospheric exposure conditions as traditional zinc-coated (galvanized) steel of similar coating thickness. 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. Lead must **not** be used.

It is not practical to solder Zincalume in the field. Economical joining and sealing systems using silicone rubber sealants are described under *Sealants* (see index).

Typical Applications

Zincalume G300 is recommended for:

Coating Class	
AZ150	General roll-forming Vertical walling Painted roof and wall cladding Swimming pools Fencing systems House frames Refrigerator and stove rear panels Air conditioning panels (NOT DUCTWORK)
AZ200	Roof decking Gutters and downpipes Ridge capping and valleys Rain-water goods and accessories Rain-water tanks

High Strength Steel Grades

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

Zinc-Hi-Ten is a flat zinc-coated quality 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 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, Zinc-Hi-Ten has been used successfully in many roll-forming and bending operations.

Zinc-Hi-Ten is readily formable on a press brake 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 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 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 Galvabond. Priming or pretreatment is necessary before painting to achieve satisfactory adhesion.

Typical Applications

Zinc-Hi-Ten is recommended for:

Coating Class	
Z200	Internal structural sections and decking Concrete formwork
Z300	Fence droppers Windmill blades

	Vertical walling Purlins Silo straps Tubing
Z430	Roll-formed roof decking Shipping containers
Z550	General items exposed to severe corrosion conditions

ZINCALUME G450, G500, G550 (AS 1397)

Zincalume provides significantly improved corrosion resistance under the same atmospheric exposure conditions as traditional zinc-coated (galvanized) steel of similar coating thickness. It is produced to meet the minimum strength requirements of AS 1397 base grades G450, G500 and G550.

The same general comments apply for Zincalume G450, G500 and G550 as for Zinc-Hi-Ten equivalent qualities. Two notable differences are that (a) priming or pretreatment are usually not necessary before painting and (b) Zincalume 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. Do **not** use lead.

Typical Applications

Zincalume is recommended for:

Coating Class	
AZ150	Fence droppers Vertical walling Painted roof and wall cladding Fencing systems
AZ200	Roof and wall cladding House lockers Mufflers Heat shields and reflectors Toasters Ovens Meter boxes Swimming pool components

A GENERAL GUIDE TO COMPARATIVE FEATURES – AS 1397 HOT-DIP PROCESS STEEL SHEET QUALITIES

Coating classes in **bold type** are normally supplied, others are optional.

	DUCTILE GRADES			STRUCTURAL GRADES		HIGH STRENGTH GRADES	
CHARAC-TERISTICS	GALVABOND GC	GALVABOND GD	ZINCANNEAL GC	ZINCFORM G250, G300, G350	ZINCALUME G300	ZINC-HI-TEN G450, G500, G550	ZINCALUME G450, G500, G550
Main feature	General pur-pose	General purpose drawing	Direct-on paintability	Guaranteed strength	Guaranteed strength	High strength	High strength
Coating type	Zinc	Zinc	Zinc/iron alloy	Zinc	Zinc	Zinc	Zinc/aluminium alloy
Coating class	**Z300**, Z200, Z430	**Z200**, Z300	**ZF100**	G250–**Z200**, Z300, Z550 G300–**Z430**, Z200, Z300, Z550 G350–**Z430**, Z200, Z300	**AZ200**, AZ150	G450–**Z200**, Z300, Z550 G500–**Z200**, Z300, Z550 G550–**Z430**, Z200, Z300, Z550	**AZ200**, AZ150

Surface finish and options	Std spangle Min spangle Colorbond Marviplate	Std spangle Min spangle Colorbond Marviplate	Smooth matte	Std spangle Min spangle Colorbond Marviplate	Std spangle Colorbond Korarma Marviplate	Std spangle Min spangle Colorbond Marviplate	Std spangle Colorbond Korarma Marviplate
Paintability	Pretreatment required	Pretreatment required	Direct-on	Pretreatment required	Direct-on for water-based 100% acrylic, pretreatment for other paints	Pretreatment required	Direct-on for water-based 100% acrylic, pretreatment for other paints
Roll-forming	Excellent	Excellent	Moderate	G250 – Excellent G300 – Very good G350 – Good	Very good	Restricted	Restricted
Bending	Excellent	Excellent	Moderate	Excellent	Excellent	Restricted	Restricted
Pressing/ drawing	Good	Very good	Moderate	Restricted	Restricted	Not recom-mended	Not recom-mended
Lock-forming	Excellent	Excellent	Not recom-mended	Not recom-mended	Not recom-mended	Not suitable	Not suitable
Soldering	Excellent	Excellent	Excellent	Excellent	Not suitable – use sealant	Excellent	Not suitable – use sealant
Welding	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent

ZINC-COATED AND ALUMINIUM/ZINC-COATED STEEL FLAT QUALITIES – AS 1397

APPROXIMATE MASS PER SHEET IN KILOGRAMS, AND SHEET COUNT PER NOMINAL TONNE
For Zinc Coating Class Z300 and Aluminium/Zinc Coating Class AZ150

Preferred thickness, mm	Preferred length, mm	Zinc Coating Class Z300						Aluminium/Zinc Coating Class AZ150			
		Preferred width, mm									
		900		1200		1500		900		1200	
		Sheet mass	Sheet count	Sheet mass	Sheet count	Sheet mass	Sheet count	Sheet mass	Sheet count	Sheet mass	Sheet count
0.30		4.350	230	5.800	172						
0.40		5.621	178	7.495	133						
0.50		6.893	145	9.191	109						
0.60		8.165	122	10.886	92						
0.80		10.708	93	14.278	70						
1.0	1800	13.252	75	17.669	57						
1.2		15.795	63	21.060	47						
1.6		20.882	48	27.842	36						
2.0		25.969	39	34.625	29						
2.5		32.327	31	43.103	23						
3.0		38.686	26	51.581	19						
0.30		5.800	172	7.733	129						
0.40		7.495	133	9.994	100			7.150	140	9.533	105
0.50		9.191	109	12.254	82			8.845	113	11.794	85
0.60		10.886	92	14.515	69			10.541	95	14.054	71
0.80		14.278	70	19.037	53			13.932	72	18.576	54

1.0	2400	17.669	57	23.558	42			17.323	58	23.098	43
1.2		21.060	47	28.080	36			20.714	48	27.619	36
1.6		27.842	36	37.123	27			27.497	36	36.662	27
2.0		34.625	29	46.166	22						
2.5		43.103	23	57.470	17						
3.0		51.581	19	68.774	15						
0.30		7.250	138	9.666	103						
0.40		9.369	107	12.492	80			8.937	112	11.916	84
0.50		11.488	87	15.318	65			11.056	90	14.742	68
0.60		13.608	73	18.144	55	22.680	44	13.176	76	17.568	57
0.80		17.847	56	23.796	42	29.745	34	17.415	57	23.220	43
1.0	3000	22.086	45	29.448	34	36.810	27	21.654	46	28.872	35
1.2		26.325	38	35.100	28	43.875	23	25.893	39	34.524	29
1.6		34.803	29	46.404	22	58.005	17	34.371	29	45.828	22
2.0		43.281	23	57.708	17						
2.5		53.878	19	71.838	14						
3.0		64.476	16	85.968	12						
0.30		8.699	115	11.599	86						
0.40		11.243	89	14.990	67			10.724	93	14.299	70
0.50		13.786	73	18.382	54			13.268	75	17.690	57
0.60		16.330	61	21.773	46	27.216	37	15.811	63	21.082	47
0.80		21.416	47	28.555	35	35.694	28	20.898	48	27.864	36
1.0	3600	26.503	38	35.338	28	44.172	23	25.985	38	34.646	29
1.2		31.590	32	42.120	24	52.650	19	31.072	32	41.429	24
1.6		41.764	24	55.685	18	69.606	14	41.245	24	54.994	18
2.0		51.937	19	69.250	14						
2.5		64.654	15	86.206	12						
3.0		77.371	13	103.162	10						

ELECTRO-ZINC-COATED QUALITY STEEL SHEET

LYSAGHT ZINCSEAL STEEL

Zincseal is an electro-galvanized flat formable steel sheet quality, with a light zinc coating which provides resistance to corrosion during storage and fabricating operations without oiling. Characteristics of the appropriate cold rolled steel base qualities are retained with added coating advantages of improved paintability, and the ability to form and draw to the limits of the steel base without loss of coating adhesion.

Zincseal electro-galvanized steel is not a substitute for hot dipped zinc-coated steel in corrosive environments or external use.

A phosphate coating applied to Zincseal during processing permits direct-on application of high gloss paint finishes without priming. For exterior applications a corrosion inhibitive primer (etch primer) must be used to upgrade the paint system as the thin zinc coating does not offer any significant degree of protection in corrosive environments.

Three Zincseal formable steel qualities cover the range of forming and drawing operations, from moderate deformation to those of the most demanding nature involving a considerable degree of stretch forming. Some operations such as drawing are facilitated because the zinc coating acts as a lubricant.

Zincseal steel is readily welded and soldered but in these operations care must be taken to avoid damage to the zinc coating.

Recommended uses for Zincseal include:

- Bus and van bodies
- Fluorescent lights
- Internal acoustic ceiling tiles
- Switchgear cabinets
- Office furniture
- Partitioning
- Lift doors and panels
- Flexible tubing

HOT-DIP LEAD/TIN-COATED STEEL SHEET

LYSAGHT TERNE SHEET

Lysaght Terne sheets are supplied as appropriate cold rolled formable grades of steel sheet with a protective coating of terne metal, an alloy of lead and tin. Characteristics of the cold rolled steel base qualities are retained, with the added coating characteristics of:

- improved paintability;
- excellent solderability;
- surface passive to petrol;
- forming and drawing to limits of steel base without loss of coating adhesion;
- spark dampening;
- lubricous coating (reduced friction and die wear during severe drawing operations).

The constituent coating metals, lead and tin, are both highly resistant to corrosion and, in conditions where zinc coating would form oxides and carbonates, terne metal remains virtually clean and free of corrosion products. This property is significant where corrosion product might otherwise detach from fuel tank metal surfaces and clog filters and fuel lines.

Coating classes are PS50, PS75 and PS100, typical uses being:

PS100
Fuel tanks
Auto rocker covers
Oil pans
Auto radiator parts

PS75 and PS50
Gaskets and washers
Fire doors and frames
Radio and TV chassis
Office equipment
Oil stoves and heaters
Air and oil filters

LYSAGHT COLORBOND PREPAINTED STEEL

Lysaght Colorbond high quality prepainted steel sheet and coil can be fabricated into an end product without further treatment. Produced on modern high speed continuous coil coating lines, Colorbond is available with a base of cold rolled uncoated, zinc-coated or Zincalume steel.

A range of colours, coating types and gloss levels has been developed for a wide variety of applications, both exterior and interior. These paints can be applied on either one or both sides of steel coil in the same or different colours.

By selecting the correct combination of steel substrate and Colorbond paint system, standard fabrication techniques such as deep drawing, roll-forming, lock-seaming, stamping, spinning and press-brake 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 25 mm to 1575 mm and in JLA preferred thicknesses from 0.30 mm to 1.6 mm depending on steel substrate. Other thicknesses may be available on application.

If it is intended to use Colorbond in exterior applications within 1 km of salt marine locations or in severe industrial or unusually corrosive environments, please contact the nearest Lysaght State Office for specialized advice.

Working with Colorbond Prepainted Steel

Manufacturers planning to use Colorbond prepainted steel are advised to contact Lysaght State Offices for specialized advice. Benefits can accrue when new or modified production lines are planned to fully exploit the advantages of using Colorbond prepainted 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 adhesives may reduce the quantity of mechanical fasteners otherwise required.

Lysaght specialists have a lot of local and overseas experience in production innovation and would appreciate the opportunity to assist in early design stages.

Typical Colorbond Coating Materials and Applications

The end product determines what paint coating type or finish is needed, and the following briefly outlines the more frequently used paint systems and their general characteristics.

EXTERIOR APPLICATIONS

Coatings for exterior applications are applied over a corrosion-inhibitive primer.

Silicone Modified Polyester Developed specifically for exterior applications, this paint system provides outstanding resistance to fading and chalking coupled with excellent corrosion resistance. It has sufficient flexibility to withstand the general fabrication processing associated with building products, particularly roll-forming.

Typical applications are roofing, walling, rain-water goods and general exterior use.

INTERIOR APPLICATIONS

Acrylic and Polyester These are hard, mar-resistant coatings used for selected interior applications in the building, lighting and appliance industries. They are not as flexible or formable as the vinyl paint system, but are resistant to heat and chemicals, particularly household stains, grease and detergents.

Typical applications would include cool room panels, fluorescent light fittings, refrigerator cabinets and liners, cooking range panels and water-heater cabinets.

Vinyl A paint system suitable for interior applications requiring a high degree of flexibility and good corrosion resistance.

Typical applications include curtain rods, light fittings, lock-seam tubing and other similar items involving severe fabrication.

Alkyd This system has been developed as a relatively low-cost interior finish with moderate forming capabilities.

Typical applications are shelving and furniture.

COLORBOND SPECIALTY COATINGS

Colorbond specialty coatings offer new dimensions to the scope of prepainted steel sheet and coil usage.

Patterned Colorbond Several types of Patterned Colorbond are available, with reproduction patterns ranging from fine woodgrain to coarse woodgrain or bold designs. Differing production processes for each system determine whether orders can be produced on a standard or special basis but all orders are subject to negotiation. All systems are suitable for interior use, some for exterior applications.

Typical and recommended applications vary according to the particular system employed, and may include garage doors, fascias, siding, carport walling, curtain rods and tracks, appliance wraps, shelving, office furniture, doors and door frames.

Ready-Prime Ready-Prime has been developed as a prime-coated sheet steel with a specially prepared surface which will accept normally available water-based or solvent-based decorative household exterior paints, after forming into such products as gutters or downpipes, and after installation.

Ready-Prime coating contains pigments for inbuilt corrosion resistance and is a characteristic green colour to emphasise that the surface should be finish painted.

Finish painting should be carried out as soon as possible after installation, at least within six months otherwise finish painting problems could arise.

Ready-Prime is suitable for such items as formed gutters, downpipes and fascias where it is desired to finish paint with a colour to match or contrast with other painted areas of a building.

Epoxy Primer Sheet steel preprimed with epoxy primer is suitable for products where it is more convenient to paint after forming, such as small production runs of articles in a wide colour range. After forming into shape the surface may be finish painted with most air-drying and stoving paints. Preprimed sheet steel strip makes it possible to combine the pretreatment and adhesion advantages of coil coating with the flexibility required for short-run production.

Three types of epoxy primer are available:

Epoxy Primer – General Purpose
Epoxy Primer – Trichlorethylene Resistant
Spot Weldable Primer

General Purpose This is the primer normally supplied on Colorbond preprimed sheet steel. It contains chromate pigments for inbuilt corrosion resistance.

Trichlorethylene Resistant A primer developed for use where product is subjected to trichlorethylene vapour degreasing prior to finish paint coating. It is similar to the General Purpose primer in other respects.

Spot Weldable Spot Weldable Primer has suitable formulation to allow spot welding without the need for removing primer from the weld area. It is intended to be used for such items as bus body parts, washing machine parts, or wherever spot welding and subsequent finish painting is required.

ORGANIC FILM LAMINATED STEEL SHEET

LYSAGHT MARVIPLATE

Marviplate is a laminate of polyvinyl chloride (PVC) film bonded to cold rolled metallic coated steel, which can be fabricated into an end product without further finishing treatment. It is available in either sheet or coil form.

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

The chemical stability of the PVC film enables Marviplate to withstand corrosive atmospheres and accidental contact with mineral acids, alkalis, alcohols and detergents.

A range of stylings and finishes has been developed for both interior and exterior applications, giving attractive

surfaces which are colour fast and virtually maintenance free. These vinyls can be applied to either one or both sides of the sheet in the same or different finishes.

Exterior Marviplate Lysaght Zincalume zinc/aluminium alloy-coated steel is the substrate for Exterior Marviplate steel/PVC film laminate. Single-sided product has exterior grade PVC film bonded to the top side and an oven-baked interior paint backing coating on the reverse side.

Double sided product has exterior PVC film on one side and either an interior or exterior film on the other side, depending on requirement. All edges of double sided Exterior Marviplate must be sealed with Parabond PVC edge sealing solution for added protection.

Exterior Marviplate is used for roofing and walling, guttering and other rainwater goods and accessories where atmospheres are aggressive. Refer to index under "Atmospheric Exposure Conditions".

Interior Marviplate Marviplate for internal use is metal-coated steel with interior grade PVC film laminated to one or both sides. An extensive range of film grades, patterns, styles and colours is available.

Marviplate is typically used for office, hospital and household furniture and equipment, component parts for appliances such as air conditioners, freezers, television units, oil and electric heaters.

Architectural uses include partitioning, acoustic ceilings, undersill assemblies, skirtings and ducting.

Marviplate provides protection in a number of "hard-wear areas" such as doors, supermarket shelving, corridors and high traffic situations.

LYSAGHT KORARMA STEEL SHEET

Lysaght Korarma is a laminate of a smooth, durable coloured acrylic film bonded to corrosion inhibitive primer-coated Zincalume steel. It is manufactured with solid acrylic film on the top surface and an oven-dried paint coating on the reverse side. It can also be supplied with the acrylic film on both surfaces. A range of practical colours is produced.

Korarma steel can be roll-formed for the production of roofing and walling sheets. The film stretches over bends during simple roll-forming operations and complete protective film integrity is maintained.

The smooth surface of Korarma steel tends to shed grime and retain its glossy appearance.

Korarma steel, in general terms, is midway in price and performance between other Lysaght prefinished products Colorbond and Marviplate steel. It is particularly suitable for use on areas of buildings not subject to washing by rain (such as upper wall area, soffits and external ceilings). Typical uses include:

External ceilings (carports, patios)
Walling and siding
Gutter and downpipe
Fascias and bargeboards
Roofing
Eaves and gable ends

on buildings 300 metres and further from salt marine locations.

LYSAGHT COOLCLAD — COATED STEEL/ALUMINIUM FOIL LAMINATED SHEET

Building Sheet with Built-in Solar Heat Barrier

Coolclad is SMP Colorbond (ideally Off White) or plain Zincalume steel sheet with a bright, low emittance aluminium foil laminated to the reverse side. It combines the strength and corrosion resistance of Zincalume steel with long-term low heat emittance.

Coolclad is suitable for roll-forming and is used primarily for the production of insulated roofing and walling sheets. Custom Orb corrugated steel and Trimdek Hi-Ten are two roofing and walling sheets available roll-formed from Coolclad laminated steel.

Coolclad laminated steel improves thermal comfort, whether used with normal ceilings or with unlined ceilings in rural, industrial and domestic buildings. Comprehensive literature is available from Lysaght State Offices.

ATMOSPHERIC EXPOSURE CONDITIONS STEEL CLADDING

CONTRIBUTING FACTORS

New technologies and innovation have resulted in many new or improved materials and products becoming available for building, construction, commercial, industrial, household and other uses. However, the products of today are exposed to much more severe conditions than were their counterparts of yesterday.

Introduction of new industries, extensions of old ones on existing sites and decentralisation to rural and semi-rural areas, greater and continuing increases in the use of chemicals, pesticides, fungicides, fertilizers and even their method of application have all led to increasing degrees of air and water pollution.

People are generally prepared to accept the fact that they need to paint their houses more often, and the family motor car needs to be washed each week. But rarely do houses or other buildings and items exposed to external atmospheres get washed other than by rain, and even rain only washes the areas it can reach.

PROTECTIVE AND/OR DECORATIVE COATINGS

Galvanized steel improvement over the years kept pace with the nation's increasing needs for corrosion resistant steel, and then in 1958 Marviplate was introduced. This was coloured PVC film laminated to zinc-coated steel, a product which enables steel roofing and walling to be used in severe marine and unusually corrosive atmospheres.

In 1966 Colorbond was introduced. Colorbond for exterior use was zinc-coated steel prepainted with an oven-baked silicone modified polyester paint system, and added a further colour dimension to steel. Both Marviplate and Colorbond now have a Zincalume steel base.

1976 saw the introduction of Zincalume, a hot-dip zinc/aluminium alloy-coated steel for the building industry. Zincalume provides improved service life compared with traditional galvanized steel with a similar coating thickness.

A recent addition to the corrosion protective coated steel range is Korarma. This is a coloured solid acrylic film laminated to Zincalume steel base.

Cost and service conditions are frequently the main factors determining selection of steel cladding.

SERVICE CONDITIONS AND SUITABLE PRODUCTS

External atmospheric exposure conditions to which coated steel products are subjected in service can generally be categorised as:

Category	Condition	Location
A	Severe marine	Salt marine, coastal
B	Marine	Salt marine, estuary, lake
C	Industrial	Industries and factories emitting fumes, etc
D	Rural	Normal, non-aggressive, 1 km from A and B, and away from C

Categories A, B and C are *adverse atmospheric conditions*. Varying degrees of severity and micro-environments exist within each category, and some can be combined (industrial/marine). It is therefore difficult to reduce a complex situation to simple terms by providing a blanket recommendation as to which type of coated steel should be used in each location.

If it is intended to use Lysaght coated steel within 1 km of salt marine locations, or in severe industrial or unusually corrosive atmospheric environments it is preferable that specialised advice be sought from a Lysaght Office. However, as a general rule Lysaght recommendations are:

Location	Recommended coated steel
1 km and further away from salt marine locations	Zincalume, Zinc-coated, Colorbond, Korarma, Exterior Marviplate
Atmospheric environments that are not severe industrial or unusually corrosive	
300 m and further away from salt marine locations	Korarma, Exterior Marviplate
Adverse atmospheric conditions (salt marine, severe industrial or unusually corrosive)	Exterior Marviplate (Depending on specific application, may need to be double sided and edge sealed)

It should be remembered that adverse conditions can be generated **within** the whole or part of a building (chemical fume, etc) even though the building may be located in a bland rural atmosphere. Choice of building materials should be made accordingly.

Areas 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 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. The use of Korarma or Exterior Marviplate steel obviates the need for this type of maintenance.

HOT ROLLED AND COLD ROLLED STEEL SHEET QUALITIES

In the 1981 revision of Australian Standards 1594 and 1595 covering repectively hot rolled and cold rolled low carbon steel plate, sheet and strip, qualities were aligned with international standards practice, modified to meet Australian conditions.

A system of symbols has been used to identify qualities and their properties.

HOT ROLLED STEEL SHEET QUALITIES

Lysaght hot rolled steel sheet qualities are produced from selected steel slab by the continuous rolling process and supplied in accordance with the revised 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 qualities, unless pickled, characteristically carry surface scale. Hot rolled qualities are not used where high quality surface finish, as produced on cold rolled qualities, is a prime requirement.

Hot rolled qualities are supplied in coils or cut lengths 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 (**R**, **A** or **U**) indicates the degree of deoxidation achieved in the steelmaking:

R = Rimming
A = Aluminium killed
U = Unspecified steel type

Two basic categories or **grades** of steel may be specified:

Formable (ductile) grades Structural grades

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

1 = Commercial forming
2 = Commercial drawing
3 = Deep drawing

For **structural grades** a three-digit number is used to represent the minimum yield strength in megapascals.

Other characters are added to the quality designation if required, for example:

S = Skin-passed
P = Pickled

LYSAGHT TYPICAL HOT ROLLED STEEL QUALITIES

Details of the full range of Lysaght hot rolled steel qualities can be obtained from Lysaght State Offices. Assistance with the selection and specification of steels is also freely available.

Typical basic Lysaght qualities are:

Formable (Ductile) Grades

HU1S – a hot rolled commercial non-drawing quality, skin-passed to ensure good shape and freedom from coil break. Formability is sufficient for simple bending operations.

In standard thicknesses and sizes, HU1S 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

HR2S–P – a hot rolled pickled quality, skin-passed to ensure good shape and freedom from coil break, and with enhanced surface for use in panel applications heavier than normally supplied from cold rolled sheet.

HR2S–P is recommended and typically used for:

Electrical panels	Auto components
Rotary mowers	Agricultural machinery

HR3–P – a hot rolled pickled and oiled quality suitable for pressings of moderate severity where surface finish is not of prime importance.

HR3–P is recommended and typically used for:

Sealed unit housings
Auto brake components
Compressors
Hydraulic jacks
Clutch parts

Structural Grades

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 200 to 380 MPa are available, all with excellent weldability. Typical examples are:

HU240 HK340

GENERAL GUIDE TO COMPARATIVE FEATURES – HOT ROLLED STEEL

Quality	HU1S	HR2S–P	HR3–P
Form	Coil	Coil, sheet	Coil, sheet
Finish	Skin-passed, not oiled	Skin-passed, pickled, oiled	Pickled, oiled
Bending	Good	Good	Excellent
Roll-forming	Moderate	Good	Good
Pressing	—	Simple	—
Drawing	—	—	Good
Welding	Excellent	Excellent	Excellent

DIMENSIONS OF LYSAGHT HOT ROLLED FLAT STEEL QUALITIES – Typical only

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

Maximum sheet length – 4880 mm

Grade	Typical thickness, mm	Maximum width, mm
Formable		
HU1S	1.6 – 3.2	900, 1200
Commercial	1.6 – 3.2	1810
Deep drawing	1.9 – 3.2	1810
Structural	2.2 – 3.2	1220

COLD ROLLED STEEL SHEET QUALITIES

Lysaght produces a variety of cold rolled steel sheet qualities to AS 1595 specification. These steels are available in coil 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, **C**.

Two basic types or **grades** of cold rolled steel may be specified:

Formable (ductile) grades Hardness grades

In addition, the quality designation indicates:

Surface finish, and
Surface quality

Formable (Ductile) Grades The second character (**R**, **A** or **U**) indicates steel type:

R = Rimming
A = Aluminium killed
U = Unspecified steel type

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

1 = Commercial forming
2 = Commercial drawing
3 = Deep drawing
4 = Extra deep drawing

A fourth character (**S** or **A**) is added if additional characteristics are required, and a fifth character (**N**) if non-ageing grade steel is necessary:

S = Skin-passed
A = Annealed last
N = Non-ageing (stabilized)

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 Finish Indicated by a letter, joined to the quality designation by a dash, to signify a **L**ustre, **M**att or **U**nspecified finish.

Surface Quality Designated by a letter (**G**, **E**, **F**) joined to the quality designation by a dash:

G = General purpose
E = Exposed panel
F = Full finish

LYSAGHT 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 Lysaght cold rolled steel qualities can be obtained from Lysaght State Offices. Assistance with the selection and specification of steels is also freely available.

Typical Lysaght qualities include:

CU1S–G – a skin-passed grade having sufficient ductility for simple commercial forming applications and produced to a general purpose surface standard.

CU1S–G is typically suitable for product normally traded as merchant stock, and used for:

Interior auto panels

General pressings

CR2S–E – a skin-passed steel intended for pressings of moderate severity. It is subject to ageing after final pressing, but freedom from stretcher strain can be obtained by flex rolling immediately prior to pressing.

CR2S–E is produced and guaranteed to Exposed Panel surface quality standard.

CA4SN–E – a non-ageing steel providing maximum drawability in conjunction with a standard of surface suitable for exposed items, such as auto panels and components.

Hardness Grades

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

Strength Grades

A range of strength 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.

GENERAL GUIDE TO COMPARATIVE FEATURES – COLD ROLLED STEEL

Quality	CU1S–G	CR2S–E	CA4SN–E
Form	Coil,	Coil, sheet	Coil, sheet
Surface quality	General purpose, oiled	Exposed panel, oiled	Exposed panel, oiled
Bending	Excellent	Excellent	Excellent
Roll-forming	Good	Excellent	Excellent
Pressing	Moderate	Good	Very good
Drawing	—	Good	Very good
Welding	Excellent	Excellent	Excellent

DIMENSIONS OF LYSAGHT COLD ROLLED FLAT STEEL QUALITIES – Typical only

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

Maximum sheet length – 4880 mm

Grade	Typical thickness, mm	Maximum width, mm
Formable		
Commercial	0.30 – 3.2	1800
Deep drawing	0.60 – 2.5	1800
Hardness	0.30 – 3.2	1800
Strength	0.60 – 2.0	1320

LYSAGHT LY-CORE ELECTRICAL STEEL QUALITIES

Lysaght produces a range of fully processed non-oriented electric steel qualities with magnetic properties covering the requirements of the electrical manufacturing industry.

These 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 millimetre thick sheet at an induction of 1.0 tesla and a frequency of 50 hertz.

The following Table is a general guide to selection of the appropriate quality for a given end use.

End use	Ly-Core grade						
	150	170	200	220	260	350	800
Large rotating machines	●	●	●				
General purpose and hermetically sealed AC motors			●	●	●	●	
Small motors and intermittent service AC motors					●	●	●
Alternators					●	●	●
Small power transformers	●	●					
Lighting ballasts		●			●	●	
Welding transformers					●	●	●

All qualities are available as wide or slit coil or as cut lengths, and with a choice of organic (CP3) or inorganic (CP4) insulating coatings. Further details are given in Lysaght Electrical Steel literature available from Lysaght State Offices.

Laminations

Sankey-Newcastle provides heat treated laminations and a general range of wound cores, including iron/nickel alloys. Details available from Lysaght State Offices or from John Lysaght (Australia) Limited, Sankey, PO Box 589, Newcastle, NSW 2300.

SANKEY – METAL PRESSINGS

The Lysaght Sankey operation provides a service to industry in the form of heat treated electrical steel laminations and a general range of wound cores, including iron/nickel alloys.

Other metal pressings are also produced to industry specification.

Full details are contained in the Sankey Electrical Steel Laminations catalogue and other literature available from John Lysaght (Australia) Limited, Sankey, PO Box 589, Newcastle, NSW 2300, or from Lysaght State Offices.

LYSAGHT STEEL SHEET – CORRECT SELECTION FOR USE

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

Steel sheet is a generic term which covers a considerable array of metallurgical products presented as continuous sheet in coil form or as sheets (cut lengths) or blanks.

The majority of sheet steel used in Australia is low carbon unalloyed steel, but even this type can be produced in differing ways to meet particular requirements of end users. Other types of steel include medium and high carbon, low-alloy high tensile.

The first section of the Referee outlines the steel sheet range regularly manufactured by Lysaght but it is emphasised that special grades or varieties of regular qualities may be produced to satisfy specific customer needs.

Technical Services

In each State capital and in some regional centres there is a Lysaght State Office with staff trained to assist customers in the selection of the most cost effective material for their requirements and in solving problems which may arise through the application of this material. Printed data and other information on sheet steel products are freely available in reply to approaches made by letter, telephone or by person.

A series of five Sheet Steel Fabrication Handbooks published to assist steel product designers, fabricators and other users, is available. These books comprehensively cover the subjects described by their titles, and like the Referee, are provided as a service.

Vol 1 – Sheet Steel
Vol 2 – Design
Vol 3 – Pressing and Forming
Vol 4 – Fastening and Sealing
Vol 5 – Finishing and Corrosion Protection

Each steel product has its own characteristics and the Lysaght staff can not only indicate the product best suited for the particular application, but can, in many cases, show how savings can be made by making use of products which reduce or simplify the customer's processing operations.

Included in the staff of each State Office are experienced and qualified technical representatives who can provide specialised services, often in customers' plants. They cover various aspects such as selection of sheet steel, processing in drawing, roll-forming or welding and finishing of components.

For more specialised advice or detailed problem investigation the local technical representative is able to draw upon the extensive Lysaght technical resources. Depending upon the problem, a detailed laboratory investigation may be arranged or a specialist may visit the customer for discussion, and in some cases an in-plant study, particularly if the problem is associated with a customer's manufacturing process.

John Lysaght (Australia) Limited has modern, well equipped and staffed laboratories which are registered and approved by NATA (National Association of Testing Authorities) for chemical, mechanical and electrical steel testing.

Although primarily engaged in the development of new products, improvement of existing ones and optimisation of manufacturing processes, the major Lysaght technical resources are also involved in quality control and have extensive experience of the type of problems which may arise in the use of the Company's products.

In optimising complex operations like rolling, heat treatment, continuous galvanizing, coil painting, shearing and slitting as well as punching, press-brake forming and roll-forming involved in the manufacture of the Lysaght product range, a knowledge of the fundamental principles involved has been gained, plus the expertise to apply these principles to actual manufacturing processes. This expertise and ability in process analysis and design is available to help customers with their particular problems.

Technical services available for the benefit of customers may be obtained through State Offices at all times. However the advice is particularly appropriate at times of product development or in the design stage or when extensions or changes to plant and equipment are being considered. By consultation prior to making decisions, economies in production and perhaps capital cost can often be achieved.

GLOSSARY OF TERMS

Ageing Changes in the properties of steel occurring with the passage of time either at ambient or higher temperatures.

Ageing may be natural or artificial as defined below.

Natural Ageing:

Spontaneous changes in the properties of steel occurring at ambient temperature and usually following solution treatment.

Artificial Ageing:

Changes in the properties of steel occurring consequent upon its being held at some elevated temperature after solution treatment.

Annealing A process involving heating and cooling, applied usually to induce softening.

The term *annealing* is also used to cover treatments:

(a) to remove stresses,

(b) to alter mechanical or physical properties,

(c) to produce a definite microstructure, and

(d) to remove dissolved gases.

Bend Test A test of ductility, wherein a test piece must withstand, without fracture, bending through a specified angle around a specified radius at ordinary temperatures.

Brazing Joining metals by fusion of a non-ferrous filler metal with a melting point above approx 450°C, but lower than those of the metals being joined.

The process may be accomplished by means of a torch (torch brazing), in each case with an appropriate flux, or by dipping in a molten flux bath (dip or flux brazing).

Carbon Steel A steel, free from intentionally added alloying elements, depending for its properties substantially upon its carbon content alone.

Camber Camber is the greatest deviation of a side edge of a sheet from a straight line. The measurement of a camber must be taken on the concave side with a straightedge which is in the same plane as the sheet.

Commercial Flatness Commercial flatness is the normal standard of flatness to which sheets are supplied and this is usually obtained by temper rolling and/or roller levelling.

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.

Ductility Relative ability of a metal to deform without fracture, that is, to work it into different or more complex shapes.

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.

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 a corrosive environment the subsequent failure is termed *corrosion fatigue*.

Finish Finish refers to the degree of smoothness or 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.

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-dipping, electroplating. Solid state diffusion (sherardizing) or spraying are not usually termed *galvanizing*.

From hot-dip galvanizing there developed a process for an aluminium/zinc alloy-coated steel known commercially in Australia as Lysaght Zincalume.

Hardness The resistance offered by a metallic material to plastic deformation by identation 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 *identation 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°C.

Mechanical Properties Properties relating to the behaviour of materials under load in conventional mechanical tests, such as elastic moduli, tensile strength, elongation, hardness.

Normalizing Heating steel to, and if necessary holding at, a suitable temperature above the transformation range, followed by cooling in a still atmosphere at 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.

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.

Pipe An axial cavity formed (especially in ingots) during the final stages of solidification creates a void, in the vicinity of which is concentrated a large proportion of the low-melting-point inclusions. Pouring technique and the design of moulds have a strong influence on the occurrence and extent of pipes, but the concentration of impurities (central segregation) cannot be completely avoided with *dirty* metal.

Resquared This term describes a sheet which has been sheared to accurate dimensional limits as a last operation in its production.

Skin-passing A light cold rolling operation which must not cause significant changes in sheet ductility. It is called *skin-passing* because it is essentially a surface treatment as distinct from *temper rolling*. Skin-passing is performed for three reasons:

(a) A small amount (about 1–2 per cent) of cold work removes the yield point in steel which otherwise causes coil break, fluting or stretcher strain in subsequent operations.

(b) To modify surface, for example, by reducing surface roughness for bright (lustre) qualities or by specially controlled roughening for matt finish for drawing qualities.

(c) Flattening.

Soldering Joining of metals by fusion with alloys that have relatively low melting points, most commonly lead-base or tin-base alloys, which are known as soft solders.

Joining with higher melting point alloys, sometimes termed hard solders at temperatures over 450°C, is generally termed *brazing*.

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 Levelled Stretcher levelled, as applied to sheets, indicates a standard of flatness. The term originated from an early method of obtaining flatness, that is, by gripping the ends of the sheet and stretching it to remove surface waves and buckles.

Stretcher Strain Markings Characteristic surface markings, usually of a wedge-shaped pattern, which appear during the early stages of the plastic deformation of mild steel and certain copper-base alloys. Their production is associated with the sudden extension at the yield point. In steel, they are called alternatively *Luders Lines*.

Temper To modify hardness of metals.

(a) Adjustment of hardness of heat treated articles by controlled heating after quenching.

(b) Increase of hardness by cold rolling or drawing by small increments.

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.

Lysaght Brownbuilt Industries
DIVISION OF JOHN LYSAGHT (AUSTRALIA) LIMITED

ZINCALUME STEEL ROOFING AND WALL CLADDINGS

Zincalume zinc/aluminium alloy-coated steel roof and wall cladding has largely replaced galvanized steel in the Australian building industry. The familiarity of steel roofing should not, however, be allowed to obscure even greater advantages derived from recent developments.

New Profiles Many modern profiles have been added to the range. Their benefits are individually discussed in following pages. Even the traditional corrugated sheet has been modernised.

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 LBI as was, for example, Deep Rib 600 for the Victorian SEC power station at Loy Yang.

Long Lengths LBI roofing and walling profiles are manufactured in long lengths so that on most applications one sheet will cover from ridge to gutter. The advantages of these long length sheets include neater appearance, reduced handling and installation costs, wider spacing for supports, the elimination of end laps and their attendant corrosion problems.

Improved Weather and Corrosion Resistance LBI roofing and walling is now produced from Zincalume, and 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 weathertightness. In some profiles, fastenings are attached below or behind the cladding, avoiding the need for piercing. Exterior Marviplate has been developed to withstand conditions of exposure met in severe marine and industrial atmospheres.

Colour Colorbond, Korarma and Exterior Marviplate sheets feature colourful organic coatings applied under controlled factory conditions.

A range of colour matched accessories and fastenings is available.

Strength and Fire Resistance Of the many roofing and walling materials now available, high tensile sheet steel remains the strongest. It offers high fire resistance; it will not crack or explode and being continuous prevents entry of flying sparks.

Thermal Insulation

Lined dwellings The Commonweaith Experimental Building Station has carried out very extensive studies of the thermal behaviour of buildings, and it has found that the major factor controlling internal room temperatures is the heat capacity or mass of the building. The material used for roof sheathing 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 possesses relatively low thermal emissivity which reduces radiation intensity to a low value. At the same time the improved light reflectivity and distribution is a considerable advantage with a single membrane roof without ceiling.

Coolclad is plain Zincalume or Off White Colorbond steel cladding with bright aluminium foil bonded to the underside.

Where Coolclad roofing and/or walling is used on unlined buildings, particularly in high temperature regions, discomfort to the occupants – human or livestock – is reduced because the direct radiation from sunlit surfaces is less. Coolclad performance is improved if Off White Colorbond is used.

Roofing Performance (Standards). LBI roofing and installation procedures comply with the requirements of the Australian Standard 1562, 'Design and Installation of Metal Roofing'. 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 Lysaght Brownbuilt building profiles are now manufactured in every Australian capital city and in numerous strategic regional centres. Products are available through LBI Roof and Wall Cladding Distributors, either in stock sizes or on prompt delivery, factory cut to a customer's own precise needs. A range of accessories and fasteners is also available. LBI State Offices can supply detailed technical literature for specific products and expert technical advice regarding any particular individual problems with may occur.

ZINCALUME STEEL ROOFING AND WALLING SELECTION GUIDE

New Homes One of the most extensive home building innovations of recent years has been the increased use of very low-pitched or flat roofs. It is in this area of design that the greater flexibility of steel over other materials has proved a significant factor. It is this flexibility that allows steel to be used successfully at lower pitches than most other roofing products, without even taking into account its other inherent advantages of strength, fire resistance, etc. In designs where a nearly flat roof is required, Klip-Lok or Brownbuilt Decking is the obvious choice since they allow pitches as low as 1°. Where the pitch is still low, but not as critical, other LBI profiles, such as Custom Orb, Trimdek Hi-Ten or Spandek may be used. In home construction the use of low-pitched roofing gives the dual advantage of design freedom with cost saving in structural framing.

Home Extensions With steel sheet roofing it is nearly always possible to add extensions beneath the existing

roof eaves and yet 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 or Brownbuilt Decking are the most suitable profiles. Where there is sufficient height to permit a slightly steeper roof fall, Custom Orb, Spandek and Trimdek Hi-Ten make excellent choices.

Carports, Garages, Roofed Outdoor Areas Where a flat roof is desired, use Klip-Lok or Brownbuilt Decking if long spans are necessary. Use Custom Orb, Spandek or Trimdek Hi-Ten where slightly more roof fall is possible. It should be noted that all these products have an underside which may be left exposed if desired, thus avoiding unnecessary additional costs where a ceiling is not required.

Fences, Privacy Screens LBI Custom Orb, Trimdek Hi-Ten, V-crimp and Easyclad Cladding Systems are all suitable, and may be used horizontally or vertically to achieve a variety of pleasing effects. Each of these products is easily attached to conventional timber or metal framework. LBI Colorscreen is a complete steel fencing system comprising posts, rails and Colorbond Trimdek Hi-Ten panels. Colorscreen fences can be do-it-yourself or be contract installed.

Colour Regular finish for all LBI roofing and walling profiles is hot dipped Zincalume steel. But with colour such an important consideration in so many applications, most LBI roofing and walling profiles are also available in Colorbond with a factory applied paint finish.

In addition to Colorbond, Exterior Marviplate or Korarma Building Shapes are also available in a selected colour range.

Exterior Marviplate has been developed to provide a building material which will withstand most severe conditions of exposure including those stemming from industrial or marine sources. It is manufactured by bonding specially formulated heavy-duty PVC film to one or both sides of Zincalume steel sheet.

Korarma coloured acrylic film/steel laminate has been developed for service in problem areas 300 m from marine atmospheres.

A range of LBI roofing and walling profiles is roll-formed from Korarma and Exterior Marviplate steel, together with a variety of matching fasteners and accessories.

The paint system used for Colorbond in exterior applications is a specially formulated silicone modified polyester. The choice of profiles in this material is matched by an attractive range of colours. In addition, a range of colour and material matching accessories is available. Since colour and, often, a number of colours used in the same building or location is being increasingly used in modern design schemes, the wide range and variety offered in LBI prepainted and prelaminated profiles and accessories is often a significant factor in the choice of building materials.

Farm Buildings LBI Custom Orb is recommended as the most suitable material for the roofing and walling of sheds, barns and other farm buildings. Custom Orb is available in custom cut lengths to suit requirements.

Shop Roofs All LBI Decking profiles are suitable for the roofing of shopping blocks. The final choice of profile will be influenced largely by the particular design. Generally, Klip-Lok or Brownbuilt Decking is used for modern low-pitched construction, while Spandek, Trimdek Hi-Ten or Custom Orb is recommended for roofs of steeper pitch.

Shop Facades There are a number of LBI building shapes which can be used to achieve a pleasing variety of design in shop facades. Easyclad Cladding systems can be used for a clean, sheer appearance. Alternatively, V-Crimp, V-Crimp Hi-Ten, Panelrib and Trimdek Hi-Ten or Spandek provide an attractive ribbed appearance. Brownbuilt Decking may also be used, erected with either the face or the reverse side exposed, with adequate weather protection, each side presenting a contrasting appearance.

Shop Awning Soffits LBI V-Crimp, V-Crimp Hi-Ten, Panelrib or any of the roof deckings may be used for awning soffits. Available in a Zincalume finish or pre-finished in Colorbond or Exterior Marviplate, long length

sheets virtually end the necessity for end lapping. The various types of cladding include the Easyclad Cladding Systems. The range takes in panels in differing tray modules, available in suitable Zincalume form for on-site painting or in Colorbond.

Factories, Warehouses Strength and economy make Trimdek Hi-Ten steel sheet the most commonly used material for the roofing and walling of factories and similar buildings. Trimdek Hi-Ten long lengths enable cladding to be carried out in a single run without end laps. The result is a saving in cladding time and a more pleasing finish.

As an alternative, Spandek is a ribbed steel sheet with a modern squared profile and can be used over longer spans, thus providing economies in framing costs.

V-Crimp and V-Crimp Hi-Ten are walling sheets that are eminently suitable for factory cladding and have a distinctive shallow ribbed appearance.

For prestige building, or for feature areas, use Klip-Lok or Brownbuilt Decking, the fastening clips for which are hidden from view. Where appearance is a factor to be considered, LBI prepainted and prelaminated profiles are an excellent choice. The range of colours and coating systems is wide enough and distinctive enough to ensure that no part of a factory area need look dreary merely because it is functional.

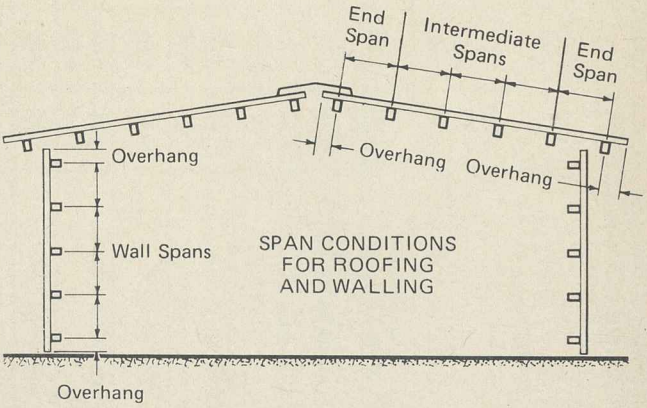
Buildings such as schools, hospitals, sporting centres, clubs and churches are usually architect-designed and the correct choice of roofing will usually be made from the individual design considerations.

Bull-nosing and Curving Many modern buildings feature bull-nosed or concave curved corrugated Zincalume Custom Blue Orb, usually in colourful Colorbond prepainted steel. Plain Zincalume or other organic finished steels are also available.

APPLICATION OF LBI CLADDING PROFILES

	Roofing	Walling	Fencing and Privacy Screens	Fascias Soffits Awnings
Custom Orb	●	●	●	●
Trimdek Hi-Ten	●	●	●	●
Spandek	●	●	●	●
Klip-Lok	●	●	●	●
V-Crimp	—	●	●	●
V-Crimp Hi-Ten	—	●	●	●
Tri-Lok	—	●	●	●
Brownbuilt 305 & 406 Decking	●	●	●	●
Easyclad Panels	—	●	●	●
Panelrib	—	●	●	●

● = Suitable for indicated application.



Refer to Table on next page

LBI ROOF AND/OR WALL SHEETING: COMPARISON OF SUPPORT SPACINGS (SPANABILITY)

Profile	Thickness, mm		Sheet cover width, mm	Max recommended support spacing for normal conditions, mm		
				Roofs		Walls
	Steel base	TCT*		Intermediate spans	End spans	Two or more spans
Custom Orb	0.42	0.48	760	1200	900	1800
Zincalume Custom Blue Orb	0.60 0.80	0.66 0.86	760 760	1200 2400	900 1800	1800 3000
Trimdek Hi-Ten	0.42	0.48	760	1700	1000	2400
Spandek	0.48 0.60	0.54 0.66	760 760	1700 2000	1300 1500	2700 3000
Klip-Lok	0.48 0.55 0.70	0.54 0.61 0.76	406 406 406	1200 1900 2400	1200 1900 2400	1500 2700 3000
Brownbuilt 406	0.55 0.70	0.61 0.76	406 406	1300 2100	1300 2100	1500 2400
Brownbuilt 406 MkV	0.55 0.70	0.61 0.76	406 406	1800 2700	1800 2700	1800 2700
Brownbuilt 305	0.55 0.70	0.61 0.76	305 305	1000 2200	1000 2200	1300 2400

Wall-Clad	0.35	0.40	760		1600
V-Crimp	0.48	0.53	610		1200
V-Crimp Hi-Ten	0.42	0.48	800	NOT	1200
Panelrib	0.42	0.48	900	FOR	600
Easyclad EG300	0.55	0.60	300	ROOFING	1500
Easyclad EC305	0.70	0.75	305		2400
Easyclad ED305	0.55	0.60	305		1800
Easyclad EF305	0.55	0.60	305		1800

WALLING ONLY

* TCT = approximate total thickness of steel plus metal alloy coating

Refer to Span Conditions illustration on previous page

LBI ROOF AND WALL SHEETING OPTIONAL FINISHES

Lysaght Brownbuilt Industries roofing and walling sheets are roll-formed from either plain or organic prefinished 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 silicone modified polyester (SMP) Colorbond prepainted steel in a range of colours. Many are also produced from Korarma acrylic film laminated steel and/or Marviplate PVC film laminated steel in a range of colours. Some selected profiles are also available formed from Coolclad steel, which is a laminate of Zincalume or Colorbond steel and aluminium foil, for use as a solar energy barrier building sheet.

For a more detailed description of these steels, refer to index under the appropriate steel name.

In the following pages briefly describing each of the LBI 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-AZ200 means steel conforming to Australian Standard 1397, with steel base minimum yield stress 550 MPa, aluminium/zinc alloy coating 200 g/m^2 minimum coating mass determined by prescribed triple spot test.

The coating classes nominated relate to plain Zincalume steel. Coating class AZ150 is used for organic prefinished steels Colorbond, Korarma and Marviplate.

LBI CUSTOM ORB
LBI ZINCALUME CUSTOM BLUE ORB
LBI WALL-CLAD
LBI CUSTOM BLUE ORB

LBI Custom Orb, Zincalume Custom Blue Orb and Wall-Clad are Zincalume zinc/aluminium alloy-coated steel sheet roll-formed to the familiar conventional 76 mm pitch corrugated profile. Custom Blue Orb is the same corrugated profile product but has a zinc coating.

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

Custom Orb – Roofing and walling.

Zincalume Custom Blue Orb – Curving quality roofing and walling sheet for bull-nosing and tank-making.

Wall-Clad – 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.

LBI CUSTOM ORB

Custom Orb is a corrugated Zincalume steel sheet combining high strength, lightness and zinc/aluminium coating for outdoor exposure and 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–AZ200 (AZ150 if organic coated); $10\frac{1}{2}$ x 76 mm corrugations; 760 mm cover width with $1\frac{1}{2}$ corrugations side lap; total coated thickness 0.48 mm, steel base thickness 0.42 mm.

Custom Orb is not suitable for curving. Zincalume Custom Blue Orb is a companion sheet which may be used where curving and bull-nosing are required.

Available in stock lengths up to 9000 mm or factory cut to lengths in 10 mm 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 provide design and installation advantages including:

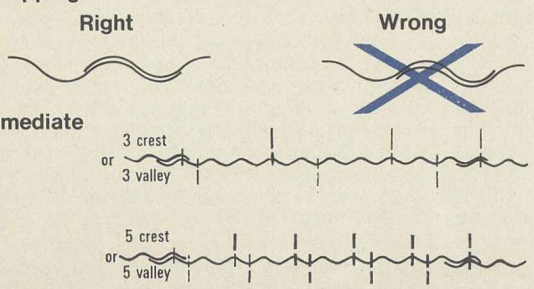
- Custom cut lengths to avoid waste.
- Wide support spacings – internal spans up to 1200 mm for roofing and up to 1800 mm for walling in normal weather conditions.
- One sheet from roof ridge to gutter – no end laps.
- Minimum roof slope of 5° (1 in 12) on roofs without end laps.
- Consecutive side lapping and laying without the need to turn over alternate sheets.
- Weather resistant $1\frac{1}{2}$ corrugations side laps.
- Maximum eaves overhang of 200 mm unstiffened, or 300 mm when stiffened with a 50 x 1.6 mm angle or equivalent.

Custom Orb can also be supplied as a Colorbond (pre-painted) or Korarma (acrylic film laminate) or Exterior Marviplate (PVC film laminate) or Coolclad (bright aluminium foil laminate) Building Shape.

Installation Data

Location of crest or valley fastenings for intermediate and end fastening for normal weather conditions. Refer page 2.

Side lapping:



LBI ZINCALUME CUSTOM BLUE ORB

Zincalume Custom Blue Orb is essentially the same as Custom Orb but being formed from a thicker ductile steel 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–AZ200; $10\frac{1}{2}$ x 76 mm corrugations; 760 mm cover width with $1\frac{1}{2}$ corrugations side lap. Two thicknesses are available:

Total coated thickness	Steel base thickness
0.66 mm	0.60 mm
0.86 mm	0.80 mm

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 0.86 mm TCT sheet maximum support spacings in normal areas are 2400 mm for roof intermediate spans and 3000 mm for wall spans.

Zincalume Custom Blue Orb can be supplied as plain Zincalume steel or as Colorbond (prepainted) or Exterior Marviplate (PVC film laminate) building shapes.

LBI WALL-CLAD

Wall-Clad is an economy corrugated walling sheet produced from Zincalume steel with the same traditional profile as Custom Orb. Wall-Clad steel conforms to AS 1397–G550–AZ150, $10\frac{1}{2}$ x 76 mm corrugations; 760 mm cover width with $1\frac{1}{2}$ corrugations side lap; total coated thickness 0.40 mm, steel base 0.35 mm.

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 1600 mm.

CUSTOM BLUE ORB

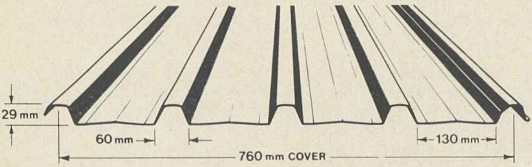
Custom Blue Orb is a curving quality corrugated steel sheet produced with a heavy zinc coating. Custom Blue Orb sheets conform to AS 1445–G300–Z550; total coated thickness 0.68 mm, steel base thickness 0.60 mm. Two widths are available:

$10\frac{1}{2}$ x 76 mm corrugations
8 x 76 mm corrugations

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

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

TRIMDEK HI-TEN



Trimdek Hi-Ten is a Zincalume, high-tensile, light-weight sheet steel roofing and walling sheet roll-formed to a modern shape.

Material conforms to AS 1397–G550–AZ200. 760 mm cover width. Total coated thickness, 0.48 mm, steel base thickness 0.42 mm.

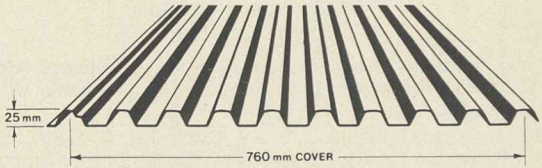
Trimdek Hi-Ten is also available as a Colorbond (pre-painted) or Korarma (acrylic film laminate) or Exterior Marviplate (PVC film laminate) Building Shape.

Available in factory cut lengths up to 12 000 mm in 10 mm increments. Longer lengths 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 760 mm.
- Minimum pitch of 3° (1 in 20) on roofs without end laps.

SPANDEK



Spandek is a Zincalume lightweight steel roofing and wall cladding sheet, roll-formed to a modern mansard profile. Spandek is also available as a Colorbond (pre-painted) or Exterior Marviplate (PVC film laminate) Building Shape.

Material conforms to AS 1397–G300–AZ200. 9 x 84 mm pitches, 760 mm cover width.

Two thicknesses are supplied:

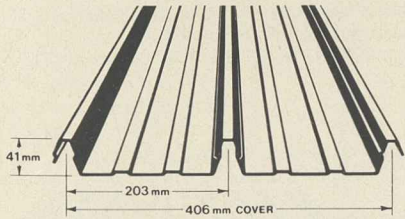
	Regular	Heavy
Total coated thickness	0.54 mm	0.66 mm
Steel base thickness	0.48 mm	0.60 mm

Available in factory-cut lengths up to 12 000 mm in 10 mm increments. Longer lengths 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 1700 mm for roofing and up to 2700 mm for walling for normal weather conditions. (Refer page 2).
- One sheet from roof ridge to gutter – no end laps.
- Effective cover width of 760 mm.
- Minimum pitch of 3° (1 in 20) on roofs without end laps.
- Patented fluted side lap for protection against moisture entry by capillary action.

KLIP-LOK



Klip-Lok is a lightweight, rigid roof decking or wall cladding roll-formed from strong Zincalume steel in a choice of three thicknesses.

Material specification is to AS 1397–G300–AZ200. The zinc/aluminium alloy coating provides outdoor exposure protection and long life. Effective cover width of Klip-Lok decks is 406 mm.

Total coated thicknesses	0.76 mm	0.61 mm	0.54 mm
Steel base thicknesses	0.70 mm	0.55 mm	0.48 mm

Klip-Lok decks are designed particularly for low pitch roof applications. The interlocking ribs, together with concealed fastening (no puncturing) ensure weather resistance on roof pitches as low as 1° (1 in 55) where no end laps are used. When used as a wall cladding, Klip-Lok may be erected with either the face or reverse side exposed, with equal protection, each side presenting 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 use of more economical framework.
- Positive side rib interlocking with concealed clips providing adequate fastening.
- Effective spreading of loads from one deck to adjacent decks.
- Modern architectural profile.

Colorbond (prepainted) or Korarma (acrylic film laminate) or Exterior Marviplate (PVC film laminate) decks are also available.

Klip-Lok decks are available factory cut to lengths in 10 mm increments up to 15 000 mm. Longer lengths available provided satisfactory transport and on-site handling can be arranged.

Design Data

For normal weather conditions. (Refer to page 2).

Total coated thickness,	Maximum recommended spacing of supports – two or more spans		Maximum eaves overhang,
	Roofs	Walls	
mm	mm	mm	mm
0.76	2400	3000	300 (1200 stiffened*)
0.61	1900	2700	300 (900 stiffened*)
0.54	1200	1500	200 (600 stiffened*)

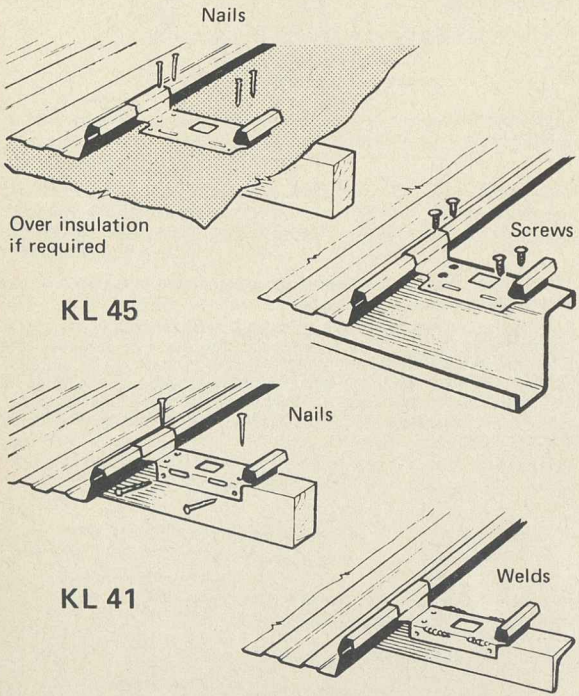
*The longer maximum eaves overhangs shown can be achieved when stiffened with a gutter system.

1° is the recommended minimum pitch. It is important that supports are in the same plane, as variation at the time of installation (or later due to the uneven shrinking of timber supports) can cause a zero or negative fall. As a precaution, it is wise to design for a minimum 2° pitch to ensure a positive fall, and avoid any danger of 'ponding' which could lead to a reduced service life, particularly in coastal areas.

Installation Data

The top (KL45) and side (KL41) fastening clips are a special feature of the Klip-Lok system. These are concealed during erection and the roofing is secured without being punctured.

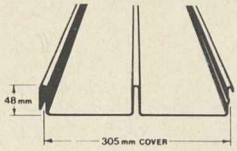
Installation accessories, tools, instructions and design data are available and detailed in the various published Klip-Lok leaflets.



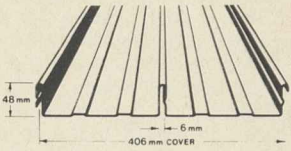
A special clip, KL55, is used for Klip-Lok HW. Refer to Klip-Lok HW literature for full information.

BROWNBUILT 305 AND 406 DECKING

305 all States except Qld and WA



406 all States except Qld and NSW



Brownbuilt 305 and 406 Deckings are self-supporting, Zincalume steel roof deckings and wall claddings featuring the aesthetically pleasing narrow rib profile. The narrow rib allows positive button punching connection of decks, which technique is predictable in strength and contributes to both concentrated and live load supports.

Both deckings are roll-formed from Zincalume steel conforming to specification AS 1397–G300–AZ200. Cover widths are 305 mm and 406 mm, rib height 48 mm. Available in lengths custom cut in 10 mm increments up to 15 000 mm. Longer lengths may be available provided satisfactory transport and on-site handling can be arranged.

Brownbuilt 305 and 406 Deckings are also produced in Colorbond prepainted steel; 406 Exterior Marviplate Decking is also available.

These decking systems provide a weather resistant roof suitable for flat, low, gable or skillion applications. The narrow rib enables clean undersoffit appearance for exposed eaves, carports, canopies, etc. When used as a wall cladding, decks may be erected with either the face or reverse side exposed, with adequate weather protection, each side presenting a contrasting appearance.

Other design and installation features include:

- Custom cut lengths to avoid waste.
- Long deck lengths.

- Less structural formwork required.
- Increased support spacing.
- Positive and predictable button punch rib connection.
- Positive male rib concealed clip securement.
- Quick erection, saving time and cost.
- Aesthetically pleasing narrow rib.
- Effective spreading of loads from one deck to another.

The Brownbuilt Decking profile system embodies patented features which permit the fitting of insulating materials from the underside of the decking after completion of the roof.

Design Data

For normal weather conditions. (Refer to page 2).

Total coated thick-ness,	Steel base thick-ness,	Maximum recommended spacing of supports – two or more spans		Maximum eaves overhang, stiffened*,
		Roofs	Walls	
mm	mm	mm	mm	mm
Brownbuilt 305				
0.61	0.55	1000	1300	900
0.76	0.70	2200	2400	1200
Brownbuilt 406				
0.61	0.55	1300	1500	900
0.76	0.70	2100	2400	1200

* Maximum eaves overhangs shown can be achieved when stiffened with a gutter system.
Minimum recommended roof slope is 1° (1 in 55).

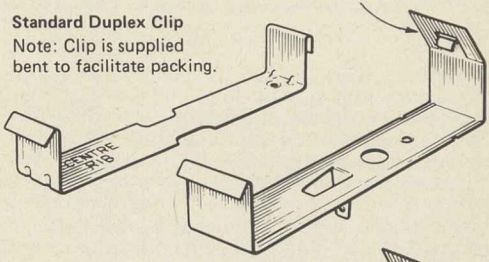
Installation Data

When button punching, it is most important that the button punch tool be correctly oriented, ie, punch indenting under the return lip of the male rib.

Clips for 406 mm Deck

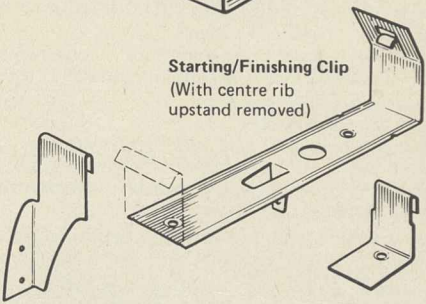
Starting/Finishing Clip
Tab folds over Rib.

Standard Duplex Clip
Note: Clip is supplied bent to facilitate packing.



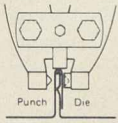
Clips for 305 mm Deck

Starting/Finishing Clip
(With centre rib upstand removed)



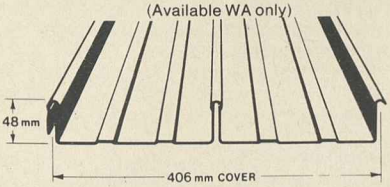
Side Fixing Clip —Right hand
(left hand also available)

Top Fixing Clip



Punch head is preset to punch 12 mm from crown of rib.
Do not punch on clips.

BROWNBUILT MARK V 406 DECKING



Brownbuilt Mark V 406 Decking is a self-supporting, Zincalume steel roof decking and wall cladding featuring the aesthetically pleasing narrow rib profile. However, the rib profile differs from the Brownbuilt 406 decks in that it reduces from 11 mm radius bulb top to the 6 mm spacing between rib walls. This bulb rib top gives added rib strength and allows the positive button punching connection of decks, which technique is predictable in strength and contributes greatly to both concentrated and live load support.

Zincalume steel specification conforms to AS 1397–G300–AZ200. Two thicknesses are produced:

Total coated thicknesses	0.61 mm	0.76 mm
Steel base thicknesses	0.55 mm	0.70 mm

Cover width is 406 mm, rib height 48 mm. Lengths are custom cut in 10 mm increments up to 15 000 mm. Longer decks may be available provided suitable transport and on-site handling can be arranged.

Mark V 406 decking is also available in Colorbond (pre-painted) steel or in Exterior Marviplate steel.

This decking system provides a weather resistant roof suitable for flat, low, gable or skillion application. The narrow rib enables clean undersoffit appearance for exposed eaves, canopies, carports, etc. When used as a wall cladding, the decks may be erected with either the face or reverse side exposed, with adequate weather protection, each side presenting a contrasting appearance.

Other design and installation features include:

- Custom cut lengths to avoid waste.
- Long deck lengths.
- Less structural framework required.

- Increased support spacing.
- Positive and predictable button punch rib connection.
- Positive male rib concealed clip securement.
- Quick erection, saving time and cost.
- Aesthetically pleasing narrow rib.
- Effective spreading of loads from one deck to another.

The Brownbuilt Mark V 406 Decking profile system embodies patented features which permit the fitting of insulating materials from the underside of the decking after completion of the roof.

Design Data

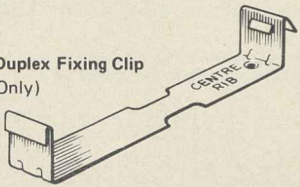
These recommendations are for normal weather conditions. (Refer to page 2).

Total coated thickness,	Steel base thickness,	Maximum recommended spacing of supports		Maximum eaves overhang stiffened*,
		Intermediate spans		
		Roofs	Walls	
mm	mm	mm	mm	mm
0.61	0.55	1800	1800	900
0.76	0.70	2700	2700	1200

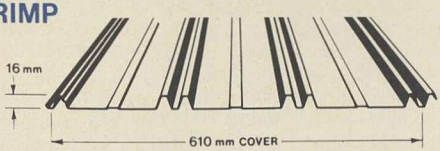
* Maximum eaves overhangs shown can be achieved when siffened with a gutter system.
Minimum recommended roof slope 1° (1 in 55).

Installation Data

Button punching is as shown for Brownbuilt 305 and 406 Decking. It is most important that the button punch tool be correctly oriented, ie, puch indenting under the return lip of the male rib.



V-CRIMP



V-Crimp is a coated steel sheet specifically designed for wall cladding and is therefore not suitable for roofing. It is roll-formed from Zincalume steel to AS 1397–G300–AZ150. Total coated thickness 0.53 mm, steel base thickness 0.48 mm.

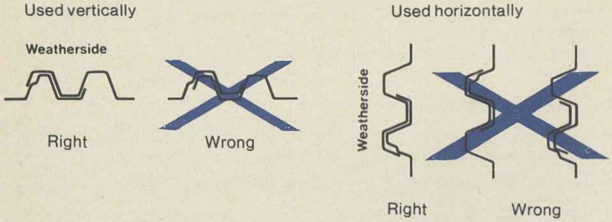
Colorbond (prepainted) or Exterior Marviplate (PVC film laminate) sheets are also produced.

V-Crimp is available factory cut to lengths in 10 mm increments up to 7500 mm. Longer lengths may be supplied provided satisfactory transport and on-site handling can be arranged.

Installation Data

The correct side lapping of V-Crimp walling can only be accomplished with the *flat face* or *bottom* of the sheet against support member, ie, the sheet is not reversible. See detailed installation information in V-Crimp literature.

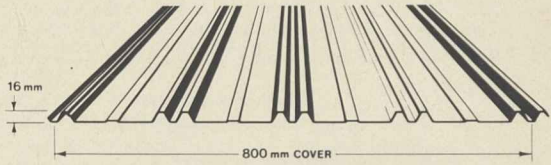
Side lapping:



Location of valley fastenings for all girts and battens under normal weather conditions. Crest fastening should not be used for V-Crimp walling.

V-CRIMP HI-TEN

(Available Qld and NT only)



V-Crimp Hi-Ten is a wide-cover walling sheet made from high strength Zincalume steel conforming to AS 1397–G550–AZ200. Total coated thickness 0.48 mm, steel base thickness 0.42 mm.

V-Crimp Hi-Ten ribs and flutes give rigidity and strength to the steel sheet and permit support spacings up to 1200 mm.

The shallow rib depths and sheet cover width of 800 mm make V-Crimp Hi-Ten suitable for a range of applications including walling, fascias, awnings, fences and garage doors.

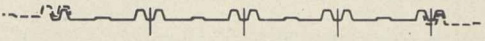
V-Crimp Hi-Ten is also produced as Colorbond (pre-painted) or Exterior Marviplate (PVC film laminate) sheet.

Available factory cut to lengths in 10 mm increments up to 7500 mm. Longer lengths may be supplied provided satisfactory transport and on-site handling can be arranged.

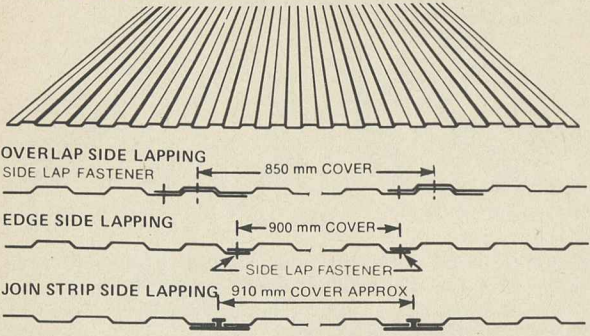
Side lapping procedures are as shown for V-Crimp.

Fastener locations are in the valley of each rib, four fasteners per sheet at each support.

Side lap fasteners are required at mid spans to hold the side laps of sheets firmly in place and maintain a weather-proof joint.



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–AZ200 specification. Total coated thickness 0.48 mm, steel base thickness 0.42 mm. Panelrib is not suitable for roofing.

Panelrib is suitable for many applications where relatively flat sheet 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 approximates that of a flat sheet six times as thick.

Panelrib material options include Colorbond (prepainted) or Korarma (acrylic film laminate) steel. It can also be produced from Exterior Marviplate steel by special arrangement.

Cover widths are:

Overlap side lapped	850 mm
Edge side lapped	900 mm
Joint strip side lapped	910 mm

Panelrib is available in stock lengths from 1200 to 5000 mm or custom cut to lengths up to 6500 mm, longer lengths subject to enquiry.

EASYCLAD CLADDING SYSTEM

Easyclad Cladding System panels are used for sidings, feature panels, soffit linings, non-acoustic ceilings, in internal and external applications. Vertical or horizontal placement for walls and fascias. A range of accessories is available. (Refer to trade literature for comprehensive data.)

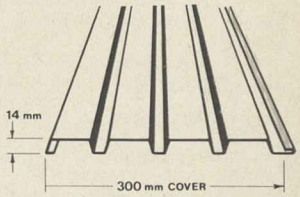
Easyclad material options:

Plain Zincalume steel	all
Colorbond steel	all
Korarma steel	EG300, EF305
Exterior Marviplate steel	EG300, ED305

Zincalume steel used conforms to AS 1397.

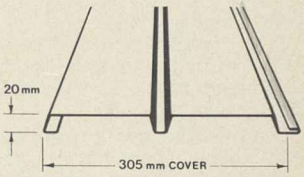
EG300

Flat trays. 300 mm metric sheet module. Suits current architectural trend for raised board profile with sharp shadow line. Concealed fastening using clip or direct fastening to supports up to 1500 mm.



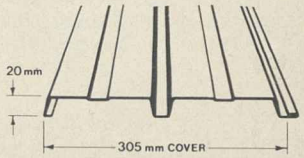
EC305

Flat trays. 305 mm sheet module. The clean, flat pans suit current architectural demands. Concealed fastening clip or direct fastening to supports up to 2400 mm centres.



ED305

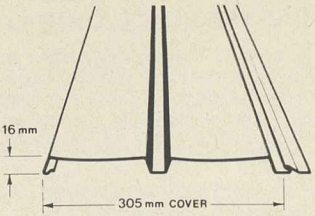
Fluted trays. 305 mm sheet module. Concealed clip or direct fastening to supports up to 1800 mm centres.



EF305

Qld. only

Doric trays. 305 mm sheet module. Curve eliminates ripple for very crisp profile. Concealed pierce fastening by nail, screw, rivet to supports up to 1800 mm centres.



LBI roofing and/or wall cladding decks such as Klip-Lok, Brownbuilt 305 and 406, Trimdek Hi-Ten, Spandek, V-Crimp, V-Crimp Hi-Ten and Panelrib can also be used to advantage in fascia, soffit, awning or walling applications. All of these shapes are produced in plain Zincalume steel or in Colorbond prepainted steel. Exterior Marviplate or Korarma steels are available in a selection of shapes.

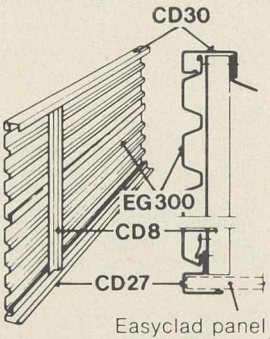
ACCESSORIES

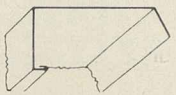
Feature Fascia System

Easyclad Panel 'Feature Fascia' systems meet flexible design needs with unique standardization of componentry, and offer almost unlimited scope for Commercial, Industrial and Domestic fascia and facade applications.

The basis of this system is the use, in combination, of components from the wide range of standard Panel profiles and accessories, thus providing great design freedom.

Example of typical feature fascia

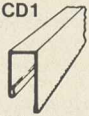




Accessory Sections

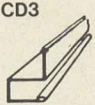
The Easyclad wide range of work-saving accessories comprises trims, membranes, purlins, secondary grounds and fastenings to reduce prime cost of panel and ceiling systems.

CD1



Trim channel

CD3



Fascia to soffit section

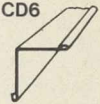
CD4

Feature section fascia to soffit

CD5

External corner trim

CD6

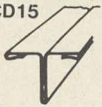


Internal corner trim

CD8

Purlin hat section

CD15



Tee section

CD27

Fascia to soffit section

CD30

Fascia capping or trim

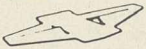
CD39

Trim channel

Accessory Clips

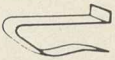
Easyclad accessory clips in many cases remove the need for power tools and hole drilling. These clips reduce installation cost considerably.

CD29



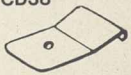
Lightning fix clip

CD37



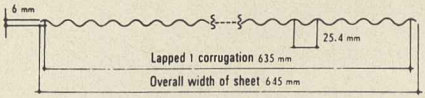
Termination clip

CD38



Fixing clip

BLUE ORB



This 25 x 25.4 mm 'ripple' corrugation Blue Orb walling sheet is typically used for linings, awnings, ceilings, showers, sheds and country halls. This sheet is suitable for curving.

Material specification conforms to AS 1397–G300–Z300; cover width is 635 mm with 1 corrugation side lap.

Total coated thickness 0.45 mm, steel base thickness 0.40 mm.

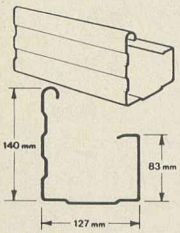
Available in sheet lengths 1500 mm to 3000 mm in increments of 300 mm.

ROOFING ACCESSORIES

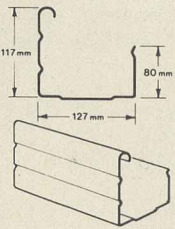
GUTTER SYSTEMS

Two LBI gutter profiles suitable for all types of roofs are Sheerline and Trimline. Fastening clips to suit various requirements are available.

SHEERLINE



TRIMLINE



These are available in plain or prepainted Zincalume steel; Sheerline also in Exterior Marviplate. Other materials may be available on application.

ROOF DRAINAGE

RAINWATER RUN-OFF

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

As a guide, Table A gives examples of maximum length sheet runs for various LBI sheet profiles at the roof slopes and rainfall intensities shown. These examples are based on CSIRO report 02–2–32 'The Influence of Slope Upon the Discharge Capacity of Roof Drainage Channels'.

The sheet run is the total length of roof sheeting including any end laps or expansion joints that may be included in the roof.

The rainfall and run-off length can be proportioned linearly for a given roof slope and profile.

Table A – RAINFALL: MAXIMUM ROOF RUN

LBI deck type	Roof slope	Rainfall intensity, mm/hr	Max run-off length, m
Custom Orb	10° (1 in 6)	200	25
Custom Orb	5° (1 in 12)	200	20
Spandek	5° (1 in 12)	250	30
Spandek	3° (1 in 20)	250	25
Trimdek Hi-Ten	3° (1 in 20)	300	30
Klip-Lok	1° (1 in 55)	400	35
Brownbuilt 406 & 305	1° (1 in 55)	400	40

RAINFALL INTENSITIES

Table B – 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
ACT	Canberra	142	185
NSW	Broken Hill	102	132
	Bathurst	150	196
	Sydney	190	239
	Newcastle	211	277
VIC	Mildura	91	119
	Melbourne	130	173
	Ballarat	135	175
QLD	Cloncurry	188	249
	Brisbane	216	262
	Rockhampton	274	361
	Cairns	376	493
SA	Mount Gambier	130	170
	Adelaide	145	196
WA	Geraldton	148	193
	Perth	155	190
TAS	Hobart	102	135
NT	Alice Springs	142	185
	Darwin	401	526

GUTTER CAPACITY

The gutter cross-sectional areas given in Table C are provided for guidance only. Where more design detail is required, the aforementioned CSIRO Report 02.2.30 and The Institute of Engineers, Australia, 'First Report of the Stormwater Standards Committee, Australian Rainfall and Run-Off' should be consulted.

Table C 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.

Australian Standard 2180 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 15 000 mm^2 cross-section, should be a minimum of 300 mm wide and fully supported to allow workmen to walk along the bottom of the gutter. Sheeting such as LBI Spandek can be used under a wide box gutter to provide full support between the gutter hangers.

Table C – GUTTER SIZES FOR VARIOUS RAINFALL INTENSITIES AND ROOF CATCHMENT AREAS PER DOWNPIPE

Roof catchment area[1]	10 m^2	20 m^2	50 m^2	100 m^2	200 m^2
Rainfall intensity[2] mm/hr	Cross-sectional area of Gutter, mm^2				
100	1 480	2 570	5 360	9 320	16 230
120	1 680	2 930	6 100	10 620	18 490
130	1 790	3 120	6 500	11 310	19 690
140	1 900	3 310	6 890	12 000	20 890
150	2 020	3 510	7 310	12 730	22 170
170	2 230	3 880	8 080	14 070	24 490
180	2 350	4 090	8 500	14 810	25 770
190	2 460	4 290	8 920	15 540	27 050
200	2 560	4 450	9 270	16 140	28 100
250	3 060	5 320	11 080	19 290	33 590
275	3 310	5 760	12 000	20 890	36 360
375	4 240	7 390	15 370	26 770	46 590
400	4 430	7 700	16 040	27 930	48 620
500	5 190	9 030	18 790	32 720	56 960
525	5 380	9 360	19 480	33 930	59 060

1 The roof catchment area for each downpipe is the length of roof run (ridge to gutter) multiplied by the spacing between downpipes.

2 Rainfall intensities, related to a storm of 5 minutes duration and a return interval of once in 20 years and once in 100 years, are listed for major and other selected localities in Table B.

3 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 25 mm freeboard, on the depth of internal box gutters, should be added to the cross-sectional areas given.

STEEL GUTTERS

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 rain-water; these included zinc oxides and carbonates from the early oxidation of galvanized roofs and mainly calcium salts leaked from asbestos cement or cement tile roofs. Today, with the increased popularity of inert roofing materials such as Colorbond steel, Zincalume steel and terracotta tiles, there is greater opportunity for the occurrence of shortened lives for galvanized gutters, 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 from steel gutters used in combination with inert roofing materials and in all but the most severe environments if protected by the hot dipped zinc/aluminium coating applied to Zincalume steel.

The Lysaght recommendation for steel gutters is that Zincalume steel (either plain or as prepainted Colorbond or other organic coated steel) specified in AS 2179 should be used in preference to galvanized steel.

DOWNPIPE CAPACITY

The cross-section of a downpipe from an eaves gutter should have 650 mm^2 for each 10 m^2 of roof area draining into the downpipe.

The cross-section of a downpipe from an internal box gutter should have 650 mm^2 for each 7 m^2 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 funnels at the head of each downpipe, particularly for internal box gutters. Where possible downpipes should be spaced at no more than 18 m centres.

INSTALLATION INSTRUCTIONS AND SITE NOTES

INSTALLATION INSTRUCTIONS

Installation instructions for each LBI roofing and walling product are provided in individual product literature. A complete 'Steel Roofing and Walling Installation Manual' for all LBI claddings is available from LBI Offices or Distributors.

CARE AND STORAGE PRIOR TO INSTALLATION

LBI plain Zincalume, galvanized or organic coated 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, should be 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, and as this trapped moisture cannot evaporate normally, it 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 LBI steel products within 1 km of salt marine locations, or in severe industrial or unusually corrosive atmospheric environments it is preferable that specialised advice be sought from an LBI Office. However, as a general guide Lysaght 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, sheets should be handled wearing clean dry gloves. 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 on to, and in the case of Colorbond, Korarma and Marviplate prefinished steels, possibly adhere to the lower sheeting. Where cutting over other sheeting cannot be avoided a protective covering should be placed over the lower sheets. When saw-cutting Colorbond, Korarma or Marviplate 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 edge than carborundum discs.

PERFORMANCE

LBI roofing and walling will perform as specified if installed in accordance with the recommendations set out in individual product literature.

WALKING ON ROOF SHEETING

When walking **along** the length of roof sheeting walk in the trays of Klip-Lok, Brownbuilt and Trimdek Hi-Ten and on at least two ribs or corrugations of Spandek and Custom Orb. When walking **across** the length of roof sheeting walk over or close to the roofing supports. Generally, keep load evenly distributed over the soles of both feet and try not to concentrate load on 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 newly laid sheets 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 up 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.

Important All LBI roofing and walling is formed from Zincalume irrespective of final finish.

DO NOT use lead head nails or any lead as flashings, washers etc, in contact with Zincalume.

CLEANING UP

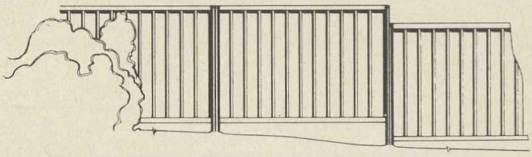
Normal installation procedures for roofing and flashing using self-drilling screws, drills, hack-saws, power saws or files will usually deposit metallic particles on or near the roof sheeting and roof area. These metallic particles and all other debris including blind rivet shanks, nails, screws, nuts, 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 surfaces subjected to moist or condensation conditions.

CEILING PANELS

Although many of the roll-formed claddings produced by LBI may be used for ceiling panels, the Easyclad Cladding Systems and Tri-Lok ranges are especially suited for this purpose.

Both systems employ concealed fastening and a full range of accessories is available.

COLORSCREEN STEEL FENCING SYSTEM



Colorscreen is a strong, impact resistant steel total fencing system for colourful dividing and wing fences, and for privacy around swimming pools and courtyards. The vertical-ribbed panels make the fence difficult for small children to climb.

The system utilises specially designed posts, top and bottom rails, and Colorbond prepainted steel Trimdek Hi-Ten sheets for panel infills.

Fence heights are 1500 mm and 1800 mm. Assembled panel lengths approximate 2370 mm and, if required, these panel lengths may be stepped to follow slopes of 1 in 8 with maximum steps of 300 mm. Steeper slopes require shorter panel lengths.

Fence height should be limited to 1500 mm in areas exposed to high winds. If Colorscreen is contemplated for use in cyclonic areas, specialized advice should be obtained from LBI Offices or product Distributors.

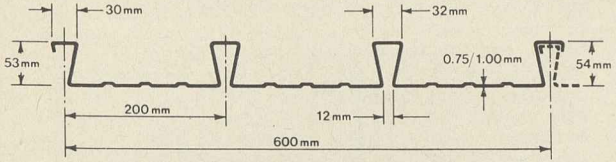
Assembly and erection are simple and may be carried out by the home handyman from details provided or be contract installed.

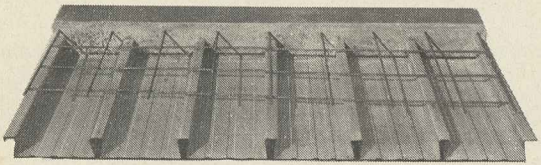
Enquiries may be directed to LBI Offices or LBI product Distributors.

STRUCTURAL DECKING

BONDEK

Lysaght Brownbuilt Industries Bondek is a high strength zinc-coated steel composite decking which acts as both permanent formwork and positive tensile reinforcement in one-way reinforced suspended concrete slab construction.





It is suited for most types of construction, high rise steel or concrete framed buildings, load bearing brickwork as in home units, cottages, hospitals, motels and many other applications.

Bondek composite slab construction conforms to SAA Concrete Structures Code AS 1480. Panels are roll-formed from zinc-coated steel in steel base thicknesses 0.75 and 1.0 mm to AS 1379-G500-Z200 (1.0 mm) and AS 1397-G550-Z200 (0.75 mm). Bondek sheets provide an effective cover width of 600 mm with interlocking ribs at each edge for side lapping. Lengths are custom cut to project requirements, limited only by transportation and handling considerations in the factory and on site.

SLAB SELECTION CHART

Simply Supported Slab Design
(Secondary Reinforcement)
Max. allowable superimposed load 4 kPa

Bondek steel thickness,	Span,	Minimum slab depth,	Minimum secondary reinforcement to AS 1480		Propping
mm	mm	mm	Indoors	External	
0.75	1500	90	F42T	F52T	No props required
	1800	90	F42T	F52T	
	2100	90	F42T	F52T	
	2400	90	F42T	F52T	
	2700	90	F42T	F52T	One row props
	3000	100	F52T	F62T	
	3300	110	F52T	F62T	
	3600	120	F52T	F62T	
	3900	140	F62T	F72T	
	4200	150	F62T	F72T	2 rows props
1.00	4500	180	F72T	F82T	

The main features of Bondek include:

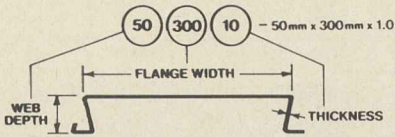
Reduced propping
Reduced reinforcement
Long lengths for continuous spans
Fast and simple construction
Does not require skilled labour for installing
Allows other trades to commence work earlier
Provides a safe working platform
Weather cover for workmen on floors below
Suitable for suspended or direct fastened ceilings
The Bondek slab with additional fire emergency reinforcement provides fire ratings of up to three hours.

TRI-LOK

Lysaght Brownbuilt Industries Tri-Lok is a system of strong, parallel interlocking steel structural panels. Applications include wall and roof cladding, structural floors and roofs, ceilings, awnings, facades and other specialised architectural features.

The interlocking design of Tri-Lok panels provides strength, economy and durability. Tri-Lok can be installed *ribs in* or *ribs out* as required.

The panels are formed from AS 1397-G250-Z300 zinc-coated steel in a range of sizes. Profile variations are to the web depths and flange widths.



Profile and catalogue number system example: Tri-Lok 5030010

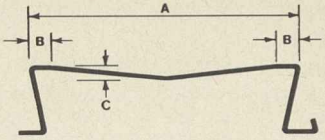
DIMENSIONS

Tri-Lok is supplied in lengths custom cut to 7500 mm.

Standard Panels

Catalogue number	Web depth, mm	Flange (cover) width, mm
5030010	50	300
7530010	75	300
7530012	75	300
10022510	100	225
10022512	100	225

W Type Panel

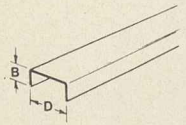
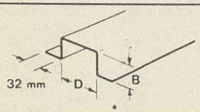
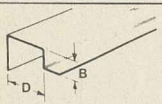
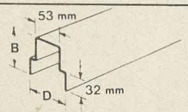
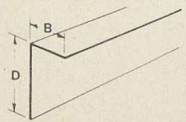


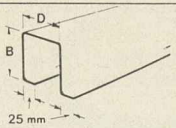
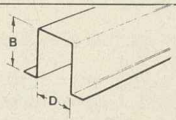
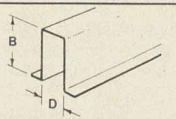
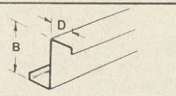
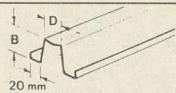
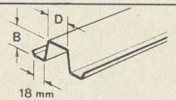
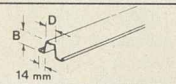
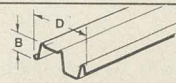
Catalogue number	Dimension A, mm	Dimension B, mm	Dimension C, mm
5030010	300	25	13
7530010	300	25	13

LBI STEEL FRAMING SYSTEMS

FOR FLOORS, WALLS AND ROOFS

Lysaght Brownbuilt Industries supplies steel framing components for fabrication into wall frames, roof frames and floor frames in domestic cottage construction. The components are roll-formed from either zinc-coated or Zincalume zinc/aluminium alloy-coated steel in the profiles as shown.

Profile, mm	Section	Dimensions D x B, mm	Steel Base thickness mm
	Standard Plate Stud Nogging Light Duty Stud Hip Rafter	78 x 31 75 x 32 72 x 34 75 x 32 104 x 35	1.2 1.2 1.2 0.8 1.6
	Junction Stud	75 x 38	1.2
	Corner Stud	75 x 38	1.2
	Stiffened Plate	79 x 75	1.6
	Angle Head Beam	100 x 70 150 x 70 200 x 72 250 x 72	2.5 2.5 3.2 3.2

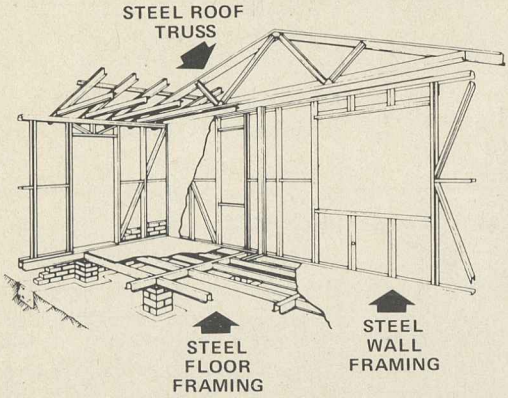
Profile, mm	Section	Dimensions D x B, mm	Steel Base thickness mm
	External Bearer	75 x 100	1.6
	Internal Bearer	75 x 100	1.2
	Joist	50 x 98	1.0
	Truss Chord	53 x 102	1.6
	Roof Batten	25 x 50	0.75
	Cyclonic Roof Batten	35 x 35	1.2
	Ceiling Batten	20 x 25	0.42
	Tile Batten	66 x 25	0.42

The LBI framing system has undergone an extensive programme of design and testing to ensure the practical and economical use of material consistent with sound engineering practice. Assembly of the frame is carried out by experienced fabricators to specifications accepted by local councils and lending authorities.

Steel frames offer the advantages that they will not warp, twist, shrink or deteriorate in normal use. Other features include:

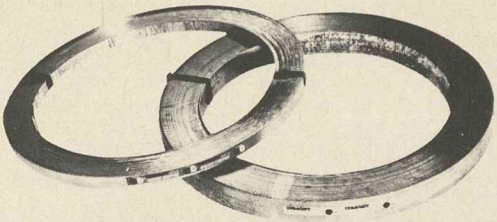
- High strength with economy, long life and reliable performance.
- Rapid construction. Factory fabricated frames are delivered to the building site ready to erect.
- Steel frames are straight, rigid and stable, eliminating wall cracking, fastener popping and door and window jamming.

The frames are compatible with all other materials currently used in home construction such as bricks, plasterboard, timber, flooring materials.



Comprehensive literature on steel framing and details of steel frame fabricators are available from LBI Offices.

BUILDERS' STRAPPING



LBI Builders' Strapping is strong galvanized steel strapping available in three popular width/thickness combinations.

Material is zinc-coated steel to AS 1397–G250–Z300 specification. Normal supply is 100 m coils but 50 m coils and other lengths, widths and thicknesses may be supplied subject to enquiry.

Builders' Strapping is typically used for:

- Fastening door and window frames to brick work.
- Wall ties for brick veneer and full brick.
- Tying timber plates to brickwork.
- Diagonal wall bracing in timber construction.
- Ceiling hangers.
- Purlin ties.
- Wall straps for vent pipes and downpipes.
- Straps for fastening timber battens to concrete with power fasteners.
- Timber truss work.
- Straps and ties for concrete formwork.
- Tie rods for vent pipes.
- Ventilation cowl construction.
- Small brackets and angle pieces.

Approximate mass per 100 m coil:

25 x 1.2 mm 24 kg
32 x 1.2 mm 31 kg
25 x 1.0 mm 20 kg

LBI Builders' Strapping is obtainable from steel merchants and builders' supply houses.

PURLIN AND GIRT SYSTEMS

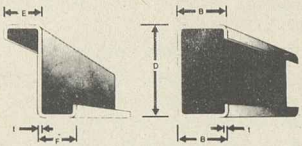
LBI ZED AND C SECTIONS

Lysaght Brownbuilt Industries Zed and C sections are lightweight structural members designed in accordance with the SAA Cold Formed Steel Structures Code, AS 1538. Cold roll-formed from high strength zinc-coated steel, they are specially designed for use as purlins and girts for the support of roofing and walling sheets.

The Zed profile has unequal flanges for lapping and additional strength.

Zed and C purlins and girts are supplied prepunched to suit most requirements. The range of accessories includes fascias, Hook-Lok bridging, bolts and nuts.

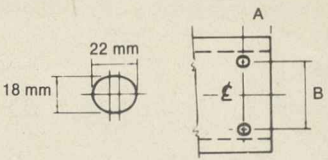
A comprehensive technical purlin brochure, which includes load span tables and sectional properties, is available from Lysaght Brownbuilt Industries offices.



Cat No	ZED SECTION				ZED or C SECTION	C SECTION			Cat No
	Dimension, mm				Mass per unit length, kg/m	Dimension, mm			
	D	E	F	t		D	B	t	
Z10016	102	53	49	1.6	2.78	102	51	1.6	C10016
Z10020	102	53	48	2.0	3.46	102	51	2.0	C10020
Z15012	152	65	61	1.2	2.88	152	64	1.2	C15012
Z15016	152	65	61	1.6	3.81	152	64	1.6	C15016
Z15020	152	65	61	2.0	4.73	152	64	2.0	C15020
Z15025	152	66	60	2.5	5.89	152	64	2.5	C15025
Z20016	203	79	74	1.6	4.78	203	76	1.6	C20016
Z20020	203	79	74	2.0	5.94	203	76	2.0	C20020
Z20025	203	79	73	2.5	7.39	203	76	2.5	C20025
–	–	–	–	–	6.81	254	76	2.0	C25020
–	–	–	–	–	8.48	254	76	2.5	C25025
Z30025	300	100	94	2.5	10.54	–	–	–	–
Z35030	350	129	121	3.0	15.25	–	–	–	–
Z35032	350	129	121	3.2	16.24	–	–	–	–

HOLE DETAILS AND GAUGE LINES FOR LBI ZED AND C SECTIONS

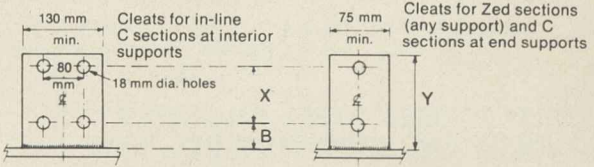
LBI standard elongated punched hole.
Holes equally spaced above and below centre line.



Purlin or Girt		Dimension, mm	
Profile	Nominal web depth, mm	A	B
Zed & C	100	35	40
Zed & C	150	35	60 (70 Vic only)
Zed & C	200	35	110
C only	250	35	160
Zed only	300	35	210
Zed only	300	35	260

CLEATS – HOLING DETAILS ONLY –

Recommended dimensions



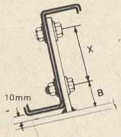
Purlin/Girt nominal web depth, mm	Dimension, mm		
	B	X	Y
100	40	40	105
150	50	60 (70 Vic. only)	145
200	55	110	195
250	55	160	245

8 mm is the recommended steel thickness for cleats up to and including the 250 series. For the 300 and 350 series, cleats will be to Consulting Engineer standards.

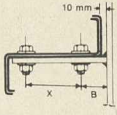
Cleat dimensions to LBI standard shown above are not necessarily suitable for purlins and girts of other manufacture.

FASTENING TO CLEATS

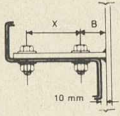
B, X, Y dimensions are as shown under *Cleats*



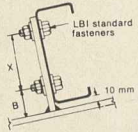
Zed Purlins lapped



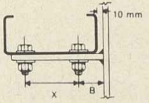
Zed Girts standard mode



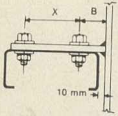
Zed Girts optional mode



C Purlins



C Girts standard mode



C Girts optional mode

COLD FORMED STEEL CHANNELS, ANGLES AND CONVEYOR SECTIONS

LBI cold formed steel sections are roll-formed from zinc-coated or hot rolled steel strip as Angles, Plain Channels, Lipped Channels (ex stock) and Top Hot Channels and Conveyor Sections (by arrangement) in steel thicknesses 1.6 to 3.2 mm.

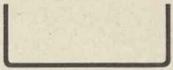
The strong, lightweight sections in a range of sizes have many uses in the fields of construction and general fabrication. Variations to standard dimensions may be produced by arrangement.

Channels and Angles: Zinc-coated steel, AS1397–G250–Z300. Hot rolled steel, AS 1594–HR240.

Conveyor Sections: Zinc-coated steel, AS1397–G450–Z300.

PLAIN CHANNELS

Standard length 6000 m

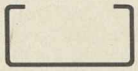


Designation	Web, mm	Flange, mm	Steel base thickness, mm	Mass per unit length, kg/m	
				Zinc-coated	Hot rolled
LC01916	19	12	1.6	0.49	0.48
LC02516	25	13	1.6	0.58	0.57
LC03816	38	16	1.6	0.84	0.82
LC05116	51	15	1.6	0.97	0.94
LC05132	51	25	3.2	2.29	2.26
LC05725	57	26	2.5	2.00	1.96
LC06425	64	22	2.5	2.00	1.96
LC07632	76	37	3.2	3.56	3.52
LC08332	83	34	3.2	3.56	3.52
LC08932	89	31	3.2	3.56	3.52
LC09532	95	35	3.2	3.92	3.87
LC10332	103	31	3.2	3.92	3.87
LC10232	102	55	3.2	5.09	5.02
LC12732	127	49	3.2	5.45	5.38
LC15232	152	50	3.2	6.11	6.03

LIPPED CHANNELS AND TOP HAT SECTIONS

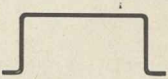
LIPPED CHANNELS

Standard length 6000 m



TOP HAT SECTIONS

Length by arrangement



Designation		Web, mm	Flange, mm	Lip, mm	Steel base, thickness, mm	Mass per unit length kg/m	
Lipped channel	Top hat section					Zinc-coated	Hot rolled
LL05116	LT05116	51	35	9	1.6	1.61	1.57
LL06420	LT06420	64	38	10	2.0	2.32	2.28
LL07620	LT07620	76	44	11	2.0	2.73	2.67
LL08920	LT08920	89	51	12	2.0	3.21	3.14
LL08932	LT08932	89	51	15	3.2	5.09	5.02
LL10225	LT10225	102	51	14	2.5	4.27	4.20
LL10232	LT10232	102	51	16	3.2	5.45	5.38
LL12725	LT12725	127	51	14	2.5	4.79	4.71
LL12732	LT12732	127	51	16	3.2	6.11	6.03
LL15232	LT15232	152	64	16	3.2	7.38	7.28
LL17832	LT17832	178	70	17	3.2	8.40	8.29
LL20325	LT20325	203	70	15	2.5	7.06	6.95
LL20332	LT20332	203	76	18	3.2	9.42	9.29
LL25432	LT25432	254	89	23	3.2	11.63	11.48

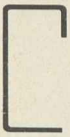
LC05116 will nest into LC05725
LC05132 will nest into LC05725
LL05116 will nest into LC05725
LC05725 will nest into LC06425
LC09532 will nest into LC10332

ANGLES

Standard length 6000 m

Designation	Leg lengths, mm	Steel base thickness, mm	Mass per unit length, kg/m	
			Zinc-coated	Hot rolled
LA2725	27 × 27	2.5	1.00	0.98
LA3225	32 × 23	2.5	1.00	0.98
LA4032	40 × 40	3.2	1.93	1.91
LA4632	46 × 35	3.2	1.93	1.91
LA5132	51 × 30	3.2	1.93	1.91

CONVEYOR SECTIONS



Standard lengths 5990 mm to suit 6 m conveyor module, other lengths by arrangement. Normally punched with LBI standard 18 × 22 mm holes as required.

Designation	Web, mm	Plain flange, mm	Lipped flange, mm	Lip, mm	Steel thick-ness mm	Mass per unit length, kg/m
CS10032	100	45	50	24	3.2	5.09
CS15032	150	55	75	24	3.2	7.25
CS20032	200	55	75	24	3.2	8.53
CS25032	250	55	75	24	3.2	9.80
CS30032	300	80	100	29	3.2	12.47

LYSAGHT BROWNBUILT INDUSTRIES CUSTOM COLD ROLL-FORMED SECTIONS

Custom Cold Roll-Forming is a service offered by LBI 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.

Roll-forming is a continuous process whereby coils of flat sheet steel or other metals are progressively shaped into a simple or complex section by passing through a series of roller dies in tandem. This enables production of long lengths virtually limited only by ability to handle and transport.

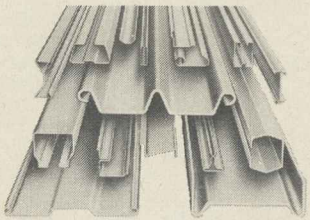
Other operations can be accomplished simultaneously during a mill run or after rolling. These include bending, punching, drilling, notching and welding. Such operations at this stage often obviate the necessity for extra work to be carried out by the client or another supplier.

The tooling design service team, available for consultation, can be used to assist in planning the most efficient section profile for specific needs.

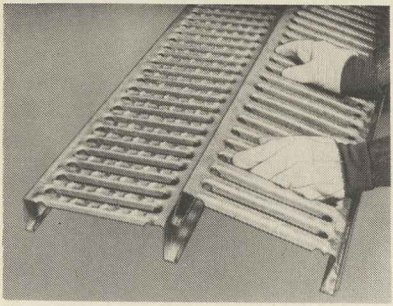
Components can often be redesigned or the number reduced by the roll-forming specialist, giving a more economic and practical product design. In many instances needs can be met from the vast range of standard tooling, or a modification thereof, giving even greater economies.

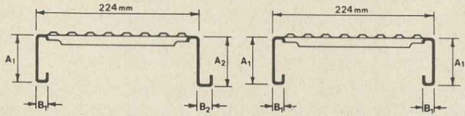
All enquiries should be directed to LBI Offices.

Some typical examples of custom roll-formed profiles are shown.



INTERLOK STEEL GRATING





LBI Interlok 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.

A range of stair treads and accessories is also available.

Material:	Zinc-coated steel to AS 1397–G300–Z300 in 1.2 and 2.0 mm thickness.
Stock lengths:	1800 and 6000 mm, other lengths produced by arrangement.
Surface finishes:	Slotted grip or anti-skid.
Leg shapes:	Double male or male/female.

Catalogue number	Thickness, mm	Dimension, mm				Mass per unit length, kg/m	Mass per unit area, kg/m²
		A1	A2	B1	B2		
G06512	1.2	63	65	15	20	3.8	16.9
G10012	1.2	98	100	15	20	4.5	19.9
G06520	2.0	64	66	16	21	6.3	27.8
G10020	2.0	99	101	16	21	7.4	32.8

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 loose or separate pieces; the strands are all part of the parent metal, rigidly unified at their junctions.

Expanded metal meshes are produced in six types:

LBI Metalath – as a base for wet plaster work in the building trade.

LBI Ornamesh – for industrial, decorative and general use where a high degree of accuracy and finish is required.

LBI Balustrade Mesh – for balcony and stair railings, screen doors, room dividers and security partitions.

LBI Louvre Mesh – for sun screens, wind breaks and privacy screens, infill panels, facades and soffits.

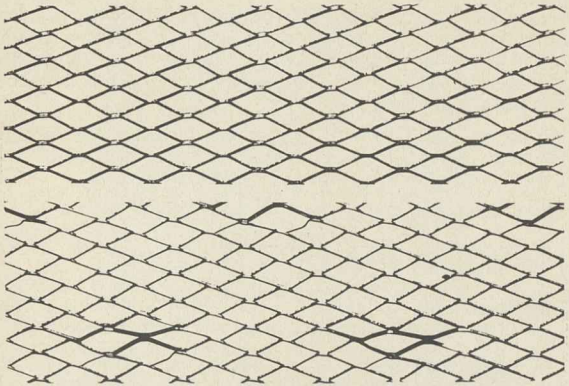
LBI Multimesh – for lightweight decorative and sun screens, infill panels, room dividers, baskets, grilles, etc.

LBI Gridmesh – produced from heavy steel plate for use on catwalks, work platforms, stair treads, livestock floors, etc.

Within the Ornamesh, Balustrade Mesh and Gridmesh ranges are many types suitable for screening doors, windows and other points against illegal entry or damage.

Many ductile materials such as steel, aluminium, copper, brass and other alloys, can be expanded, but the chief material for expanded metal meshes is high-grade low carbon steel sheet.

LBI METALATH



Metalath is a galvanized steel lathing mesh used extensively in the building industry, particularly as a base for plaster ceilings, ceramic wall tiles on timber frames, soffits and other architectural effects. Metalath is widely used also to support fire proofing sprays on steel columns and beams in fire rated construction and for cement rendering. The product is complemented with a range of corner beads and plaster partition accessories.

Metalath is produced in two steel thicknesses and two styles.

Catalogue No and thickness	Application
PL25, FL25 0.42 mm	For general plastering and wall tiling
PL34, FL34 0.65 mm	For lightweight fireproof construction

All available in sheets 685 mm wide x 2400 or 2700 mm long. PL25 is also produced in 60 metre coils; longer subject to inquiry.

Accessories A complete range of accessories for walls, ceilings and partitions is available for use with Metalath.

LBI ORNAMESH

Whether it is for machinery guards in heavy industry, speaker grilles in transistor radios, room dividers or anti-dazzle screens on an express-way, there is a style and mesh size in the Ornamesh range to suit the purpose.

Ornamesh admits light and air and permits easy vision, yet it forms an effective barrier against entry, helps prevent accidents and has numerous other uses.

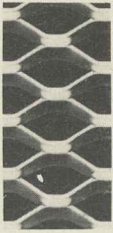
Ornamesh is used extensively in industry for machinery guards, shelving pallets and racking; in manufactured products and equipment of all kinds; and in the building industry for concrete formwork, partitions, room dividers and similar applications.

In some uses of Ornamesh – 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 mesh type required.

TYPE T

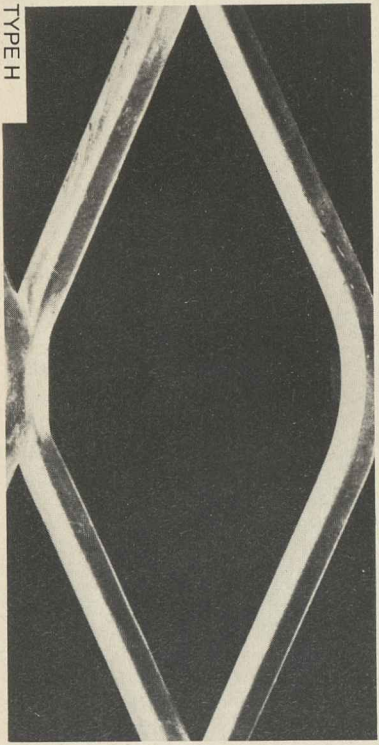
TYPE S



TYPE R

TYPE Q

LBI ORNAMESH (cont)

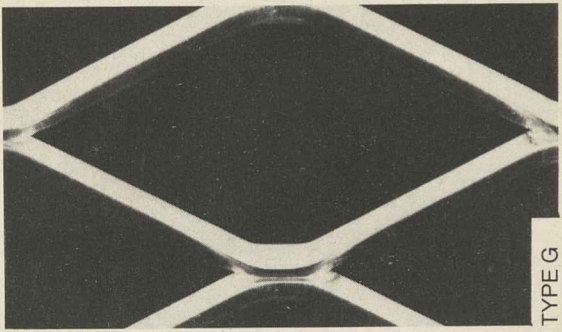


TYPE A

TYPE M

TYPE P

LBI ORNAMESH (cont)



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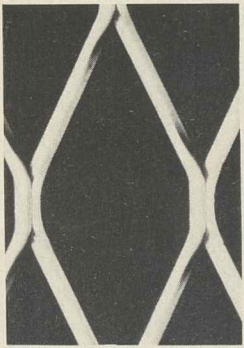

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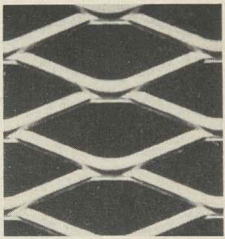
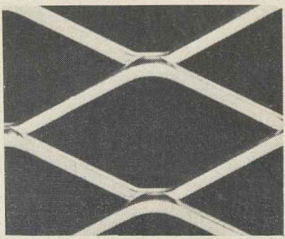


TYPE C

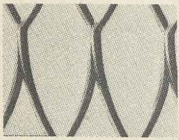
TYPE D



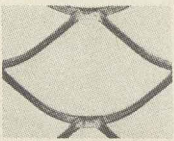
LBI BALUSTRADE MESH

Balustrade Mesh is an ornamental expanded metal with a high percentage of open area giving the appearance of delicate wrought iron.

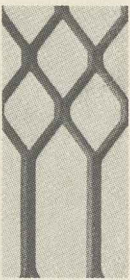
Intended for internal and external balustrades, grilles and dividers, window and door protectors, security partitions and stair railings. Four standard patterns are supplied in uncoated or zinc-coated steel or in aluminium in sizes to suit most domestic or architectural applications.



CAMELOT



PACIFIC



GOTHIC

SCROLL

LBI LOUVRE MESH

Louvre Mesh 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 heavily galvanized steel.

In addition to being used for 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 to blend with modern building styles or can be painted with readily available paints.

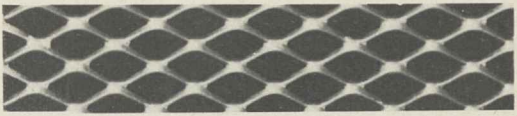
LBI MULTIMESH

The LBI Multimesh range of ten meshes meets the many needs of the hobbyist and home handyman.

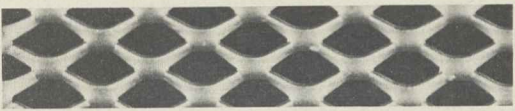
Multimesh is lightweight but strong and is easily worked. Its multitude of uses ranges from air vents and fire grilles to display stands and screen doors.

Designation	Metal	Sheet size, mm
Trellis	steel	900 x 1200
Lace	steel	600 x 900, 900 x 1200
Honeycomb	steel	600 x 900, 900 x 1200
Fretwork	steel	600 x 900, 900 x 1200
Classic	anodized aluminium	600 x 900
Crochet	anodized aluminium	600 x 900
Filigree	aluminium	600 x 900, 900 x 1200
Lattice	aluminium	900 x 1200
Chainmail	aluminium	600 x 900, 900 x 1200
Fineline	aluminium	600 x 900, 900 x 1200

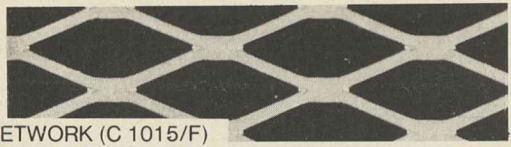
TRELLIS (F 2028)



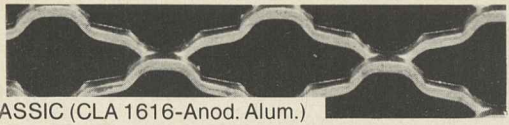
LACE (Q 0510)



HONEYCOMB (R 0820)

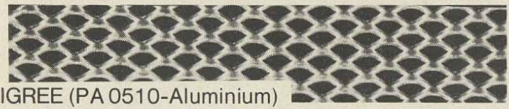


FRETWORK (C 1015/F)



CLASSIC (CLA 1616-Anod. Alum.)

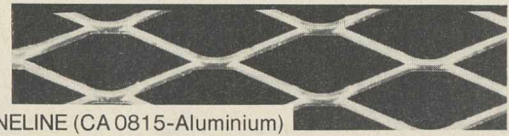
CROCHET (CRA 0812-Anod. Alum.)



FILIGREE (PA 0510-Aluminium)

LATTICE (DA 1620-Aluminium)

CHAINMAIL (RA 0820-Aluminium)



FINELINE (CA 0815-Aluminium)

LBI GRIDMESH

LBI Gridmesh is the heavy duty mesh in the LBI range. Uses include heavy duty walkways and stair treads, gratings, ramps, flooring, work platforms, security screens, farrowing pens, abattoir floors.

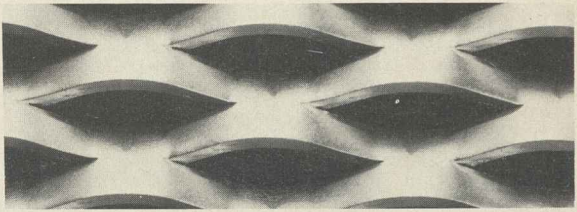
The GR series is comparatively open mesh for general use. GM series is for heavy duty use and where a smaller mesh opening is desirable.

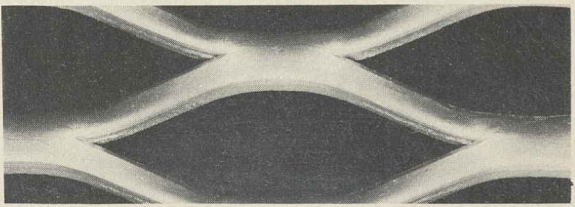
Meshes for farrowing (FM) and weaner (WM) floors are supplied in a flattened condition.

Gridmesh is supplied in zinc-coated or uncoated steel or in aluminium.

Steel Meshes

Cat No	Steel thickness, mm	Mass (±10%), kg/m²	Nom sheet sizes, mm
GR 50080	5	14.6	2000, 3000 x 600, 750, 900, 1200
GR 50110	5	19.5	2300 x 600, 750, 900, 1200
GM 50075	5	22.0	2000, 3000 x 600, 750, 900, 1200
GM 50105	5	28.1	1500, 2300 x 600, 750, 900, 1200
FM 30075/F	3	13.7	1800, 2400 x 900, 1200
WM 30080/F	3	12.5	2000, 2400 x 900, 1200
F 5060	5	15.9	1800, 2400, 3600 x 600, 750, 900, 1200



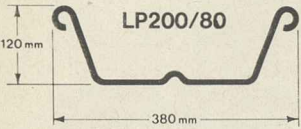


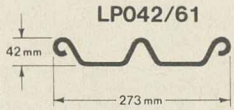
LBI SHEET PILING

LBI Sheet Pilings are high strength structural steel panels cold roll-formed from AS 1594 Grade 280 hot rolled steel, 6 mm and 4.8 mm thick. They are designed for the efficient construction of virtually earth and watertight permanent or temporary walls, either straight or contoured (free form).

Two profiles are manufactured: LP042/61 for where a lightweight section is adequate; LP200/80 for medium-duty applications outside the capacity of lightweight sections but below the point where the heavier BHP hot rolled steel pilings become necessary.

LBI Sheet Piling is long lasting, extremely resistant to scouring forces, and extractable for re-use.





Cat No	SINGLE SECTION		INTERLOCKED WALL		Standard* lengths, m
	Steel thickness, mm	Mass per unit length, kg/m	Wall thickness, mm	Mass per unit area, kg/m²	
LP200/80	6	27.9	200	79.8	5, 8, 12, 14
LP042/61	4.8	14.9	42	60.9	2.4, 3, 4.2, 4.8, 5.4, 10.8

* Custom cut lengths available subject to enquiry.

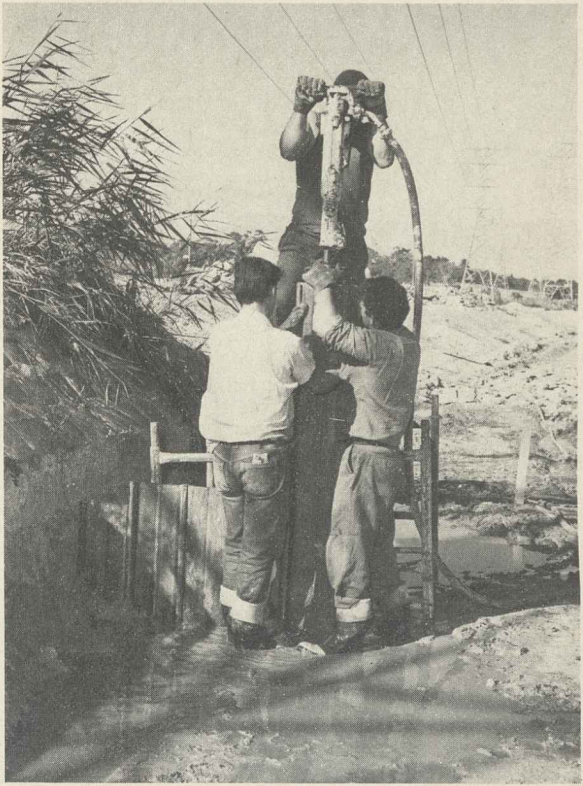
Handling, driving and extraction are assisted when proper practices and precautions are used. Holes for extraction can be provided near sheet ends, or special extracting machines with positive grip clamps may be used.

Typical applications include:

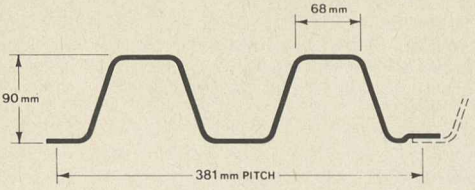
- Trenching: Pipe-laying and similar operations.
- Water conservation: Dams, dam cores, well housings, coffer-dams.
- Waterways: Canal walls, lakeside walls, dock walls, bulkheading, development of recreational areas.

- Erosion control: Check dams, beach groynes, cliff protection, dyke walls.
- Structural: Excavation and retaining walls, underpinning, form-work, machine-well linings, bridge decks and piers, footings, jetties, docks, causeways.

Full details are available from LBI Offices.



LBI ROAD BRIDGE DECKING



The principal function of LBI galvanized steel road bridge decking is to provide a serviceable material to substitute for timber decking on road bridges. AS 1397–G450 strength steel deck panels act as the main load-carrying element of the bridge deck.

Lengths of 8, 10, 12 and 14 m are available ex stock, custom cut lengths by negotiation.

Bridge redecking can be speedily achieved, minimizing costs and keeping traffic disruption to a minimum.

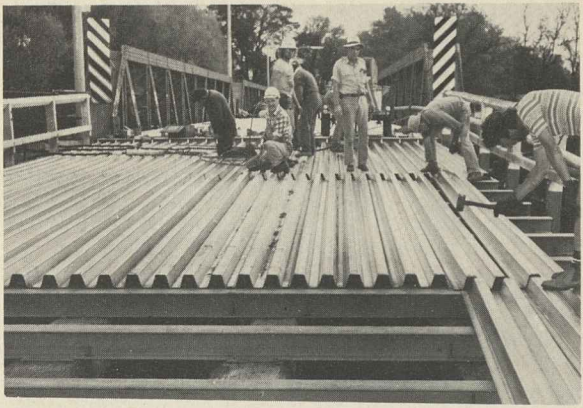
Road Bridge Decking can be used for other applications such as railway platforms, loading docks etc.

Some helpful features include:

- **Minimal traffic disruption** Half width of bridge can remain open to traffic while work in progress, when decks are laid longitudinally.
- **Directional placement** Suitable for both longitudinal and transverse placement.
- **Easy handling** Decks 5 or 6 metres can be handled by two men. Decks nest to reduce packaging size.
- **Bridge Widening** Widening from one lane to two lanes can be achieved using cantilevered supports.
- **Reduced Redecking time** Redecking time can be one-third that for timber. Possible to redeck and bitumen on one day.
- **Reduced maintenance checking time** Maintenance checking time is reduced compared with timber decks.

The infill materials used can vary from locally available earth to bitumen or structural grade concrete.

A comprehensive Road Bridge Decking Installation Manual is available from LBI Offices.

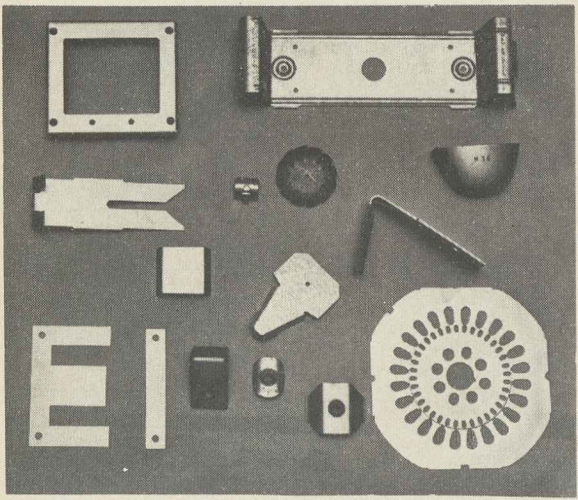


SANKEY – METAL PRESSINGS

The Lysaght Sankey operation provides a service to industry in the form of heat treated electrical steel laminations and a general range of wound cores, including iron/nickel alloys.

Other metal pressings are also produced to industry specification.

Full details are contained in the Sankey Electrical Steel Laminations catalogue and other literature available from John Lysaght (Australia) Limited, Sankey, PO Box 589, Newcastle, NSW 2300, or from Lysaght State Offices.



Some typical examples of pressings

Brownbuilt

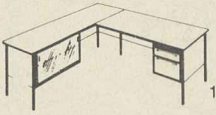
(Addresses in front pages of Referee)

STEEL FURNITURE AND EQUIPMENT
BROWNBUILT OFFICE FURNITURE

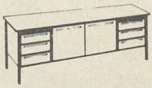
FLITELINE 700 SERIES

A comprehensive range of steel furniture matching in both design and colour. The wide range of standard components and Australian environmental colours enables units to be assembled to meet specific requirements.

Many hundreds of configurations are available. Dimensions shown are in mm.

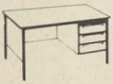


Modular Desk
(L-shaped)
FSH–2030 x 510–1525 x 760–M10–2
Fliteline 700–2030 x 510 Wing top on left–1525 x 760 Desk Top–Wing Pedestal with glass sliding doors and one adjustable shelf–Desk Pedestal with one box and one filing drawer.



Credenza
FSH–2030 x 510–M3–M9–M3
Fliteline 700–2030 x 510 Credenza Top–Credenza Pedestal with three box drawers on left–Credenza Pedestal with steel sliding doors and one adjustable shelf–Credenza Pedestal with three box drawers.

Double-Pedestal Desk
FSH–1675 x 760–2–3
Fliteline 700–1675 x 760 Desk Top–Pedestal with one box drawer and one filing drawer on left–Pedestal with three box drawers on right.



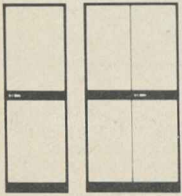
Single-Pedestal Desk
FSH–1370 x 760–P–3
Fliteline 700–1370 x 760 Desk Top–Panel End on left–Desk Pedestal with three box drawers on right.

Table
FSH–1220 x 760–T
Fliteline 700–1220 x 760 Top–Table

Filing Cabinets and Cupboards

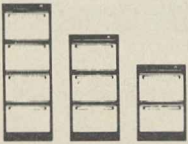
Personal
Executive
File

Counter-high
Cupboards



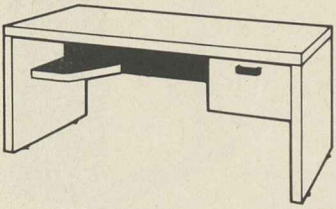
Full-height
Cupboards/
Wardrobes

Vertical Filing Cabinets



900 SERIES MODULAR OFFICE SYSTEM

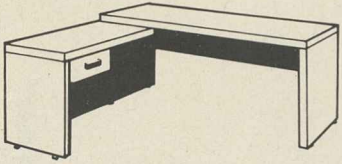
Colours available are beige, leaf brown, green and traditional Brownbuilt colours.



Executive Desks

Use single, double or mobile pedestals to achieve desired result.

Outside dimensions (mm) 700H × 1650W × 750D



Secretarial Desks

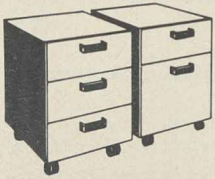
Desks can be fitted with a wing unit to accommodate a typewriter and leave the desk top clear. Pedestals can go either end or use mobile units.

Outside dimensions (mm) Desk 700H × 1650W × 750D; Wing Unit 650H × 1050W × 500D

Lateral File

Files are within easy reach. Narrow depth saves floor space. Constant stability—unique locking device locks other drawers as one is opened.

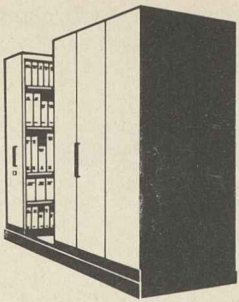
Outside dimensions (mm) 1350H × 915W × 470D



Desk Pedestal Units

Static fixture at either end of desk, or mobile units. One, two or three drawers and a variety of filing drawers.

Outside dimensions (mm) 550H × 457W × 465D



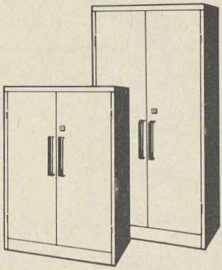
Compactus

Mobile filing and storage unit to reduce floor space. Adjustable shelves.

Tudor Cupboard

Three adjustable shelves. Multi-purpose cupboard for such uses as lateral filing, open box filing, compartment filing or as a combination cupboard/wardrobe.

Outside dimensions (mm)
1800H x 915W x 460D



Three-quarter Cupboard

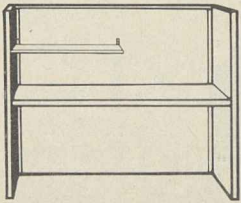
Same style and combinations as for Tudor Cupboards but has lower height for open plan office use.

Outside dimensions (mm)
1350H x 915W x 460D

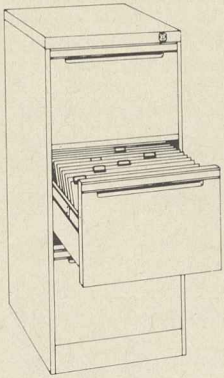
Work Station

Self-contained work module. Static pedestal drawers can be fitted under either end of the desk or mobile units can be used. Bookshelves can be fitted. Unit can be extended to double size.

Outside dimensions (mm)
1350H x 1680W x 750D



BROWNBUILT OFFICE EQUIPMENT



Vertical Filing Cabinets

Two, three and four drawer.
Foolscap.

Outside cabinet dimensions (mm)
Four drawer—1335H x 470W x 624D
Three drawer—1030H x 470W x 624D
Two drawer—725H x 470W x 624D

Inside drawer dimensions (mm)
265H x 385W x 565D

Cupboards/Wardrobes

Single and two door, 25 mm adjustable shelves.
Three-point locking or sliding door cupboards.

Outside dimensions (mm)
1800H x 920W x 455D
1030H x 920W x 455D
1030H x 1525W x 455D

Computer Disc and File Storage Cabinets

Accessible storage and filing for tapes, computer discs, computer printout, lateral filing, suspension filing, card cabinet filing, records/books filing.

Outside dimensions (mm) 1355H x 920W x 450D

Plan File Cabinets

Horizontal six or ten drawer cabinet in both A1 (Double Elephant) or A0 sizes.

Dimensions (mm) Outside 550H x 1145/1360W x 830/960D
Inside 30/50H x 1055/1270W x 780/906D

Visible Record Cabinets

Seven, twelve or sixteen drawer cabinets.

Standard card sizes (mm) 205 x 125, 205 x 150, 150 x 100

Flat File Cabinets

Twelve removable flat filing trays or shallow box drawers, hinge type or lever arch fittings.

Outside dimensions (mm) 1135H x 340W x 470D

Card Index Cabinets

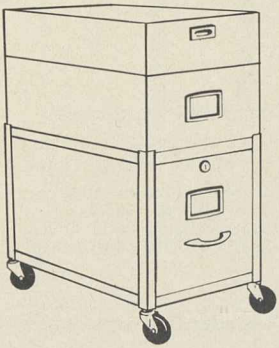
Single or two drawer units.

Takes standard cards 125 x 75 to 210 x 150 mm

Posting Mobile

Ledger card mobile storage, capacity up to 2000 cards. Available with transfer drawer below card tray. Both lockable.

Maximum card size 305 x 305 mm.



Telephone Cabinet

Combines shelf space with lockable cupboard.

Outside dimensions (mm) 760H x 455W x 455D

OTHER OFFICE EQUIPMENT

Stationery Cabinets. Smokers Trays.

Filing Systems:

Suspension filing, lateral suspension filing, computer printout suspension or lateral filing, open box filing, compartment filing, flat filing, computer tape storage.

Office Mobiles:

For typewriters, accounting machines, audio visual equipment.

Chairs:

Brownbuilt Series 300 range, includes Executive, Secretarial and Typist chairs.

BROWNBUILT COMPACTUS OFFICE FILE

A complete mobile office filing and storage unit mounted on its own self-levelling base.

Three basic units with extension units give up to nine variations. Basic units are COF-A, COF-B and COF-C catering for various filing systems such as Suspension, Lateral, Computer Printout, Computer Discs and Tapes.

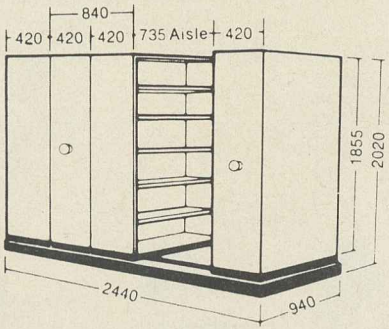
The COF-A unit is equal to ten, four drawer foolscap vertical filing cabinets.

Storage cabinets roll apart to reveal access aisle.

All cabinets lock from a single point, provide dust and security protection.

COF-A	Four nominal 400 mm deep faces
COF-B	Six nominal 300 mm deep faces
COF-C	Three nominal 300 mm plus two nominal 400 mm deep faces

Outside dimensions (mm) 2020H x 2440W x 940D for A, B and C



FACTORY PRODUCTS

Lockers

For factories, offices and sports clubs.

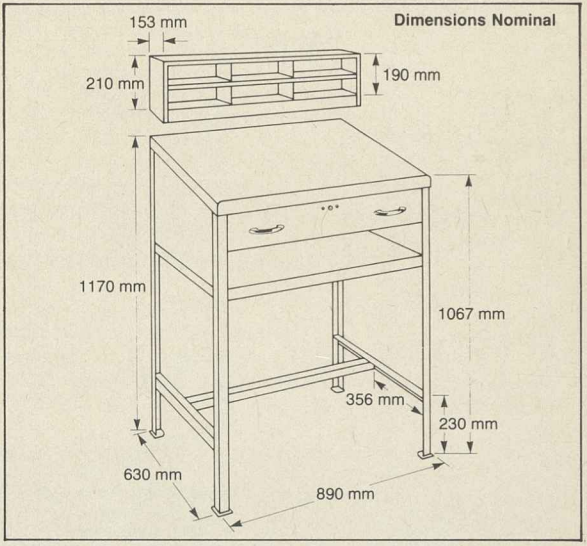
Full length, two and four tier. Combination lockers with single and three-point locking.

Outside dimensions (mm) 1830H x 305/380W x 455D

Industrial Desk

Increases efficiency by allowing work to be checked and completed close to the job. Large sloping desk top area. Pigeon hole compartments optional.

A large drawer with shelf space provided underneath, or two drawers can be fitted.



Paint Storage Cabinets

Used for safe storage for paint and solvents. Capacity, up to 225 litres.

Conform to AS 1940 and local authorities requirements.

Overall dimensions (mm) 1590H x 1300W x 500D

BROWNBUILT STEEL STORAGE SYSTEMS

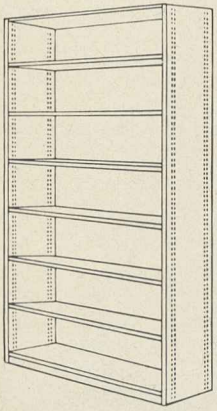
STATIC STORAGE SHELVING

Choice of six types, depending on type of application, load factors and adjustability required.

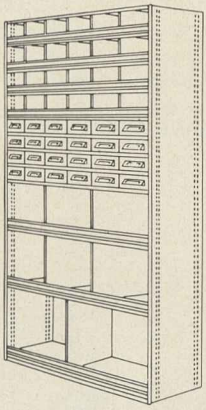
Rolled Upright Shelving

Provides shelf clip adjustability at 25 mm centres and for evenly distributed loads up to 110 kg per shelf.

Dimensions in mm



Type G.P./B.
Type R.U./B.
2175H x 900W x 300/350/400/500D



Type R.U./P.
2175H x 900W x 300/400/500D

General Purpose Shelving

Shelf clip adjustable at 25 mm centres and for evenly distributed loads up to 240 kg per shelf.

Rolled Upright and General Purpose shelving have a wide range of standard shelving component sizes and accessories to suit needs.

Slotted Angle Storage and Structural Systems

Shelving, light duty bulk storage

Metric Channel Storage System

A versatile system to carry loads of varying shapes and sizes from small parts boxes to light/medium duty bulk storage, including pallet storage.

Five systems in one:

- Selective pallet rack
- Light/medium duty bulk storage
- Double deck structures
- Shelving—standard height
- Shelving—high rise

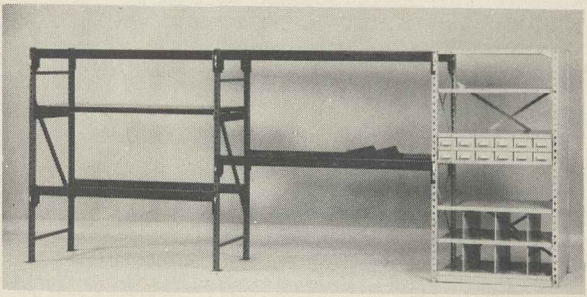
Library Shelving

Free standing types, cantilever, single or double sided shelves adjustable 25 mm or 19 mm centres.

Complete range of accessories.

Modular Wall Shelving System

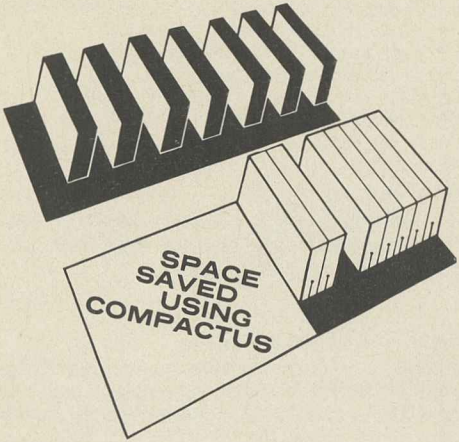
Designed for offices, educational and other institutions. The system comprises shelving and modular units simply attached to wall stripping. Adjustable at 25 mm centres.



MOBILE STORAGE

One *movable* aisle serves complete unit. Storage cabinets or racking are placed on mobiles running on rails set into the floor.

Mobiles roll apart either manually, mechanically or automatically.



- **Compactus** Office Storage Unit. For bulk storage of stationery, light machinery parts, etc.
- **Compactus** hand operated system, maximum load 2 t per mobile.
- Brownbuilt Mechanically Operated Handle-to-Sprocket operation. For loads up to 17 t per movement/system.
- **Compactus** Semi-Automatic for heavier loads. Electrically powered to 80 t per system.
- **Maxtor** Heavy Duty Automatic for heavy to extremely heavy loads. Electric remote control pneumatic and/or hydraulic power. Capacity up to 500 t per system.

RACK SYSTEMS

Designed to carry heavier loads of varying shapes and sizes from light duty rack to large mobile storage units and rack supported buildings. Each system is supported with a range of products and accessories to make maximum use of cube space with inbuilt adjustability and simple clip-together construction.

Selective Rack and Accessories

Simple and economical rack structure designed for many different requirements with access to all items. Rigid and strong. Basic components, upright frames and shelf beams available in a range of sizes. Standard type frames up to 24 t capacity per frame and beams to 5.5 t per pair.

Drive-In Drive-Through

Designed for high density storage of palletised items. Economical use of space, requiring fewer aisles. Drive-In has a common entry and exit, Drive-Through has a separated entry and exit.

High Rise Racking

Involves many special design racking structures using standard components for special applications including automated warehouses, cold stores, rack-clad buildings etc. Installations have been carried out to 21 m high.

Mobile Storage System

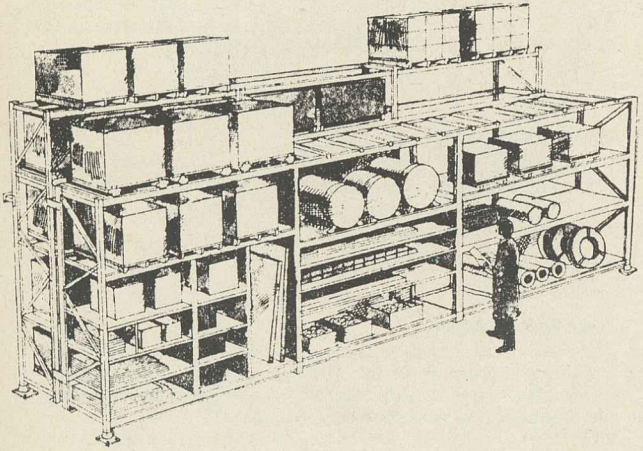
Mobile rack units that use one transferable access aisle for the complete system. Electric or pneumatic push-button operation can almost double storage capacity for selective low access requirements.

Versa Q-A

Versatile quick assembly is a feature of this system designed to store a wide variety of different sized products on one large shelf. Offers the versatility of pallet storage and hand storage in the same area.

Miscellaneous

Gravity Flow for order picking and Cantilever Rack for storage of long items are two of the other variations available in the racking/storage area.



AUSTRALIAN STANDARDS

With increased industrialization and rapidly changing technology, standardization now plays a bigger part in the life of the individual than ever before.

Everyone needs standards.

Apart from the essential part standards play in health and safety and their assistance to designers and specifiers their appeal to the consumer is based mainly on guiding him towards getting value for money.

In Australia standards are prepared and published by the Standards Association of Australia.

Standards are in the form of specifications for materials and products, codes of sound or safe practice, methods of testing, nomenclature etc. They are prepared by representative committees which co-ordinate manufacturing capacity and production efficiency with the users' reasonable needs. Standards seek to achieve fitness for purpose by ensuring suitable quality and dimensions, economy through simplification of production and distribution, replacement interchangeability and adequate variety of choice without wasteful diversity.

Standards therefore lead to good, rational, economic design.

The presence of the standards mark or number is the consumer's guide to assured quality and acceptable value.

Standards result from full enquiry and are based on voluntary agreement, and recognition of the community of interest of producer and consumer.

Membership of the Standards Association of Australia is open to individuals, associations, industrial and commercial companies and public and local authorities.

It is to everyone's advantage to see that standards are promoted and adopted.

A list of the standards referred to in this publication follows.

AUSTRALIAN STANDARDS RELEVANT TO ITEMS APPEARING IN REFEREE

(a) Dimensions and Tolerances

AS 2338 Preferred Dimensions of Wrought Metal Products.

AS 1365 Tolerances for Hot-Rolled and Cold-Rolled Unalloyed Low Carbon Steels (Coils and Cut Lengths).

AS 1238 Preferred (Soft Metric) Sizes of Steel Pipes.

AS 1131 Dimensions of Hot-Rolled Structural Steel Sections.

(b) Flat and Formed Products

AS 1594 Hot-Rolled Unalloyed Low Carbon Steel Plate, Sheet and Strip.

AS 1595 Cold-Rolled Unalloyed Low Carbon Steel Sheet and Strip.

AS 1397 Hot-Dipped Zinc-Coated or Aluminium/Zinc-Coated Steel Sheet in Coils and Cut Lengths.

AS 1734 Wrought Aluminium and Aluminium Alloy Flat Sheet, Coiled Sheet and Plate for General Engineering Purposes.

AS 1445 76 mm Pitch Corrugated Hot-Dipped Zinc-Coated or Aluminium/Zinc-Coated Steel Sheet.

AS 2179 Metal Rainwater Goods.

AS 1227 General Requirements for Supply of Hot-Rolled Steel Plates, Sections, Piling and Bars for Structural Purposes.

(c) Building Codes

AS 1170 SAA Loading Code.
Part 1 – Dead and Live Loads.
Part 2 – Wind Forces.

AS 1562 Design and Installation of Metal Roofing.

AS 1538 Cold Formed Steel Structures Code.

AS 2180 Code of Practice for Selection and Installation of Metal Rainwater Goods.

AS 1640 SAA Brickwork Code.
AS 1250 SAA Steel Structures Code.
AS 1480 SAA Concrete Structures Code.

(d) Structural Steels and Sections

AS 1204 Structural Steels – Ordinary Weldable Grades.
AS 1205 Structural Steels – Weather Resistant Weldable Grades.
AS 1163 Welded Seamless Steel Hollow Sections for General Structural Purposes.

(e) Reinforcement

AS 1302 Steel Reinforcing Bars for Concrete.
AS 1303 Hard-Drawn Steel Reinforcing Wire for Concrete.
AS 1304 Hard-Drawn Steel Wire Reinforcing Fabric for Concrete.

(f) Pipes and Tubes

AS 1074 Steel Tubes and Tubulars Threaded or Suitable for Threading with Pipe Threads of Whitworth Form.

(g) Fasteners and Screw Threads

AS 1110 ISO Metric Hexagon Precision Bolts and Screws.
AS 1111 ISO Metric Hexagon Commercial Bolts and Screws.
AS 1112 ISO Metric Hexagon Nuts Including Thin Nuts, Slotted Nuts and Castle Nuts.
AS 1252 General Grade High Stength Steel Bolts With Associated Nuts and Washers for Structural Engineering – ISO Metric Series.
AS 1390 Metric Cup Head Bolts.
AS 1393 Coach Screws – With ISO Hexagon Heads.
AS 1420 ISO Metric Hexagon Socket Head Cap Screws.
AS 1421 ISO Metric Hexagon Socket Set Screws.
AS 1427 ISO Metric Machine Screws.
AS 1474 Hexagon and Square Pressed Nuts.

AS 1476 Metric Wood Screws.
AS 1275 Metric Screw Threads for Fasteners (Based on ISO recommendations).

(h) Bricks and Concrete Blocks

AS 1225 Burnt Clay and Shale Building Bricks.
AS 1346 Concrete Building Bricks.
AS 1500 Concrete Building Blocks.

(i) Cement and Concrete

AS 1315 Specifications and Methods of Test for Portland Cement.
AS 1316 Masonry Cement.
AS 1317 Blended Cement.
AS 1379 Ready-Mixed Concrete.

(j) Miscellaneous

AS 1834 Tin-Lead and Other Tin-Based Solder Alloys.
AS 1552 Classification of Covered Electrodes.
AS 1553 Low Carbon Steel Covered Electrodes for Manual Metal-Arc Welding.
AS 1650 Galvanized Coatings on Ferrous Articles.
AS 1376 Conversion Factors.
AS 1377 Conversion Tables – Parts 1 to 6.

PREFERRED DIMENSIONS OF WROUGHT METAL SHEET AND STRIP

STEEL, COPPER, COPPER ALLOYS, ALUMINIUM, ALUMINIUM ALLOYS, ZINC AND ZINC ALLOYS

AS 2338 establishes preferred sizes of wrought metal products manufactured from steel, copper, copper alloys, aluminium, aluminium alloys, zinc and zinc alloys.

Selected information following relates to sheet and strip only. Refer to AS 2338 for other items. All sizes are not necessarily produced in all metals and grades.

PREFERRED THICKNESSES OF SHEET AND STRIP, mm

Preference		Preference	
First	Second	First	Second
0.10	0.11	1.0	1.1
0.12	0.14	1.2	1.4
0.16	0.18	1.6	1.8
0.20	0.22	2.0	2.2
0.25	0.28	2.5	2.8
0.30	0.35	3.0	3.5
0.40	0.45	4.0	4.5
0.50	0.55	5.0	5.5
0.60	0.70	6.0	7.0
0.80	0.90	8.0	9.0
		10.0	11.0
		12.0	

WIDTH AND LENGTH

Ferrous and Non-Ferrous Sheet and Strip.

First preference: Increments of 100 mm.

Second preference: Increments of 5 mm.

Width and length increments less than 5 mm are subject to special negotiation.

HANDLING AND STORAGE OF COATED SHEET STEEL PRODUCTS

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

Both sheet and coil 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 and Marviplate and Korarma 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 in buildings, promotes 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 of any sheet or coil product the resulting corrosive reactions are far more aggressive than those encountered in normal service. In extreme cases and with Colorbond or lighter coating class qualities such as Zincseal and Zincanneal, this may lead to early failure of the coating.

If, inadvertently, a stack or pack of any sheet product becomes wet, the suggested remedial action would depend greatly upon 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 de-

watering agent such as Castrol Electric Motor Solvent or WD40.

Obviously these procedures are not practical with coil, and technical advice should be sought without delay from the nearest Lysaght State Office.

FORMED CLADDING PROFILES

Plain Zincalume, galvanized or organic coated 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 are easily drawn in between tightly nested sheets by capillary action; because this moisture cannot then evaporate in the normal way it will cause unsightly stains which can detract seriously from the finished appearance of the installation. In the extreme a significant loss of coating will occur.

On large building projects handling time can be reduced by using a crane to lift bundles directly on to the roof. If required, Lysaght State 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, Marviplate, Korarma and Coolclad, do not drop sheets or drag one sheet over another. Always wear soft soled shoes, 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. Use the touch-up paint supplied for the correction of minor erection damage. In other words use sensible care that befits a high-quality finish so that it may perform properly.

RAIN-WATER STORAGE TANKS MADE FROM CORRUGATED LYSAGHT ZINCALUME STEEL OR ZINC-COATED STEEL

Corrugated steel walled tanks, so familiar all over Australia, have for over a century been made from hot-dip zinc-coated (galvanized) steel. This material is still a popular choice for rain-water tanks but from the traditional process there has evolved an improved hot-dip zinc/aluminium alloy-coated steel, known in Australia as Zinclume steel, and this has proved to be a superior material for the manufacture of corrugated steel tanks.

Where piped water supplies are not available, common practice is to install storage tanks of corrugated steel, varying in size from 4 to 5 kilolitres for domestic purposes to the large 90 to 135 kilolitre tanks for sheep and cattle stations. Steel tanks are relatively inexpensive to buy and transport, and erection on the site is not difficult.

Australia is a naturally dry country and every endeavour should be made to conserve all available rain-water. Most roofs form a suitable catchment and circular tanks of corrugated Zincalume or galvanized steel are an efficient and economical method of storing water. Any desired size tank can be built by the choice of appropriate lengths of corrugated steel conforming to Australian Standard 1445. LBI Zincalume Custom Blue Orb and galvanized Custom Blue Orb are manufactured to AS 1445 specification.

ROOF CATCHMENT MATERIAL AND AREA

The nature of the catchment areas from which rain-water tanks are filled is of importance in determining the conditions in the tank, because the composition of the water may be influenced by both the size of the catchment and the material used.

Large catchment areas, over 16 square metres per kilolitre of water storage capacity, have been found to be associated with shorter tank lives. This is only of importance where very heavy rains are usual, and is considered to be due to the fact that rapid filling occurs, overflowing the tank and washing away any silt and leaving behind high purity water.

The type of material used for the roof catchment area, including surface treatment, can influence the rate of corrosion and hence the life of the tank. Rain-water from a zinc-coated steel, or asbestos cement roof catchment normally contains traces of zinc and/or calcium salts which promote a passive film on the inside of a tank wall.

Zincalume, Colorbond, Korarma and Marviplate prefinished steels, aluminium (including aluminium paint) glazed terra cotta and most painted roofs do not change the characteristics of water run-off. To overcome any uncertainty rain-water tanks should be constructed from Zincalume steel.

Advice should be obtained from a paint manufacturer before painting any roof intended as a water catchment area to ensure that the paint system is suitable. For example, calcium plumbate primer contains lead and MUST NOT be used in this situation.

Zincalume or galvanized steel water tanks are **not** suitable to collect run-off from a copper catchment.

Lead flashings should **not** be used, but if present must be painted.

TANK INSTALLATION

A little care in the choice of the location of a rain-water tank can often mean a difference of many years in its life. Whenever possible, tanks should be installed in a shady position, preferably on the southern side of a building but away from trees from which falling leaves might clog up the strainer or contaminate the water. Direct sunlight falling on a tank for long periods on hot days creates temperature differentials in the water which tend to promote corrosion.

Tanks should be fitted with a top, since this will not only help to prevent harmful contamination of the water but will also reduce the growth of algae. Most algae are not at all harmful but a few evolve acids during their normal process of growth and as a consequence are detrimental to Zincalume or galvanized steel. Green algae may grow to an appreciable length inside a tank but are usually quite harmless.

Inlet filling pipes should discharge into a filter located in a position that will not let the water flow down the inside of the tank wall and possibly cause corrosion.

Metals such as copper, brass or bare steel should **not** be in contact with the coating on the sheets nor be in the tank water. When brass fittings are used in tanks, they should be thoroughly tinned before fitting otherwise severe corrosion may result in their immediate vicinity.

INTERCONNECTED TANK INSTALLATIONS

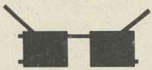
If two or more tanks are installed with top or bottom connections, make sure that each tank receives some water directly from the catchment. This is called *parallel connection*, and is the recommended method for interconnected tank installations.

Filling one tank entirely by overflow or by bottom connection from another tank is called *series connection*. This is likely to reduce useful tank life and is not recommended. The reason for early failures in series connected tanks appears to be associated with differences in water purity and siltation between the first and subsequent tanks.

Interconnected Tank Installations

RECOMMENDED

Parallel, lower connection

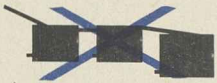


Parallel, upper connection

Each tank directly connected to catchment

NOT RECOMMENDED

Series, lower connection



Series, upper connection

One tank only connected to catchment

GROUND WATER STORAGE

Bore, well, dam and river waters can vary widely in composition; many are aggressive to the tank material, some are protective. The behaviour of water from any one source may fluctuate from one extreme to the other as a result of floods or droughts. Waters from different locations vary considerably, dependent upon the nature of the terrain over or through which the water has passed.

If in the initial stages of filling, a protective film or crust is formed, either by reaction of the water with the coating metal or by the deposition of solids from the water, a long tank life is assured. However, the variability of ground waters is such that it must be considered unwise to be unduly optimistic in this regard, and the safest practice is to paint the inside of ground water tanks before their first filling. (Refer to index for Painting notes pages.) Bituminous paints are not recommended for painting coated steel tanks. The performance of these paints has been found to be variable and whilst some are quite satisfactory, others actually cause corrosion.

Dimensions of Water Tanks made from Single Sheet Rings of Custom Blue Orb or Zincalume Custom Blue Orb Corrugated Sheets

Tank capacity in kilolitres	MEAN DIAMETER AND SHEET LENGTH REQUIRED TO CURVE RING FROM SINGLE SHEET ALLOWING FOR 100 mm END LAP, mm					
	Mean dia	Sheet length	Mean dia	Sheet length	Mean dia	Sheet length
	Single sheet rings of $10\frac{1}{2} \times 76$ mm corrugated sheet					
	1 ring, 810 mm high		2 rings, 1620 mm high		3 rings, 2380 mm 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 76 mm corrugated sheet					
	1 ring, 620 mm high		2 rings, 1230 mm high		3 rings, 1840 mm 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 $10\frac{1}{2}$ corrugation three ring high tanks for slip joint assembly method.

CAPACITY OF TANKS—CALCULATIONS

Square or Rectangular Section All dimensions in metres:
Length × breadth × depth = capacity in kilolitres.

Circular Capacity in kilolitres given by either of the following rules:

A Capacity $= \frac{\pi}{4} \times (\text{diameter})^2 \times \text{height}$

B Capacity = Multiply the circumference by itself and by $\frac{8}{100}$ times the height $- C^2 \times \frac{8h}{100}$

C Capacity = Multiply the diameter by itself and by $\frac{4}{5}$ times the height $- D^2 \times \frac{4h}{5}$

Example using Rule C.— Diameter 2 metres, height 2 metres.

$$2 \times 2 \times \frac{4}{5} \times 2 = \frac{32}{5} = 6.4 \text{ kilolitres approximately.}$$

NOTES

NOTES

PAINTING OF LYSAGHT ZINC-COATED OR ZINCALUME STEEL SHEET

The painting of Lysaght zinc-coated or Zincalume steel sheet for either decoration or added protection may be easily and effectively carried out, providing certain basic requirements are observed. Ordinary techniques combined with readily available appropriate paints should be used, but care must be taken in the choice of paint to ensure its suitability for 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 Lysaght zinc-coated or Zincalume steel sheet.

Painting in the factory, normally on a line designed specifically for the purpose and using elaborate cleaning and pretreatment, usually requires **oven drying** paints.

Selection of paint for factory use . . . is dictated by the final use and exposure 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, marine, industrial or other special conditions. Table 2 lists some proprietary paints which have been found suitable for use in a wide range of conditions. Omission of a system from this Table does not necessarily indicate unsuitability, but merely that circumstances have not permitted its evaluation by John Lysaght (Australia) Limited.

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.

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 to be withstood; reference to the information listed in detail in Table 2 is strongly advised.

Use of the recommended brands should produce a satisfactory result provided care is taken to follow the manufacturers' mixing and application instructions closely. 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 where a total of two is sufficient. Spray painting can be used to cover larger areas at lower cost providing the paint is suitable for this method of application.

SECTION 2 – FACTORY PAINTING

Pretreatment of Galvabond, Zincform or Zinc-Hi-Ten with a phosphate coating system is usually employed in factory applications prior to painting. Since Zincalume does not phosphate the appropriate pretreatment is normally a chromate type.

Chromate coatings or two-pack etch primer may also be used. This confers a valuable combination of 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 Oxy Metal Industries (Australia) Pty Limited and Dulux Australia Limited. Where pretreatment facilities are not available, two pack etch primers may be used.

Material to be pretreated should be ordered unchromated 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 the works prepared prepainted sheet or coil, Lysaght Colorbond.

A wide variety of basic paint types is available for factory finishing, but it is important that the most appropriate paint for the particular application is selected. 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. Alkyds are less expensive coatings, widely used where their properties are applicable to the end product.

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.

Lysaght Colorbond Steel In many instances, it is possible – and desirable – to avoid either field or factory painting. John Lysaght (Australia) Limited produces Colorbond, a prepainted zinc-coated or Zincalume steel quality, on Australia's largest fully integrated coil coating lines. Colorbond is available in a wide range of roofing and cladding profiles or as coil for fabrication.

TABLE 1 – GENERAL APPROACH TO THE FIELD PAINTING OF LYSAGHT ZINC-COATED OR ZINCALUME SHEET STEEL

Cleaning	Priming and Finishing
1 Remove dirt by washing with water.	1 Select paint system from Table 2 with due regard to environmental requirements.
2 Wipe off greasy deposits with paint thinners.	2 Follow the paint manufacturer's instructions explicitly.
3 Remove any corrosion product by wire brushing, taking care not to unnecessarily remove any of the metal coating.	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 where two coats in total is usually sufficient.
	5 Finishing coats may be applied directly to Zincanneal without priming, but when a 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.

TABLE 2 – FIELD PAINTING OF LYSAGHT ZINC-COATED OR ZINCALUME SHEET STEEL

(a) Recommendations for rural, urban, moderate industrial and moderate marine conditions approximately 800 metres and further from surf, depending on terrain and prevailing winds.

Primer Type	Application	Brand Example	Finish Type	Application	Brand Example
Two pack etch primer	Brush or spray. Spray preferred.	Dulux Etch Primer Taubmans Met-L-Etch	Alkyd	Brush or spray.	Dulux Hi-Gloss Taubmans Butex
			Oleoresinous/ micaceous iron oxide	Brush or spray.	Dulux Ferrodor Taubmans Mironite Roof and Metal
Zinc-dust/ zinc-oxide	Brush or spray.	Berger Galvanized Iron Primer Grey Taubmans Galva Kote	Zinc-dust/ zinc-oxide	Brush or spray.	Berger Galvanized Iron Primer Grey Taubmans Galva Kote
			Alkyd	Brush or spray.	Berger Roofmaster Taubmans Butex
			Oleoresinous/ micaceous iron oxide	Brush or spray.	Berger Roofmaster MIO Taubmans Mironite Roof and Metal
Oil based calcium plumbate primer	Brush. Spray not permitted.	Dulux Calcium Plumbate Primer	Alkyd	Brush or spray.	Dulux Hi-Gloss Taubmans Butex

Note: Before use, 3 kg zinc dust must be added per 5 litres of zinc-dust/zinc-oxide paint.

Note: Calcium plumbate primer contains lead and must not be used on water catchments.

Continued next page

TABLE 2 *(Continued)* – FIELD PAINTING OF LYSAGHT ZINC-COATED OR ZINCALUME SHEET STEEL

(b) Recommendations for rural, urban and moderate industrial conditions.

Primer Type	Application	Brand Example	Finish Type	Application	Brand Example
Low gloss water-borne acrylic	Brush.	Taubmans Primer for Galvanized Iron Berger Galvaprime Dulux Galvanized Iron Primer British Paints Galvanized Iron Primer	High gloss water-borne acrylic	Brush.	Taubmans All Weather Gloss Dulux Weathershield Gloss Berger Bonanza British Paints Four Seasons
High gloss water-borne acrylic	Brush.	Dulux Trim Coating	High Gloss water-borne acrylic	Brush.	Dulux Trim Coating

Note: As some acrylic paints may contain chromium compounds, their use on water catchments is not advisable.

Note: For acrylics, overpainting with oil-based paints can reduce adhesion of total system; white is suitable for mild conditions only, colours contain anti-corrosive pigments.

(c) Recommendations for severe industrial and severe marine conditions within approximately 800 metres of open surf, depending on terrain and prevailing winds. The paint types listed are the most appropriate for these severe conditions, and maintenance frequency will vary with the degree of severity. The alternative use of Exterior Marviplate will generally solve such maintenance problems.

Primer Type	Application	Brand Example	Finish Type	Application	Brand Example
Two pack etch primer	Brush or spray. Spray preferred.	Dulux Etch Primer Taubmans Met-L-Etch	High build vinyl	Spray preferred.	Dulux VR3 Vinyl Taubmans Valchem Vinyl Enamel
			Two pack polyurethane	Brush or spray.	Dulux Durethane Dimet Alumidise Taubmans Interthane
			Chlorinated rubber	Brush or spray.	Dulux Thik-Clor Taubmans Valchem Chlorinated Rubber
			Two pack coal tar epoxy	Brush or spray.	Dulux Duretar Taubmans Bitoxy

Note: Suppliers' recommendations should be followed explicitly in regard to film builds and appropriate undercoats.

(d) Recommendations for severe marine and buried or immersion conditions, such as tanks storing ground waters.

Primer Type	Application	Brand Example	Finish Type	Application	Brand Example
Two pack etch primer	Brush or spray. Spray preferred.	Dulux Etch Primer Taubmans Met-L-Etch	Two pack coal tar epoxy	Brush or spray.	Dulux Duretar Taubmans Bitoxy

The proprietary products referred to for guidance in the above tables are among those which have been evaluated by John Lysaght (Australia) Limited and found satisfactory. The performance of a system is influenced by the quality of preparation and application. The paint manufacturers' instructions should be followed explicitly.

Contact the nearest John Lysaght (Australia) Limited Office for further information.

TABLE 3 – FACTORY PAINTING OF LYSAGHT ZINC-COATED OR ZINCALUME SHEET STEEL

QUALITY	COATING TYPE		CLEANING	PRETREATMENT	PAINT FINISH
	Type	Comment			
Galvabond Zincform Zinc-Hi-Ten Zincmatte	Zinc	For phosphating ensure that 'unchromated and oiled' is specified on the order.	Alkaline, usually part of pretreatment.	Phosphates, chromates, or two pack etch primers.	Stoving appliance or outdoor finishes (acrylics, alkyds, vinyls, epoxies).
Zincseal	Zinc	Provided with sophisticated phosphate coating.	Solvent wiping. 1,1,1-trichloroethane vapour degrease.	None required. Two pack etch primers for damaged phosphate coating.	Stoving appliance finishes (acrylics, alkyds).
Zincanneal	Zinc/iron alloy	Provided with simple phosphate coating.	Solvent wiping. 1,1,1-trichloroethane vapour degrease.	None normally. Performance can be upgraded by two pack etch priming.	Stoving appliance or outdoor finishes (acrylics, alkyds, epoxies).
Zincalume	Zinc/aluminium alloy	For chromating ensure that 'unchromated and oiled' is specified on the order.	Alkaline, usually part of pretreatment.	Chromate or two pack etch primers.	Stoving, outdoor finishes.

SOLDERING GALVANIZED STEEL SHEETS

All qualities of Lysaght zinc-coated steel sheets may be soldered quickly and effectively if the simple procedures given below are followed.

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	Fluxing

Storage of Sheets

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:

(a) Hand Seaming.
Use a wooden dresser or mallet in preference to a steel hammer. A groover of the correct size should be used.

(b) Machine Seaming.
The size of the seam should be carefully tailored to suit the grooving machine. Care should be taken to ensure that machines are correctly set.

Cleanliness in Forming and Soldering

Forming tools and working surfaces should be thoroughly clean, as grit ground into the surface during forming can not be readily removed. 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. Before fluxing, the job should be thoroughly cleaned to remove dirt, grease or oil picked up from the forming tools.

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.* This is particularly important with the thin coating of electro-galvanized 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 but this sheet may be readily soldered if Kemtex Pinnacle or Baker's No 47 Soldering Fluid is used.

1 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 and 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. These materials are normally obtainable from plumbing supply houses.

2 Proprietary Soldering Fluids.
Kemtex Pinnacle and Baker's No 47 soldering fluids are the preferred choice for soldering and are highly recommended. Kemtex Pinnacle is manufactured by O. T. Lempriere and Co Ltd, and Baker's No 47 by Aston and Fendley Pty Ltd. Both products are available through normal supply sources in all capital cities as well as from many hardware and plumbing supply houses in both city and country areas. 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 with better joint penetration. The slightly higher cost tends to be offset by the smaller quantity required for effective fluxing. For best results the time between fluxing and soldering should be minimized 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, which is very reactive with zinc.

The flux should be applied until is 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.

The wetting agent may be an industrial surface active agent such as Nonidet P40, which is available from Shell Chemical (Australia) Pty Ltd. Alternatively, many of the readily available household detergents, preferably non-ionic, are satisfactory and a simple trial will establish suitability. Some cloudiness may occur following the addition of the detergent but this will not affect the fluxing operation.

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 a 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. This problem can normally be overcome by the use of Pinnacle or Baker's flux.

At regular intervals the flux pot should be cleaned and filled with fresh flux. Constant use of the same flux, or adding to used flux, will result in contamination and ineffective fluxing action.

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. Solder sticks should be clean and the use of badly oxidized sticks should be avoided.

Applying the Solder

To obtain 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 it causes an excessive solution of the zinc coating, giving a rough sandy finish. The seam must, however, be adequately heated if good penetration is to be obtained. To achieve these objectives the following points should be observed:

1 Avoid heat conduction away from the joint. This will occur when the work is in contact with a heat conductor, such as a steel block, and inadequate heating may result.

2 Avoid soldering in draughty conditions. Inadequate heating may result.

3 Use a soldering iron with a high rate of heat transfer. It is desirable to dress the bit face to provide a large surface area in contact with the work.

4 The soldering iron should be clean and well tinned.

5 Do not overheat the soldering iron. An overheated iron, indicated by a predominance of green coloration in the heating flame, will cause overheating of the work.

6 Avoid applying a direct flame to the work. Overheating may result.

7 Solder the joint in one run wherever possible. A second run serves little purpose if the first run has been properly applied.

8 Avoid undue abrasion of the zinc surface with the soldering iron.

9 The soldering iron should always be drawn along the seam towards 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.

Sealants

As a substitute for soldering, zinc-coated sheets may be joined by use of mechanical fasteners such as blind rivets in conjunction with a sealant. Refer to following pages for information on sealants for steel.

Zincalume

Zinc/aluminium alloy coatings are impractical to solder in the field, therefore soldering is not recommended for Zincalume. Lysaght recommended sealants are suitable for use with Zincalume roofing and walling. Literature on current, economical, easy-to-use sealing and joining systems is available from Lysaght or Lysaght Brownbuilt Industries State Offices.

SEALANTS FOR LYSAGHT ZINCALUME, GALVANIZED, COLORBOND, MARVIPLATE OR KORARMA STEELS

Sealant is the descriptive word used, in this handbook, to mean polymeric sealants. Polymeric sealants are formulated to 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 nitrile, 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.

EXTERIOR EXPOSURE APPLICATIONS

Joints for exterior applications such as sheet steel roofs, walls, flashing and ducting constitute a special case due to the number of exposure environments and variables. The wide use of precoated sheet steels for exterior use contributed to the development of sealants suitable for seams and joints.

Many sheet steel roofing and walling shapes marketed under various respected brand names are formed from Lysaght sheet steel coated with the protective and/or decorative finishes Exterior Marviplate, Korarma, Colorbond, Zincalume and zinc.

A need for a common sealant which could be suitable for and compatible with all Lysaght sheet steel exterior finishes was indicated. The building trade strongly favoured the use of elastomer (synthetic rubber) type sealants. Extensive research and evaluation were undertaken by Lysaght to select elastomeric sealants which could be recommended for use with all Lysaght exterior finishes.

Tests indicated that the **acetic acid-free** and **amine-free** neutral curing silicone rubber sealants possess the most complete relevant list of properties required to service the total range of Lysaght sheet steel exterior finishes, together with an adequate range of flashing materials.

Recommended Sealants

Information on specific and alternative brands of silicone rubber sealants recommended by Lysaght is available in frequently updated special literature available from Lysaght State Offices.

The recommended sealants possess all the following necessary requirements:

Compatible with and adherent to all Lysaght exterior finishes
Non-corrosive
Flexible
Water resistant
Ultra-violet (sunlight) resistant
Heat and cold resistant
Mould resistant
Non-slumping (gap-filling)
No primer needed

It is not implied that other sealants may not be suitable. In fact, many others are satisfactory for some or all of the Lysaght finishes, even though they may not provide all the optimum characteristics of those recommended. For example, silicone rubber sealants containing either **acetic acid** or **amines** should **not** be used on zinc or zinc/aluminium finishes. This is due to the fact that wet conditions during early stages of sealant cure can promote a corrosive situation.

Other generic types such as butyl rubber and styrene butadiene rubber are quite acceptable in some cases where the optimum characteristics of the recommended sealants are not required.

Where doubt exists on the suitability of a sealant, the above list of required properties should be used as a basis for choice.

As part of the Lysaght policy of continuous testing and technological review of existing and new products, likely sealants are consistently under study. The latest information can be readily obtained through Lysaght State Offices.

Joint Design

Seams should **always** be mechanically fastened for strength, whether soldered or sealant sealed. Therefore the sealant does not require significant total adhesive strength, but it must bond positively to both opposing surfaces as a continuous layer. When sealing laps in roof sheeting, additional fasteners are not necessary where the join is held together by the roof fasteners.

The recommended sealants contain curing agents and do not rely on solvent evaporation for polymerization. To ensure complete sealant cure, the width of sealant in a lap should not exceed 25 mm when compressed.

The sheet thickness will determine distance between fasteners, but for roofing/walling applications generally, 45 to 50 mm should be considered the maximum. Fastener diameter size is dependent upon the sum of all material thicknesses driven. Where doubt exists it is better to select a thicker fastener as thin fasteners tend to work loose during thermal movement.

Spot Welded Joint If a *sealed* spot welded joint is required, and for aesthetic or practical reasons a *sealing over* technique is unacceptable, the sealant may be sandwiched between the workpieces and the joint spot welded as usual along the glue-line. The spot welding operation must take place as soon as possible after sealant placement and **before** the sealant cures.

Normal welding pressures used for the particular substrates have been found to be sufficient for local displacement of sealant to occur and permit current flow. The recommended sealants do not emit volatile fumes.

Spot welding cannot be performed this way when the sealant has cured; the cured sealant layer acts as an insulator and impedes current flow.

Surface Preparation

For bonding, all workpiece surfaces must be clean and dry and free from contaminants such as old sealant or oil. An oil-free solvent such as toluol or xylol should be used to clean the surface, but this should be wiped off with a clean dry cloth before evaporation occurs. Mineral turpentine is a suitable and practical alternative, but being less volatile than toluol or xylol more wipe-off care may be necessary to ensure complete removal of residual solvent.

Sealant must be applied on the **same day** as the surface is prepared.

Lap Seam Fabrication

The preferred method for lap seam fabrication is:

1 Assemble and drill.

2 Separate components and remove drilling debris etc.

3 Clean joint surfaces.

4 Apply a 3 mm sealant bead in a continuous line so that it envelops the fastener hole.

5 Relocate components and fasten as soon as practical after sealant placement.

6 Place some sealant over and around fasteners.

Fastening techniques are well established, but the need to seal over and around fasteners with a long lasting sealant is emphasised due to total exposure to sunlight in this situation.

For practical purposes it is sometimes necessary to place sealant prior to drilling.

Other Sealant Types

Apart from the cartridge-extrudable sealant types, a number of varieties are commercially available, all of which would probably perform predictably in given situations and with specific materials. It is not practicable for Lysaght to extensively research and evaluate each and every one.

If a user is of the opinion that a particular sealing method may suit his purposes better than the method recommended, Lysaght State Offices may be able to asist by suggesting a simple test, and/or to provide relevant additional information that could help.

Solid Sealants in Tape Form Solid sealants in tape form are generally semi-cured butyl rubber possessing positive initial adhesion to both opposing surfaces. As with the other sealants, the tapes are used in combination with mechanical fasteners.

For the tape to make positive contact with both surfaces and form a seal, it is important that the tape initial thickness is greater than the gap between the components of the finished joint.

Used correctly under suitable conditions, these tapes would be satisfactory for use with Lysaght exterior finishes. However, some types may be difficult to compress within a joint during cold weather, possibly resulting in a loose joint later.

Preformed Gaskets Gaskets preformed to some of the popular roofing profiles are generally made from cellular material, and intended for compression between such irregular surfaces as roofing sheets. By varying the compression they can perform different functions of sealing against water, dust, noise, draughts and snow.

The gaskets are non-adhesive and are often saturated with bitumen or acrylic resin. Fitted correctly they would be suitable for use with Lysaght exterior finishes in situations where the installation of such bulky seals is indicated.

INTERIOR APPLICATIONS

Sealants for use on assemblies such as interior ducting or containers that will not be exposed to exterior environments, may not need to possess the same properties and characteristics required for exterior exposure. They would, however, need to be:

Compatible with and adherent to the component surface finishes
Suitable for the application
Non-corrosive
Flexible
Resistant to materials in the environment to which the sealant is exposed
Heat and cold resistant
Mould resistant
Non-slumping (gap-filling)

There would probably be additional requirements depending on the reason for sealing. For example, if an assembly is to contain water, the sealant would need to be impervious to water and may need some pressure resisting capability. In some circumstances, primers may be necessary to improve adhesion.

Possible uses being so varied and complex it is always good practice, particularly for specialized applications, to consult the sealant manufacturer for expert advice. Lysaght State Offices may also be contacted for assistance in such matters. Exterior exposure application recommendations for Joint Design, Surface Preparation and other pertinent items also apply, as appropriate, for interior applications and should be followed.

ADHESIVES FOR JOINING LYSAGHT STEEL SHEET

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 progress from simple natural rubbers and adhesives to the more highly specialized synthetic elastomers and resins has enabled new dimensions in strength, flexibility and resistance to environmental conditions to be achieved. New formulations are being developed at an accelerating rate, increasing the number and variety of applications using Lysaght steel sheet products.

REASONS FOR USING ADHESIVES

Adhesive bonding is often a preferred method for joining and sealing steel sheet, with most benefits in the field of precoated sheet.

Subject to the provision of a uniform surface condition, the performance of modern adhesives is both reliable and predictable, and joints of moderate strength can be produced. As with any fastening method, the limitations must be recognised along with the 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. In cleavage or peel loading, stress is concentrated at a fine line at the joint edge and unless the joint is wide or the stress small, failure will occur.

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 temperature, moisture or corrosive conditions likely to be met. In many instances an adhesive can have the dual role of supporting the design load and acting as a sealant. In addition, depending on the final formulation, the adhesive can act as an insulator, conductor, gap filler, etc. 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. The complexity of available variations possible with the use of adhesives makes it mandatory for adhesive suppliers to be consulted in the design stage of both the product to be 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 of adhesives. 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 (less surface preparation)
- low creep strength

Differences in formulation permit a wide range of strength properties in hot melt adhesives.

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. The high solvent action of reactive acrylics is less affected by oil on steel surfaces than other adhesives. Nevertheless, properly prepared surfaces give a better joint strength and may be necessary for critical applications. As reactive acrylics may not give a consistent performance with zinc surfaces, advice should be sought from adhesive suppliers before using them on zinc-coated steel sheet.

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.

Cyanocrylates 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. Resistance to impact loading is low.

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 for the application. This is the most critical step in adhesive bonding for most adhesives, not only for the initial bond strength but also for the durability of the bond when exposed to normal environmental conditions. Lysaght 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 is used to remove surface debris such as mill scale and corrosion layers from metal surfaces by physically removing part of the metal. Abrading has a tendency to furrow the metal surface such that the metal filings are turned over and trap contaminants. It is not a uniform process and is only slightly better than the use of cleaners alone.

Abrasive blasting results in a more uniform surface finish. Dry blasting is the most common method although wet blasting is sometimes used. A sharp cutting abrasive like aluminium oxide, silicon carbide or quartz is used to obtain a sharp angular surface profile on the metal surface. Round blasting media such as metal shot give very poor results because they have a peening action that creates a surface consisting of overlapping metal particles loosely attached to the surface. Peened surfaces have poor adhesive wetting characteristics and result in relatively weak bonded joints.

Chemical etching usually provides the most uniform and most consistent bond quality. By chemical or electro-chemical means a reaction takes place with the metal surface stripping away the adsorbed surface contaminants and exposing the base metal. This can then react with salts in the cleaning bath to form a conversion coating, which is often rough and hence assists the bonding process by purely mechanical means.

Any calculations for bond areas needed to give the required joint strength must make allowances for variations in surface treatment likely to be encountered in normal production conditions.

FASTENERS FOR STEEL ROOFING AND WALLING

THE IMPORTANCE OF FASTENERS AND THEIR MANUFACTURE

All fasteners used for steel roofing and walling should be of reputable manufacture and be protective coated in accordance with the requirements of appropriate Australian Standards such as AS 1897, AS 1789, AS 1214, AS K132 and AS 1791. Fasteners produced in Australia by leading manufacturers are identified by a head-mark.

Some fasteners, including many imported varieties, have been found to be sub-standard and to have inadequate coatings which lead to rapid fastener corrosion, causing unsightly staining and reduced service life of claddings. In addition there have been high cost problems resulting from fastener heads breaking away from the shanks.

Australian fastener manufacturers will provide advice and assist in the choice of correct fasteners.

Lead head nails or lead washers must not be used with Zincalume steel claddings.

Fastener information provided in this section of the Referee represents a general range of steel roofing/walling fasteners manufactured in Australia for the purposes indicated. It is emphasised, however, that it is important to use specific fasteners as recommended in the various steel roofing and walling suppliers' literature. Fasteners are an integral part of reliable roofing systems, and performance testing data are based on correct fastener usage.

Fastener recommendations are for normal (non-cyclonic) weather conditions. Advice should be sought from cladding system manufacturers for cyclonic weather conditions recommendations.

FASTENER DETAIL

Roofing and walling threaded fastener detail shown has been prepared in conjunction with:

	HEAD-MARK
Ajax Fasteners Australia Limited	**A**
W.A. Deutsher Pty Limited	**BX**
Sidney Cooke Fasteners Pty Limited	**SC**
Spurways Industries Pty Limited	**SI**

The headmarks **A**, **BX**, **SC**, and **SI** appearing with fastener detail in the following pages indicate supply by those manufacturers as appropriate.

Protective coatings on fasteners vary according to manufacturer preference but each system employed is an alternative contained in the appropriate standard. In general, the coating systems on steel screws for normal service conditions are an electrodeposited coating of zinc (nom 12 μm) or cadmium (nom 8 μm) and yellow chromate treatment. The coating method or thickness may be varied to suit specific requirements.

It is important to remember that the fasteners listed are for standard finishes on the cladding sheets (such as plain Zincalume steel) and that upgraded fastener material will be required for cladding sheets made from Marviplate or Korarma steel. For example stainless steel or monel fasteners are required for Marviplate, otherwise the cladding may outlast the fasteners; also the reason for using Marviplate would invariably be because of some form of aggressive atmosphere.

COLOURED FASTENERS

Fasteners **A**, **BX**, **SC**, **SI** can be supplied with painted coloured heads to match the standard Lysaght SMP Colorbond steel colours:

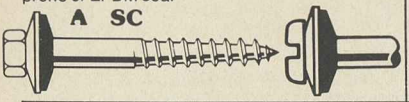
Bronze Olive	Off White	Beige
Gold	Weathered Copper	Mt Olga Orange

Other colours may be supplied subject to negotiation. In addition, some approved coloured fastener capping systems are available.

FOR PIERCE-FASTENING STEEL CLADDINGS TO TIMBER SUPPORTS

CREST FASTENING – ROOFING AND WALLING

Hex head or slotted pan head wood screw with metal-coated steel washer and Neoprene or EPDM seal



Hard or soft timber
CUSTOM ORB
No 12 x 45 mm

TRIMDEK HI-TEN
SPANDEK
No 12 x 60 mm

Type 17 hex washer head self-drilling wood screw with Neoprene or EPDM seal

Hard or soft timber
CUSTOM ORB
No 12 x 50 mm

TRIMDEK HI-TEN
SPANDEK
No 12 x 65 mm

Roofing Nails:
Holdfast, National or Gripwell brand roofing nails 3.75 mm dia x 60 mm with special shank and Neoprene washer may be used for fastening Custom Orb corrugated steel to hardwood 32 mm or more deep or softwood 40 mm or more deep. Roof slope should be greater than 1 in 12.

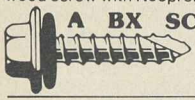
VALLEY FASTENING – WALLING ONLY

Slotted pan head type AB screw with metal-coated steel washer and Neoprene or EPDM seal

Hard or soft timber

CUSTOM ORB
TRIMDEK HI-TEN
SPANDEK
No 10 x 25 mm

Type 17 hex washer head self-drilling wood screw with Neoprene or EPDM seal



Hard or soft timber
CUSTOM ORB
TRIMDEK HI-TEN
SPANDEK, PANELRIB
No 12 x 25 mm

Cross-recessed or slotted pan head type AB screw

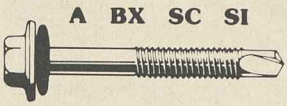
Hard or soft timber
V-CRIMP
V-CRIMP HI-TEN
PANELRIB
No 8 x 25 mm

Galvanized clouts 2.8 mm dia x 25 mm may be used for Panelrib.

FOR PIERCE FASTENING STEEL CLADDINGS TO STEEL SUPPORTS
CREST FASTENING – ROOFING AND WALLING

Self-drilling screws: **A, BX** = Teks
SC, SI = Dril-Kwick

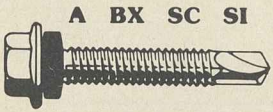
Hex washer head self-drilling, thread-forming screw with Neoprene or EPDM seal



Steel 1.5 to 5 mm
CUSTOM ORB
No 12 x 35 mm

TRIMDEK HI-TEN
SPANDEK
No 12 x 45 mm

Hex washer head self-drilling, thread-cutting and/or thread-forming screw with Neoprene or EPDM seal

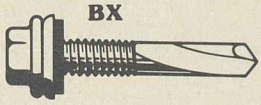


Steel 5 to 6.3 mm
CUSTOM ORB
No 14 x 40 mm

SPANDEK
No 14 x 45 mm

TRIMDEK HI-TEN
No 14 x 50 mm

Hex washer head self-drilling, extended point, thread-forming screw with Neoprene or EPDM seal

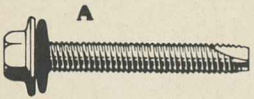


Steel 6.4 to 13 mm
CUSTOM ORB
No 12 x 50 mm

TRIMDEK HI-TEN
SPANDEK
No 12 x 65 mm

CREST FASTENING – ROOFING AND WALLING (Cont)

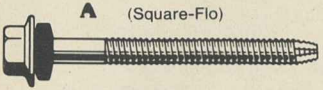
Type 23 hex washer head thread-cutting screw with Neoprene seal

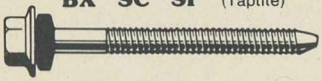


Steel all thicknesses (predrill)
CUSTOM ORB
SPANDEK
No 12 x 40 mm

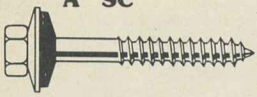
TRIMDEK HI-TEN
No 12 x 50 mm

Hex washer head thread-rolling screw with pilot point and Neoprene or EPDM seal





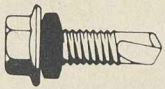
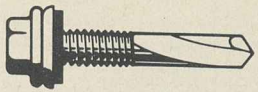
Hex head type AB thread-forming screw with metal-coated steel washer and Neoprene or EPDM seal



Steel all thicknesses (predrill)
CUSTOM ORB
SPANDEK
No 12 x 40 mm

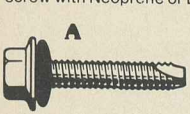
VALLEY FASTENING – WALLING ONLY

Self-drilling screws: **A, BX** = Teks
SC, SI = Dril-Kwick

Hex washer head self-drilling, thread-forming screw with Neoprene or EPDM seal **A BX SC SI** 	**Steel 1.5 to 4.5 mm** **(SC, SI)** **Steel 1.5 to 5 mm** **(A, BX)** CUSTOM ORB TRIMDEK HI-TEN SPANDEK PANELRIB No 10 × 16 mm
Hex washer head self-drilling, thread cutting and/or thread-forming screw with Neoprene or EPDM seal **A BX SC SI** 	**Steel 4.5 to 6.3 mm** CUSTOM ORB TRIMDEK HI-TEN SPANDEK, PANELRIB No 14 × 22 mm
Hex washer head self-drilling, extended point, thread-forming screw with Neoprene or EPDM seal **BX** 	**Steel 6.3 to 13 mm** CUSTOM ORB TRIMDEK HI-TEN SPANDEK, PANELRIB No 12 × 32 mm

VALLEY FASTENING – WALLING ONLY (Cont)

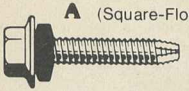
Type 23 hex washer head thread-cutting screw with Neoprene or EPDM seal

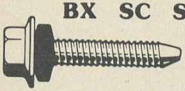


Steel all thicknesses (predrill)
CUSTOM ORB
TRIMDEK HI-TEN
SPANDEK, PANELRIB
No 12 x 20 mm (Type 23)

No 12 x 16 mm (Square-Flo or Taptite)

Taptite or Square-Flo hex washer head thread-rolling screw with pilot point and Neoprene or EPDM seal





Hex head type AB thread-forming screw with metal-coated steel washer and Neoprene or EPDM seal

Steel all thicknesses (predrill)
CUSTOM ORB
TRIMDEK HI-TEN
SPANDEK, PANELRIB
No 12 x 20 mm

Cross-recessed or slotted pan head type AB thread-forming screw

Steel all thicknesses (predrill)
V-CRIMP
V-CRIMP HI-TEN
PANELRIB
No 8 x 13 mm

Monel blind rivets 4 mm dia may be used to fasten V-Crimp, V-Crimp Hi-Ten and Panelrib.

FOR SIDE LAP FASTENING (STITCHING) STEEL ROOFING AND WALLING SHEETS

Cross-recessed or pan head type AB thread-forming screw with metal-coated steel washer and Neoprene or EPDM seal **A SC SI** 	Predrill No 8 x 13 mm
Type S point hex washer head self-drilling, self-tapping screw with Neoprene or EPDM seal **A BX** 	No 8 x 12 mm
Hex washer head self-drilling screw with Neoprene or EPDM seal **A BX SC SI** 	No 8 x 12 mm

Side laps may also be fastened by **blind rivets**:
4 mm dia Monel rivet, sealant sealed in centre hole.
4.8 mm dia aluminium sealed rivet.

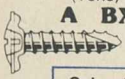
FOR FASTENING CONCEALED FASTENING CLIPS

TO TIMBER SUPPORTS

Type 17 wafer head self-drilling, thread-forming screw

(Teks) (Dril-Kwick)

A BX SC SI



Hard or soft timber
KLIP-LOK
No 10 x 25 mm
Use 35 mm long screws over insulating blanket

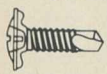
Galvanized spiral thread nails 3.15 mm dia x 40 mm or 3.75 mm x 60 mm may be used for Klip-Lok and Brownbuilt 305 or 406 decking clips.
Refer to product literature for recommendation details.

TO STEEL SUPPORTS

Wafer head self-drilling, thread-forming screws

A BX (Teks)

SC SI (Dril-Kwick)



Steel supports 1.5 to 4.5 mm
(SC, SI)
Steel supports 1.5 to 5 mm
(A, BX)
KLIP-LOK
BROWNBUILT 305/406
No 10–24 x 16 mm*

Steel supports 1.5 to 2.5 mm
KLIP-LOK HW
No 10–16 x 16 mm*

Steel supports 2.5 to 4.5 mm
(SC, SI)
Steel supports 2.5 to 5 mm
(A, BX)
KLIP-LOK HW
No 10–24 x 16 mm*

Taptite or Square-Flo wafer head thread-rolling screw

A (Square-Flo) **BX SC SI** (Taptite)

Steel supports 5 mm and over (predrill)
KLIP-LOK
KLIP-LOK HW
BROWNBUILT 305/406
No 10 x 16 mm*
(A, BX, SI)
M5 x 25 mm **SC**

* Use 25 mm long screws over insulating blanket.

DRILL SIZES FOR PREDRILLING LOW CARBON STEEL TO ACCEPT SELF-TAPPING (THREAD-FORMING, THREAD-CUTTING OR THREAD-ROLLING) SCREWS

Screw type	Steel thickness mm*	Drill size mm
Type AB	1.6	4.5
No 12	2.0	4.6
	2.5	4.7
	3.0	5.0
†	4–9	5.1
Type AB	0.6–0.9	3.7
No 10	1.2–1.5	3.8
	2.0–2.5	4.0
	3.0–3.5	4.3
	4	4.4
†		
Type AB	0.6–0.9	3.2
No 8	1.2	3.3
	1.5	3.4
and	2.0	3.5
	2.5–3.2	3.8
Type 23	3.5	3.9
	⩾5	3.5
†		
Square-Flo		
Taptite Type 23	⩾5	5.0
No 12		
No 10		4.4

* Sum of all thicknesses driven.
† General guide only. Refer to AS B194 for more specific detail.

NAILS: Approximate quantity per kilogram

Bright Nails

Size, mm	Flat head	Bullet head
100 × 4.50	78	76
75 × 3.75	150	148
65 × 3.15	235	234
65 × 2.80	295	310
50 × 2.80	405	382
50 × 2.50	560	490
40 × 2.00	990	930
30 × 2.00	1250	1150
25 × 1.80	2000	1840
25 × 1.60	2425	2320

Galvanized Nails

Type and size, mm	Qty
Clouts	
30 × 2.80	525
25 × 2.80	600
Twisted shank roofing nails	
60 × 3.75	140

AJAX FASTENERS AUSTRALIA LTD

STANDARD BOLT PRODUCTS

Lengths shown are standard. Special lengths can be produced by arrangement with manufacturers.

ISO METRIC HEXAGON COMMERICAL BOLTS AND SCREWS TO AS 1111

Hexagon bolts and screws replacing the BSW inch Black Bolt products and conforming with the ISO Standards; coarse pitch series threads to AS 1275 Class 8g. Physical properties are to strength grade 4.6 with a minimum tensile strength of 400 MPa.

STANDARD DIAMETERS, THREAD PITCHES, HEXAGON HEAD SIZES AND LENGTHS—in millimetres

Std nom dia	M6	M8	M10	M12	M16	M20	M24	M30	M36
Thread pitch	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0
Hex A/F max	10	13	16	18	24	30	36	46	55
Hd height max	4.38	5.88	6.85	7.95	10.75	13.40	15.9	19.75	23.55
Lengths	20–150	20–150	20–300	25–600	25–600	30–600	50–600	75–300	100–300

ISO METRIC HEXAGON PRECISION BOLTS AND SCREWS TO AS 1110

Hexagon bolts and screws replacing unified high tensile products and conforming with ISO Standards with coarse pitch series threads to AS 1275 Class 6g.

AS 1110 provides six strength grades (property classes) 4.6, 5.8, 8.8, 9.8, 10.9 and 12.9 having minimum tensile strengths of 400, 520, 800, 900, 1040 and 1220 MPa respectively.

Strength Grade 8.8 is equivalent in strength to the popular Grade 5 High Tensile unified inch bolt which it replaces.

STANDARD DIAMETERS, THREAD PITCHES, HEXAGON HEAD SIZES AND LENGTHS—in millimetres

Std nom dia	M5	M6	M8	M10	M12	M16	M20	M24
Thread pitch	0.8	1.0	1.25	1.5	1.75	2.0	2.5	3.0
Hex A/F max	8	10	13	16	18	24	30	36
Hd height 100–150 mm over 150 mm	 3.65 3.74	 4.15 4.24	 5.45 5.54	 6.58 6.69	 7.68 7.79	 10.18 10.29	 12.72 12.85	 15.22 15.35
Lengths	12–50	12–65	12–70	16–90	20–150	30–150	40–150	50–150

ISO METRIC HEXAGON NUTS TO AS 1112

These nuts replace with a single class, the inch BSW and unified nuts formerly supplied in precision and black. Threads are to AS 1275 Class 6H.

Strength grades are 5, 8, 9, 10 and provide for proof load stresses which vary with diameter in each grade such that when mated with bolts of the strength grade indicated, at least 10% of the assemblies will fail by bolt breakage rather than thread stripping if overtightened. The occurrence of bolt breakage will thus indicate an unsatisfactory tightening procedure which may not be so obvious if progressive stripping was to occur.

Strength grade of bolt	4.6	5.8	8.8	9.8	10.9
Required strength grade of nut	5	5	8	9	10

Two property grades of thin nut with thickness of 0.6 times nominal diameter are included. The stripping strength of these nuts varies with the grade of bolt they are assembled with as follows:

	Stripping strength of nut, MPa		
Thin nut property class	Property class of mating bolt or screw		
	8.8	10.9	12.9
04	300	330	350
05	370	410	450

STANDARD DIAMETERS, THREAD PITCHES AND DIMENSIONS—in millimetres

Std nom dia	M1.6	M2	M2.5	M3	M4	M5	M6	M8	M10
Thread pitch	0.35	0.4	0.45	0.5	0.7	0.8	1.0	1.25	1.5
Hexagon A/F max	3.2	4.0	5.0	5.5	7.0	8.0	10.0	13.0	16.0
Thickness normal nuts max	1.3	1.6	2.0	2.4	3.2	4.7	5.2	6.8	8.4
Thickness thin nuts max	1.0	1.2	1.6	1.8	2.4	3.0	3.6	4.8	6.0
Std nom dia	M12	M16	M20	M24	M30	M36	M42	M48	
Thread pitch	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
Hexagon A/F max	18.0	24.0	30.0	36.0	46.0	55.0	65.0	75.0	
Thickness normal nuts max	10.8	14.8	18.0	21.5	25.6	31.0	34.8	38.8	
Thickness thin nuts max	7.2	9.6	12.0	14.4	18.0	21.6	25.2	28.8	

METRIC COACH SCREWS TO AS 1393

Hexagon head dimensions and physical properties of metric coach screws are identical with those nominated for Metric Hexagon Commercial Bolts and Screws to AS 1111.

METRIC CUP HEAD SQUARE NECK BOLTS TO AS 1390

The metric cup head square neck bolt replaces the cup square bolt with BSW threads, and is sold with hexagon nut strength Grade 5, to AS 1112. Threads are to AS 1275 Class 8g.

The strength grade is 4.6 with a minimum tensile strength of 400 MPa.

STANDARD DIAMETERS, HEAD DIAMETERS, HEAD THICKNESSES AND LENGTHS—in millimetres

Nom dia thread size	M6	M8	M10	M12	M16	M20
Head dia max	14.2	18.7	23.3	27.8	37	46
Head thickness & length of square neck max	3.6	4.8	5.8	6.8	8.9	10.9
Lengths	20–150	20–200	20–375	30–500	50–450	65–600

METRIC HIGH STRENGTH BOLTS FOR STRUCTURAL ENGINEERING TO AS 1252

High strength structural bolts replacing the unified inch products and conforming generally with ISO bolt Standards. Threads are to AS 1275 Class 6g coarse pitch series.

The Standard provides one strength grade 8.8 with a minimum tensile strength of 830 MPa.

BOLT AND NUT—STANDARD DIAMETERS, THREAD PITCHES, HEXAGON HEAD SIZES AND LENGTHS—in millimetres

Std nom dia	M16	M20	M24	M30	M36
Thread pitch	2.0	2.5	3.0	3.5	4.0
Bolt & nut hexagon A/F, max	27	32	41	50	60
Bolt head height, max	10.45	13.9	15.9	20.05	24.05
Bolt lengths	40–100	40–150	50–150	75–200	
Nut thickness, max	17.1	21.3	25.3	25.3	31.3

FLAT ROUND WASHERS—HARDENED—in millimetres

Standard bolt dia	M12	M16	M20	M24	M30	M36
Inside dia min	14.0	18.0	22.0	26.0	33.0	39.0
Outside dia max	28.0	34.0	39.0	50.0	60.0	72.0
Thickness max	4.25	4.25	4.25	4.25	4.25	4.25
min	2.77	2.77	3.75	3.75	3.75	3.75

SQUARE TAPER WASHERS–in millimetres

Standard bolt dia	M12	M16	M20	M24	M30	M36
Inside dia min	14.0	18.0	22.0	26.0	33.0	39.0
Width across flats, nom	31.75	31.75	44.45	44.45	57.15	57.1
Mean thickness						
5° taper	4.76	4.76	4.76	4.76	4.76	4.76
8° taper	6.35	6.35	6.35	6.35	6.35	6.35

METRIC FLAT METAL WASHERS FOR GENERAL ENGINEERING PURPOSES TO AS 1237

The metric standard product range covers four varieties of washers defined below with appropriate applications.

Bright Metal Washers—Small Series
—for Machine Screws and Socket Head Cap Screws.

Bright Metal Washers—Normal Series
—for Hexagon Head Precision Bolts and Screws.

Black Washers—Normal Series
—for Hexagon Head Commercial Bolts and Screws.

Black Washers—Large Series
—for Hexagon Head Commercial Bolts and Screws requiring larger bearing areas.

WASHER DIMENSIONS

BRIGHT METAL WASHERS

Nominal washer size (thread dia), mm	Small series Steel			Normal series Steel and Brass			
						Thickness	
	ID min, mm	OD max, mm	Thickness nom, mm	ID min, mm	OD max, mm	Steel nom, mm	Brass nom, mm
1	1.1	2.5	0.3	—	—	—	—
1.2	1.3	3	0.3	—	—	—	—
1.6	1.7	3.5	0.3	1.7	4	0.3	0.3
2	2.2	4.5	0.3	2.2	5	0.3	0.3
2.5	2.7	5	0.5	2.7	6.5	0.5	0.5
3	3.2	6	0.5	3.2	7	0.5	0.5
4	4.3	8	0.8	4.3	9	0.8	0.8
5	5.3	9.5	1	5.3	10	1.0	0.8
6	6.4	11	1.2	6.4	12.5	1.2	1
8	8.4	14	1.2	8.4	17	1.2	1.2
10	10.5	18	1.6	10.5	21	1.6	1.2
12	—	—	—	13	24	1.6	1.6
16	—	—	—	17	30	2.0	2
20	—	—	—	21	37	2.0	2
24	—	—	—	25	44	2.0	2
30	—	—	—	31	56	2.5	2
36	—	—	—	37	66	2.5	2

BLACK STEEL WASHERS

Nominal washer size (thread dia), mm	Normal series			Large series		
	I D min, mm	O D max, mm	Thick-ness nom, mm	I D min, mm	O D max, mm	Thick-ness nom, mm
5	5.5	10.0	1	—	—	—
6	6.6	12.5	1.6	—	—	—
8	9.0	17.0	1.6	9.0	21.0	2
10	11.0	21.0	2	11.0	24.0	2
12	14.0	24.0	2.5	14.0	28.0	2.5
16	18.0	30.0	3	18.0	34.0	3
20	22.0	37.0	3	22.0	39.0	3
24	26.0	44.0	4	26.0	50.0	4
30	33.0	56.0	4	33.0	60.0	5
36	39.0	66.0	5	39.0	72.0	6
42	45.0	78.0	7	45.0	84.0	7
48	52.0	92.0	8	52.0	96.0	8
56	62.0	105.0	9	62.0	112.0	9
64	70.0	115.0	9	70.0	128.0	9

COTTER PINS

METRIC SPLIT COTTER PINS TO AS 1236—in millimetres

Australian Standard 1236 provides a range of standard cotter pins with diameters and tolerance with recommended hole sizes and combinations with bolt sizes as listed below:

Nominal diameter	1.6	2	2.5	3.2	4	5	6.3	8	10	13
Shank dia max,	1.4	1.8	2.3	2.9	3.7	4.6	5.9	7.5	9.5	12.4
min,	1.3	1.7	2.1	2.7	3.5	4.4	5.7	7.3	9.3	12.1
Recommended hole size min	1.6	2.0	2.5	3.2	4.0	5.0	6.3	8.0	10.0	13.0
Recommended combinations with bolt size.										
min	M6	M8	M10	M12	M16	M22	M30	M42	M64	M80+
max	—	—	—	M14	M20	M24	M36	M56	M80	
Lengths	10–56	20–50	12–71	16–80	20–63	16–90	25–90	50–100	40–80	40–80

Lengths are measured from the end of the short leg to the underside of the eye.

STANDARD SCREW PRODUCTS

ISO METRIC MACHINE SCREWS TO AS 1427

These metric machine screws conform with the standards of ISO (International Standards Organization), with ISO metric threads of the coarse pitch series to AS 1275 Class 6g.

Tensile strength: 4.8 strength steel—400 MPa
Aluminium alloy and brass—320 MPa
Drive: Slotted
Head styles: Countersunk, raised countersunk, pan, cheese, mushroom
Diameter range: Mushroom head M3 to M8. All others M2.5 to M10

STANDARD DIAMETERS, PITCH AND STOCK LENGTH RANGE

Diameter	M2.5	M3	M3.5	M4	M5	M6	M8	M10
Pitch, mm	0.45	0.5	0.6	0.7	0.8	1.0	1.25	1.5
Lengths, mm	5–25	5–40	6–25	6–75	6–75	10–75	12–75	20–75

CLEARANCE AND TAPPING HOLE SIZES

Recommended clearance hole and drilled tapping hole drill sizes are:—

Screw nominal diameter	Fine clearance hole diameter, mm	Medium clearance hole diameter, mm	Tapping hole drill size, mm
M1.6	1.7	1.8	1.20
M2	2.2	2.4	1.60
M2.5	2.7	2.9	2.05
M3	3.2	3.4	2.50
M3.5	3.7	3.9	2.85
M4	4.3	4.5	3.30
M5	5.3	5.5	4.20
M6	6.4	6.6	5.00
M8	8.4	9.0	6.70
M10	10.5	11.0	8.50

ISO METRIC PRESSED NUTS HEXAGON AND SQUARE TO AS 1474

The Pressed Nuts are for use in combination with Machine Screws AS 1427.

RANGE OF SIZES, ACROSS FLATS AND THICKNESSES FOR BOTH HEXAGON AND SQUARE—in millimetres

Nominal diameter	M1.6	M2	M2.5	M3	M4	M5	M6	M8	M10
Width A/F max	3.2	4	5	5	7	8	10	13	17
Thickness max	1.16	1.36	1.78	1.78	2.20	2.70	3.22	4.24	5.26

METRIC TAPPING AND DRIVE SCREWS

There is agreement at ISO on International Standards for spaced thread types, ie, types AB and B which adopts a soft conversion of imperial inch dimensions and properties, maintaining interchangeability with imperial inch products. There is no agreement in respect of Type C and its derivatives which employ machine screw type threads, and Australia supports the adoption of hard conversion to metric thread forms.

Australia is reluctant to decide on a National Standard before agreement is reached at the International level.

METRIC WOODSCREWS TO AS 1476

At time of publication there is no ISO Standard for woodscrews. Although Australian Standard 1476 covering metric woodscrews does exist it is a soft conversion of the imperial gauge range. Woodscrews are marketed in imperial gauges, threads and lengths. Metric lengths can be supplied by negotiation with screw manufacturers.

AERIAL AGRICULTURE

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.

AIRSTRIP REQUIREMENTS

The development and maintenance of good airstrips on your own property can be highly advantageous to you in the following ways:

1 Greater safety for the pilot and aircraft while operating on your property.

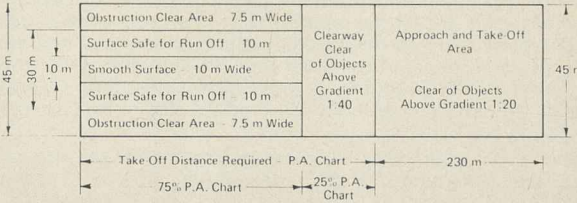
2 Fast and efficient operation of aircraft.

3 Airstrip facilities add to the capital value of your property.

4 Good operating conditions mean fuller utilization of contractor's equipment, which affects the cost to you.

The minimum requirements for an airstrip are set out below but it is stressed that much depends upon particular aircraft that would be using the airstrip. A property owner contemplating construction of an airstrip on his property should consult the aircraft operator to ensure that the area complies with the approved standards specified in the operator's Operations Manual as being applicable to the type of aircraft and class of operation. It will be appreciated that it will also be necessary to provide a good access road and dump site for the storage of fertilizers, etc. Selection of the dump site in relation to the airstrip should be made in conjunction with the aircraft operator.

Full details are, of course, available from Transport Australia, but below are the authorized landing area dimensional and other specifications for day operations.



The strip width and the dimensions of the clearway and approach and take-off areas shall not be less than those shown in the diagram.

The clearway and approach and take-off gradients shall not be steeper than those shown in the diagram.

The term 'objects' used in the diagram includes any suspended object such as wires.

It is necessary to ensure that objects immediately beyond the approach and take-off area are not hazardous to the normal manoeuvring of an aircraft prior to landing or after taking-off.

The effective length of strip available must not be less than that prescribed in the relevant Performance of Aircraft (PA) chart for the prevailing conditions. In determining the effective length it shall be acceptable for the final 25 per cent of the take-off distance required as prescribed in the relevant PA chart to be 'clearway'. Clearway is an area in which there are no obstructions above a plane of 1:40 measured from the end of the prepared surface over a width of 45 metres.

The maximum overall longitudinal gradient shall be 1:8. Where the overall longitudinal gradient exceeds 1:50, one way operations only are permitted (ie, down-hill take-off and up-hill landing).

The maximum transverse grade in the centre 10 metres of the strip shall be 1:33; in the 10 metres either side of the central 10 metres it shall be 1:20 and over the remainder of the strip it shall be 1:8.

The central 10 metres of the strip over its length shall be smooth, the 10 metres on each side of the central 10 metres shall be such that an aircraft running over it following a swing on take-off or landing would not suffer damage. There shall be no obstructions above ground level over the whole area and in connection with this requirement, obstructions shall be deemed to include suspended objects such as wires. A reasonable test for smoothness of the central section would be to drive a heavily sprung vehicle over the surface at 50 km/h without discomfort to the occupants.

The strip surface should be well graded and then grassed so that it can stand up to maximum work and resist

erosion. This will reduce maintenance costs to a minimum. When it becomes overgrown it should be mowed to the full length and the loose grass should be removed from the approach and take-off area, and all around the loading area. Long grass will retard aircraft acceleration and, if wet, can reduce brake control to a serious extent.

The reason for removing the cut grass as suggested is that it could otherwise be drawn into the intake of the aircraft with serious results, and there is always the possibility of dry loose grass being set alight by the aircraft exhaust.

It is recommended that airstrip boundaries be indicated by frangible type markers.

AERIAL AGRICULTURE: AUSTRALIA – 1974 TO 1979

Year ended 31 March	Area, '000 ha			Materials used, t		Total flying time, hours
	Top dressed and seeded	Sprayed	Total (a)	Super-phosphate	Seed	
1974	4870	1870	6857	546 000	2500	93 300
1975	3378	1544	5080	473 800	4800	89 200
1976	1164	2059	3314	105 200	3500	53 800
1977	1381	1624	3064	151 500	2500	49 600
1978	2403	1782	4260	287 200	3800	69 500
1979	3205	2981	6243	374 200	5900	100 600

(a) Includes other types of treatment (rabbit baiting, etc)

ARTIFICIAL FERTILIZERS: AUSTRALIA – AREA AND USAGE

Year	Area fertilized, '000 ha	Materials used, '000 t		
		Super-phosphate used	Nitrogenous fertilizers used	Other fertilizers used
1972–73	26 076	3491	276	392
1973–74	29 529	4110	340	360
1974–75	24 858	3349	335	360
1975–76	18 975	2216	353	296
1976–77	21 266	2303	326	428
1977–78	24 324	2538	490	383

AREA OF LAND IRRIGATED: CROPS AND PASTURES – AUSTRALIA, 1972–73 TO 1975–76[a]

Year	Sown and native pastures[b]	Cereals for all purposes	Sugar cane	Vegetables for human consumption	Fruit	Grape-vines	All other	Total	% of total crops
	'000 ha								
1972–73	1099.7	250.8	70.9	64.9	59.5	44.9	94.9	1685.5	11.8
1973–74	983.5	177.4	66.2	59.2	54.6	44.3	85.4	1470.6	9.7
1974–75	955.1	183.7	74.0	68.9	56.1	44.9	86.3	1469.0	10.6
1975–76	920.4	252.7	73.3	63.4	52.9	45.6	66.6	1474.9	10.1

(a) Not collected 1976–77 or 1977–78.
(b) Includes lucerne.

MAJOR DAMS AND RESERVOIRS IN AUSTRALIA

(H/E = hydro-electricity, FC = flood control and/or mitigation)

EXISTING

Name (Year of completion)	Location	Gross capacity, million cubic metres	Height of wall, metres	Purpose
NEW SOUTH WALES				
Eucumbene (1958)	Eucumbene River	4 807	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	137	Water supply for Sydney, H/E
Menindee Lakes (1960)	Darling River, near Menindee	1 794	18	Conservation, storage for Murray River Agreement
Burrendong (1967)	Macquarie River, near Wellington	1 680	76	Conservation, FC, water supply
Blowering (1968)	Tumut River	1 628	112	H/E, irrigation
Copeton (1976)	Gwydir River	1 364	113	Irrigation
Wyangala (1936, 1971)	Lachlan River	1 218	85	Irrigation, stock, etc.
Burrunjuck (1927, 1956)	Murrumbidgee River	1 026	79	Irrigation, H/E
Talbingo (1971)	Tumut River	921	162	H/E
Jindabyne (1967)	Snowy River	688	72	H/E
Lake Victoria (1928)	Murray River, near SA border	680	–	Conserves supplies for SA
Keepit (1960)	Namoi River, near Gunnedah	426	55	Conservation, irrigation, H/E
Glenbawn (1958)	Hunter River, near Scone	362	78	Conservation, irrigation, FC
Tantangara (1960)	Murrumbidgee River	254	45	H/E
Avon (1927)	Avon River	214	72	Water supply for Sydney
Googong (1978)	Queanbeyan River	125	59	Water supply for Canberra-Queanbeyan

VICTORIA

Dartmouth (1979)	Mitta Mitta River	4 000	180	Irrigation storage, H/E
Eildon (1927, 1955)	Upper Goulburn River	3 392	79	Irrigation, H/E
Waranga (1910)	Near Rushworth (Swamp)	411	12	Irrigation
Mokoan (1971)	Winton Swamp, near Benalla	365	10	Irrigation
Rocklands (1953)	Glenelg River	336	28	Domestic and stock water supply
Eppalock (1964)	Campaspe River	312	45	Irrigation, water supply
Cardinia (1973)	Cardinia Creek, near Emerald	287	79	Water supply for Melbourne
Upper Yarra (1957)	Yarra River	207	89	Water supply for Melbourne
Glenmaggie (1927, 1958)	Macalister River	190	37	Irrigation

QUEENSLAND

Fairbairn (1972)	Nogoa River, central Qld	1 440	49	Irrigation, industrial
Somerset (1959)	Stanley River	893	50	Water supply for Brisbane, H/E
Fred Haigh (1975)	Kolan River, near Gin Gin	586	52	Irrigation
Ross River (1974)	Near Townsville	417	35	FC, water supply
Tinaroo Falls (1958)	Barron River	407	47	Irrigation, H/E
Glenlyon (1976)	Pike Creek, near Stanthorpe	261	62	Irrigation
Wuruma (1968)	Nogo River, near Eidsvold	194	46	Irrigation
Koombooloomba (1961)	Tully River	180	52	H/E, irrigation
Julius (1977)	Leichhardt River, near Mt Isa	127	35	Water supply, mining

WESTERN AUSTRALIA

Lake Argyle (Ord) (1971)	Ord River, near Wyndham	5 720	99	Irrigation, FC, H/E
South Dandalup (1973)	Near Mandurah	208	41	Water supply for Perth
Wellington (1933, 1944, 1960)	Collie River	185	37	Irrigation, water supply
Serpentine (1961)	Serpentine River	178	55	Water supply for Perth

MAJOR DAMS AND RESERVOIRS IN AUSTRALIA (Cont)

(H/E = hydro-electricity, FC = flood control and/or mitigation)

EXISTING

Name (Year of completion)	Location	Gross capacity, million cubic metres	Height of wall, metres	Purpose
TASMANIA				
Lakes Gordon and Pedder (1974)–				
Gordon	South West	11 671	140	H/E
Scotts Peak			43	
Serpentine		2 960	38	
Edgar			17	
Miena (1967)	Great Lake	2 390	18	Storage for H/E
Lake St Clair (1938)	Central Plateau	est. 2 000	3	Natural storage for H/E
Lake Echo (1956)	Lake Echo	725	19	H/E
Lake King William (Clark) (1949, 1966)	Derwent River	541	73	H/E
Arthur's Lake (1965)	Source of Lake River, near Great Lake	511	17	H/E
Devils Gate (1969)	Forth River, near Devonport	180	84	H/E
Rowallan (1967)	Mersey River	131	43	H/E
NORTHERN TERRITORY				
Darwin River (1972)	Darwin River	259	31	Water supply for Darwin

UNDER CONSTRUCTION OR PROJECTED

Name (Year of completion)	Location	Gross capacity, million cubic metres	Height of wall, metres	Purpose
UNDER CONSTRUCTION				
Wivenhoe	Brisbane River, near Fernvale, Qld	1 150	58	Water supply, FC, H/E
Thomson	Thomson River, near Erica, Vic	1 110	160	Water supply, irrigation
Tallowa (Lake Tarrunga)	Confluence of Shoalhaven, Kangaroo Rivers, NSW	135	43	Water supply
PROJECTED				
Burdekin Falls Dam	Burdekin River, Qld	1 750	68	Irrigation
Mackintosh	Mackintosh River, Tullibardine River, near Queenstown, Tas	922	77 24	H/E
Lower Pieman	Pieman River, near Queenstown, Tas	641	120	H/E
Split Rock	Manilla River, Namoi Valley, NSW	370	64	Irrigation
Windamere	Cudgegong River, near Mudgee, NSW	353	69	Irrigation
Boondooma	Boyne River, near Proston, Qld	212	50	H/E, Irrigation
Tanjil (Blue Rock)	Tanjil River, near Willow Grove, Vic	200	75	Cooling water (power)
Gunpowder	Gunpowder Creek, near Mount Isa, Qld	141	44	Mining, water supply
Spencer	Denison Creek, near Nebo, Qld	127	24	Mining, water supply
Bastyan (Lake Rosebery)	Pieman River, near Queenstown, Tas	124	74	H/E

AVERAGE DISTRICT RAINFALL THROUGHOUT AUSTRALIA

	DISTRICT	Annual fall, mm	DISTRICT	Annual fall, mm
NSW	Western Far North West	288	Manning	1359
	Western Lower Darling	251	Hunter	905
	Western Upper Darling	350	Central Tablelands North	655
	Western SW Plains	346	Central Tablelands South	909
	Central Western Plains South	480	Central Western Slopes North	637
	Central Western Plains North	477	Central Western Slopes South	608
	North-west Plains East	521	Metropolitan East	1157
	North-west Plains West	588	Metropolitan West	827
	North-west Slopes North	680	Illawarra	1118
	North-west Slopes South	663	South Coast	964
	Northern Tablelands Western	816	Southern Tablelands, Goulburn, Monaro	683
	Northern Tablelands Eastern	1001	Southern Tablelands, Snowy Mountains	895
	North Coast Upper	1456	South-west Slopes South	807
	North Coast Lower	1506	South-west Slopes North	611
			Riverina East	477
			Riverina West	366
VIC	Mallee North	310	East Gippsland	779
	Mallee South	357	West Gippsland	916
	North Wimmera	416	East Central	893
	South Wimmera	501	West Central	614
	Lower North	437	North Central	722
	Upper North	518	Western Plains	635
	Lower North-east	778	West Coast	777
	Upper North-east	1108		

AVERAGE DISTRICT RAINFALL THROUGHOUT AUSTRALIA

	DISTRICT	Annual fall, mm	DISTRICT	Annual fall, mm
TAS	Northern	1005	Central Plateau	985
	East Coast	825	West Coast Mountain Region	2335
	Midland	555	King Island	950
	South-east	756	Flinders Island	643
	Derwent Valley	684		
SA	North-west Interior	192	Central West	427
	Far North Interior	184	Central East	599
	Western Agricultural	341	Murray Valley	325
	Upper North	334	Murray Mallee	311
	North-east	213	Upper South-east	423
	Lower North	442	Lower South-east	659
WA	North Kimberley	1016	North Coastal	401
	East Kimberley	523	Central Coastal	857
	West Kimberley	534	South Coastal	922
	De Grey	296	Central North	362
	Fortescue	277	Central South	440
	West Gascoyne	215	Eucla	240
	East Gascoyne	226	South-east	258
	Murchison	231	North-east	227
NT	Northern Rivers Darwin-Daly	1310	Northern Plateau Victoria	606
	Arnhem	1217	Barkly	426
	Roper-McArthur	745	Alice Springs	252
QLD	Peninsula North	1439	Upper West	356
	Peninsula South	977	Lower West	250
	Carpentaria Lower	623	South Coast, Port Curtis	928
	Carpentaria Upper	632	South Coast, Moreton	1173
	North Coast, Barron	1634	Darling Downs East	699
	North Coast, Herbert	1935	Darling Downs West	563
	Central Coast East	995	Maranoa	550
	Central Coast West	623	Warrego	428
	Central Highlands	616	Far South West	301
	Central Lowlands	476		

AREA DISTRIBUTION OF MEDIAN ANNUAL RAINFALL (per cent)

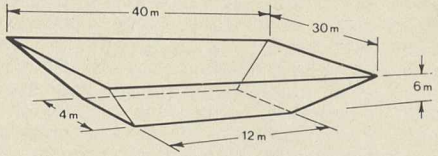
Median annual rainfall	WA	NT	SA	Qld	NSW (a)	Vic	Tas	Aust
Under 200 mm	43.5	15.5	74.2	10.2	8.0	–	–	29.6
200 to 300 mm	29.6	35.6	13.5	13.0	20.3	6.3	–	22.9
300 to 400 mm	10.5	9.0	6.8	12.3	19.0	19.2	–	11.2
400 to 500 mm	4.3	6.6	3.2	13.5	12.4	11.8	–	7.6
500 to 600 mm	3.1	5.8	1.8	11.6	11.3	14.1	12.2	6.6
600 to 800 mm	4.6	11.6	0.5	20.5	15.1	24.5	18.2	10.7
800 to 1200 mm	3.7	9.6	–	12.6	11.3	17.7	25.0	7.7
Above 1200 mm	0.7	6.3	–	6.3	2.6	6.4	44.6	3.7
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

(a) Includes Australian Capital Territory.

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	Temperate 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	984 000	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**

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 x 4 = 48

(b) Length at top multiplied by width at top = 40 x 30 = 1200

(c) Sum of the lengths multiplied by sum of the widths = 52 x 34 = 1768

(a) + (b) + (c) = 3016

(d) (a) + (b) + (c) multiplied by the depth and divided by six $= \frac{3016 \times 6}{6} = 3016\ m^3$

1 cubic metre is equal to 1 kilolitre.

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: 12 m by 6 m at base; 15 m by 7 m at eaves;

9 m long at the ridge; eaves 3 m above the ground; ridge 3 m vertically above the eaves. Applying the formula:

Volume of base or body =

(a) 12×6 = 72

(b) 15×7 = 105

(c) $(12+15) \times (6+7)$ = $27 \times 13 = 351$

(a) + (b) + (c) = 528

$$\frac{528 \times 3}{6} = 264 \text{ cubic metres}$$

Volume of portion above eaves =

(d) 15×7 = 105

(e) $7 \times (15+9)$ = $7 \times 24 = 168$

(d) + (e) = 273

$$\frac{273 \times 3}{6} = 136.5 \text{ cubic metres}$$

Total volume of stack = 400.5 cubic metres

Cubic Contents of a Circular Stack

To determine the volume of a circular stack:

(a) Measure the circumference at both the base and eaves in metres.

(b) Add these together and multiply this figure by itself (ie, *square* it).

(c) Multiply the circumference at the base by the circumference at the eaves and deduct this from the result of (b).

(d) 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 by 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 18 m, at the eaves 21 m and 3 m high at the eaves and 2 m at the top from the eaves. Applying the formula:

Volume of body of stack

$$= [\,(18+21)\times(18+21)-(18\times21)\,]\times\frac{3}{38}$$

$$=(1521-378)\times\frac{3}{38}$$

$$=1143\times\frac{3}{38}$$

$$=90.2 \text{ cubic metres}$$

Volume of conical top

$$=\frac{21\times21\times2}{38}$$

$$=\frac{882}{38}$$

$$=23 \text{ cubic metres}$$

Total volume of stack = 113.2 cubic metres

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, metres	Average length, metres	Height to eaves, metres	Height of ridge, metres	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

FARM FENCING CONSTRUCTION AND HANDLING OF FENCING MATERIALS

Few, if any, capital items on a farm or grazing block improve the general appearance of the property more than sturdy, well constructed boundary and sub-divisional 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 upon 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 material, 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 100 mm in diameter. They are driven with a tubular driver into a pilot hole.

Other posts are set in the ground manually, with shovel and soil rammer.

On flat ground, posts would be spaced evenly apart (eg, each 7 m) but in undulating or hilly country, post spacings need not be regular. A nominal distance apart should be determined (eg, 7 m) but this would be varied to allow for ground undulation. Whether posts are driven at right angles or perpendicular to the ground 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 for the fence and, as such, should be immovable. Considerable loss of tension is experienced for a small amount of movement in a corner. A Waratah steel strainer assembly is suitable for either a single strain or with the addition of an extra stay, can be used as a corner post. Another type of strainer assembly can be constructed from treated timber posts or solid local timbers, using two posts and a horizontal strut.

Where the ground has poor holding properties, a double end assembly with three posts can be used. A diagonal brace is made of wire of the thickness being used in the fence, and is run around four times prior to straining up and tying off. Posts should not be bored as this allows moisture into the interior of the post and 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 thickness is influenced by the cost per kilometre, length of strain, type of stock run and so on. High

tensile wires, such as Tyeasy, 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. Their disadvantages include difficulty in handling and tying of knots, the need for more accurate straining and relatively small diameters (less metal present to corrode away over the years). The *softer* fencing wires are easier to handle and have more metal present. They can also be restrained many times without fear of breaking. Disadvantages of soft wires are that they are heavier and more difficult to get to the fence line, and have a greater tendency to stretch in service. This makes it necessary to have strainer posts closer together; four 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 a coil easy. The coil is placed on the spinner, with the *top* 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. If the coil is a *two-piece* coil, the outside ties are removed and the first piece run out. The tie on the second piece should not be removed until the first piece is run out or tangles may occur with the loose ends.

The wire should be tied on to the Star steel posts with preformed fence post clips or 1.60 mm 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 all fences are 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 fence by pulling it up with a tractor or four-wheel-drive

vehicle. Whilst this is a quick method, it generally results in the material being over strained, unless a tension indicator is used.

The Waratah Field Fence Strainer comprises a clamp suitable for holding all sizes of field fence, a tension indicator and a hand tensioning mechanism. Components can be supplied individually if required.

It is only necessary to tie every second wire of fabricated fence to each fence post.

Horse Sighter Wire

Horses have difficulty seeing the wire component in fences. Horse sighter wire, designed to overcome the problem of horses colliding with fences, comprises a 4 mm standard galvanized wire coated with white PVC to a finished diameter of 5.2 mm. It has a minimum breaking force of 4.8 kN and is packaged in coils of 400 m, weighing 44 kg.

A horse fence should consist of four or five lines of horse sighter wire. If other stock are likely to be run in the same paddock, then only two of the top wires should be horse sighter wire. Sighter wire should be strained to 1.8 kN and the strain should be greater than 100 m. Posts should be spaced at 5 m centres.

Wire Netting

Wire netting is erected in a similar manner to fabricated fencing except that the trench in which the netting is buried is dug prior to running-out. Netting should not be strained as tightly as other wires as it may distort under the stain. It is fastened to the fence by means of tie wire or ring fasteners. The final step in erecting a netting fence is to replace the soil in the trench. This can help to tighten the netting on the fence.

An alternative method of fixing netting is to lay the bottom 180 mm flat on the ground and secure with rocks every 300 to 500 mm. After two to three months, vegetation will grow through the netting and bind it to the ground. Rabbit netting should be placed in the ground at a depth of 180 mm, 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 60 mm 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 1050 mm wide netting, the third should be 515 mm above the ground. Fasten the netting to the top wire with strong tie wire or ring fasteners at intervals of 1200 mm, but there should be a tie 300 mm on each side of every post. Also fasten the netting to the centre wire.

WARNING Attention is drawn to the absolute necessity of removing 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 special spinner.

After straining, barbed wire is tied to fence posts, or in the barb slot of Star steel posts with either tie wires or pre-formed fence post clips. Strains not longer than 500 m are recommended, as longer strains become difficult to handle.

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.

Fence post 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 cartons of 3000 containing ten 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 & 3.15 mm Fencing Wire	–	1000 m
2.50 & 2.80 mm HT Wire	–	1500 m
Barbed Wire	–	500 m
Fabricated Fencing	–	400 m
Wire Netting	–	500 m

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:

4.00, 3.55 & 3.15 mm Fencing Wire	–	1.8 kN
2.50 mm Flexabel	–	1.4 kN
2.50 mm Tyeasy	–	2.0 kN
2.80 mm HT Fencing Wire	–	3.0 kN
2.50 mm Iowa pattern and 1.60 mm HT Barbed Wire	–	1.3 kN
Fabricated Fencing	–	1.0 kN (per wire)
Wire Netting	–	Only until tight

A wire strainer should always incorporate a tension gauge. The jaws of the strainer must be smooth or the wire will be damaged, causing a weakness at that point.

WARATAH HT FENCE DROPPERS

These fence droppers are made from high tensile galvanized steel so that 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 4.00 mm and 2.50 mm diameter, and barbed wire.

A suggested fence construction would be posts spaced at up to twenty metres apart with droppers clipped at intervals of two to four metres, depending on the number of line wires and site conditions.

Specification	Length, mm	Mass per bundle, kg	Fastening clips – included in bundles sufficient for fences of
HT galvanized steel fence droppers punched at 25 mm centres complete with fixing tool, instruction sheet & clips	635	12	5 wires
	815	16	6 wires
	940	21	7 wires
	1070	24	9 wires
	1170	25	9 wires

Packs measure approximately 40 x 150 mm x length of dropper. Packs of 250 clips weigh 0.5 kg.

STRIPLEX HT FLEXIBLE FENCE DROPPERS

Striplex flexible fence droppers are formed from Zincalume high tensile steel for long life and corrosion-resistance. They are used to form HT flexible fence barriers including horse, electric and special fences.

After the line wires have been strained the droppers are fastened at each wire with a special clip which is clamped and set with a fastening tool. Fence post and flexible dropper spacing should suit terrain and stock management requirements. Enquiries to PO Box 29 Burrawang NSW 2577.

Droppers	Clips	Wire types accepted by fastening tool
Standard length 1170 mm Splice to lengthen, cut to shorten. Recesses at 25 mm centres. Bundles of 100 (8 kg per bundle.)	1 clip per joint. Boxes of 1000.	All HT plain wire. 1.6 mm HT barbed wire. Standard plain wire up to 3.15 mm. Note: By simple adaption, droppers can be applied to Iowa HG barbed wire and tied for this and other purposes.

WARATAH STEEL FENCE POSTS

Lengths, 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 40 m = 25 per km
1 Post per 20 m = 50 per km
1 Post per 15 m = 67 per km
1 Post per 10 m = 100 per km
1 Post per 7 m = 143 per km
1 Post per 5 m = 200 per km
1 Post per 3 m = 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, m	Gross mass per reel, kg	Recommended tension, kN
2.50 mm Std galv Iowa Pattern	Wood	400	40	1.3
2.50 mm Hvy galv Iowa Pattern Red Reel	Wood	400	40	1.3
1.60 mm Hvy galv HT Red Reel	Wood	500	23	1.3
1.60 mm Hvy galv HT Red Reel	Wood	500	22	1.3

GALVANIZED FENCE WIRE

Diameter, mm	Type	Length per coil, m	Recommended tension, kN
4.00	Standard galv	500	2.5
3.55	Standard galv	600	2.0
3.15	Standard galv	750	1.5
2.80	HT Heavy or std galv	1000	3.0
2.50	HT Std galv Flexabel	1500	1.5
2.50	HT Hvy or std galv Tyeasy	1500	2.0

The above represents standard thicknesses regularly produced for fencing purposes.

WIRE NETTING

The main sizes regularly produced are:

Type	Mesh, mm	Wire diameter, mm	Width, mm
Rabbit-proof	30 & 40	1.4	300, 900, 1050
Sheep	75	1.6	600, 900
Sheep	100	1.6	750, 900
Dingo 3 ply 3 twist	75	1.6	1200, 1800
Poultry	25	1.4	900
Poultry	50	1.0	900, 1800
Fish Trap	50	1.6, 1.4	900, 1200, 1500, 1800

FENCE SPECIFICATIONS

1500 m Length of fence	No of strainer assemblies	Additional stay and base plates (if required)
100 m strain	16	14
200 m strain	9	7
400 m strain	5	3
800 m strain	3	1
1500 m strain	2	—

WARATAH HINGED JOINT FENCING

Type	Length per roll, m	Mass per roll, kg	Mass per kilo-metre, kg	Height of roll nominal, mm	Line-wire spacings from top, nominal, mm	Picket spacing nominal, mm
5/67/30	200	65	325	670	200, 180, 150, 140	300
6/70/30	200	74	375	700	180, 150, 140, 130, 115	300
6/90/30	200	75	400	900	230, 200, 180, 150, 140	300
7/90/30	200	88	430	900	200, 180, 150, 140, 130, 115	300
8/80/15	100	63	320	800	150, 140, 130, 115, 100, 90, 75	150
8/90/30	200	99	495	900	180, 150, 140, 130, 115, 100, 90	300
8/115/30	200	104	525	1150	230, 200, 180, 150, 140, 130, 115	300

POPULATION, DENSITY, AND RATE OF INCREASE FOR THE WORLD AND CONTINENTS – SELECTED YEARS

(Source: United Nations Demographic Yearbook, 1978)

Continent and region	Population Estimates of mid-year population (millions)								Annual rate of increase 1970–75 (per cent)	Density (persons per square kilometre) 1978
	1950	1955	1960	1965	1970	1975	1978	1979*		
World Total	**2513**	**2745**	**3027**	**3344**	**3678**	**4033**	**4258**	**4336**	**1.8**	**31**
Africa	**219**	**244**	**275**	**311**	**354**	**406**	**442**	**456**	**2.7**	**15**
Western Africa	62	69	79	90	104	121	133		3.0	22
Eastern Africa	61	68	76	87	100	115	126		2.8	20
Northern Africa	52	58	65	73	83	94	103		2.5	12
Middle Africa	29	31	34	38	41	47	50		2.4	8
Southern Africa	16	18	20	22	25	29	31		2.6	11
America	**330**	**369**	**414**	**461**	**509**	**559**	**591**	**603**	**1.9**	**14**
Northern America	166	182	199	214	226	236	242		0.9	11
Latin America	164	187	215	247	283	323	349		2.6	17
Tropical South America	86	99	115	134	154	177	193		2.8	14
Middle America	36	42	49	57	67	79	87		3.2	35
Temperate South America	25	28	31	33	36	38	40		1.3	11
Caribbean	17	19	20	23	25	28	30		2.1	126

Asia	**1380**	**1514**	**1683**	**1878**	**2091**	**2319**	**2461**	**2509**	**2.1**	**89**
East Asia	673	738	816	899	981	1063	1108		1.6	94
China	557	614	682	754	826	895	933		1.6	94
Japan	84	90	94	99	104	112	115		1.3	309
Other East Asia	33	34	39	45	51	57	60		2.2	34
South Asia	706	775	867	979	1111	1255	1353		2.5	85
Middle South Asia	486	530	590	664	750	845	910		2.4	134
Eastern South Asia	177	196	221	251	286	325	350		2.5	78
Western South Asia	43	49	57	65	74	85	93		2.8	20
Europe	**392**	**408**	**425**	**445**	**460**	**474**	**480**	**482**	**0.6**	**97**
Western Europe	122	128	135	143	148	152	153		0.6	154
Southern Europe	109	113	118	123	128	134	137		0.9	104
Eastern Europe	89	93	97	100	103	106	108		0.6	109
Northern Europe	72	74	76	79	80	82	82		0.3	50
Oceania	**12.6**	**14.2**	**15.8**	**17.5**	**19.3**	**21.2**	**22.1**	**22**	**1.8**	**3**
Australia and New Zealand	10.1	11.4	12.7	14.0	15.4	16.7	17.4		1.7	2
Melanesia	1.8	2.0	2.2	2.5	2.8	3.1	3.4		2.5	6
Polynesia and Micronesia	0.7	0.8	0.9	1.0	1.2	1.3	1.4		2.1	47
Union of Soviet Socialist Republics	**180**	**196**	**214**	**231**	**244**	**254**	**262**	**264**	**0.8**	**12**

Reference should be made to the detailed comments contained in the United Nations Demographic Yearbook, 1978 regarding geographical units used, boundaries of areas, reliability of estimates, etc.

* Information in 1979 column is a provisional estimate extracted from United Nations 'Population and Vital Statistics Report' as at April 1980.

LYSAGHT REFEREE

POPULATION OF STATES AND TERRITORIES, 1971 TO 1979

30 June	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Aust
	'000 PERSONS								
1971	4 679.4	3 520.4	1 881.4	1 185.3	1 043.1	390.2	91.9	145.6	12 937.2
1972	4 746.9	3 577.4	1 932.5	1 202.4	1 070.9	392.2	96.6	158.0	13 177.0
1973	4 793.4	3 628.4	1 987.3	1 217.9	1 089.8	395.7	99.7	168.2	13 380.4
1974	4 839.4	3 676.8	2 046.1	1 236.2	1 117.4	399.3	104.4	179.6	13 599.1
1975	4 884.5	3 719.1	2 084.0	1 252.1	1 146.7	404.7	89.4	190.9	13 771.4
1976	4 914.3	3 746.0	2 111.7	1 261.6	1 169.8	407.4	101.4	203.3	13 915.5
1977	4 956.7	3 782.3	2 136.8	1 276.8	1 197.1	410.6	105.5	208.2	14 074.1
1978	5 011.8	3 818.4	2 166.7	1 287.6	1 222.3	413.7	112.5	215.6	14 248.6
1979	5 075.8	3 853.3	2 196.4	1 294.3	1 241.9	417.7	115.7	222.1	14 417.2
Percentage of total population in 1979	35.21	26.73	15.23	8.98	8.61	2.90	0.80	1.54	100

POPULATION IN AUSTRALIAN CAPITAL CITIES AND OTHER MAJOR TOWNS OF 100 000 PERSONS OR MORE

	30 June 1976	30 June 1977	30 June 1978
Sydney	3 094 800	3 121 800	3 155 200
Melbourne	2 672 000	2 694 100	2 717 600
Brisbane	985 900	995 100	1 004 500
Adelaide	912 100	922 800	930 500
Perth	820 100	843 800	864 900
Newcastle	370 500	372 300	375 300
Canberra	221 800	227 000	234 700
Wollongong	218 900	220 300	222 000
Hobart	162 700	164 500	166 500
Geelong	135 600	137 900	139 800
Gold Coast	122 100	125 900	133 100
Total	**9 716 500**	**9 825 500**	**9 944 100**
Percentage of total population	69.83	69.81	69.79

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																	
2885	2610	DARWIN																
3435	1315	1300	ALICE SPRINGS															
2705	645	3255	1955	MELBOURNE														
3175	1055	3665	2370	475	LAUNCESTON													
3320	1260	3870	2570	615	145	HOBART												
3090	970	3585	2285	470	945	1085	CANBERRA											
3285	1165	3220	2020	705	1180	1320	235	SYDNEY										
3600	1485	3540	2340	1025	1500	1640	555	320	TAMWORTH									
3725	1605	3660	2460	1145	1620	1765	675	440	185	COFFS HARBOUR								
3595	1475	3530	2330	1015	1490	1630	545	310	625	750	DUBBO							
3070	1005	3620	2320	365	840	980	160	365	685	805	675	WAGGA WAGGA						
4030	1910	2850	2245	1375	1850	1990	980	745	510	320	765	1110	BRISBANE					
4550	2430	3370	2335	1895	2370	2510	1500	1265	1025	840	1285	1630	520	ROCKHAMPTON				
3960	1845	2940	2700	1330	1805	1945	915	680	600	415	860	1045	90	610	COOLANGATTA			
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	MACKAY	
5420	3300	1680	1455	2765	3240	3380	2370	2135	1900	1715	2155	2500	1390	880	1480	285	615	CAIRNS

PERTH 1310 1245 2885
PORT HEDLAND 195 1575
KARRATHA 1760
DARWIN

DISTANCES BY ROAD BETWEEN CITIES AND SELECTED TOWNS (nearest 5 kilometres)

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.

PERTH
725 NORSEMAN
2395 3120 BROOME
410 685 2705 ALBANY
2765 2040 4353 2725 ADELAIDE
2445 1725 4035 2405 315 PORT AUGUSTA
4430 5150 2030 4835 3215 2900 DARWIN
3815 3095 2665 3775 1685 1370 1535 ALICE SPRINGS
3405 2685 4995 3470 745 960 3865 2330 MELBOURNE
3010 2285 4750 2970 395 565 3470 1935 555 MILDURA
3800 3075 5390 3760 1180 1355 4260 2725 650 785 CANBERRA
3975 3250 5560 3930 1400 1525 4435 2895 890 1025 300 SYDNEY
3395 2670 5255 3355 1050 950 3225 2320 1055 835 745 785 BOURKE
2855 2135 4445 2815 510 410 3310 1780 850 295 1090 1170 540 BROKEN HILL
3430 2710 5010 3390 815 985 3890 2355 305 420 335 585 750 835 ALBURY
4290 3570 4780 4250 2065 1845 3450 3055 1655 1585 1300 1000 1050 1545 1280 BRISBANE
4470 3750 4265 4430 2280 2025 2935 2490 1995 1785 1960 1660 1570 2110 1605 660 ROCKHAMPTON
5095 4375 3850 5055 2580 2650 2520 2075 2515 2275 2735 2435 1580 2120 2225 1440 780 TOWNSVILLE
5270 4550 4200 5230 2830 2825 2870 2425 2865 2580 3090 2790 2020 2555 2580 1795 1130 355 CAIRNS
4970 4250 2960 4930 2625 2525 1630 1185 2765 2410 2335 2360 1575 2115 2460 1815 1305 885 1240 MT ISA

QUEENSTOWN 170 235 330 255
BURNIE 60 160 330
DEVONPORT 100 270
LAUNCESTON 200
HOBART

OVERSEAS TRADE: AUSTRALIA, 1958–59 TO 1979–80 (fob)

Year	Exports, $m	Imports, $m	Excess of exports (+) or imports (–) $m
1958–59	1 623	1 593	+ 30
1959–60	1 875	1 854	+ 21
1960–61	1 938	2 175	– 237
1961–62	2 155	1 769	+ 385
1962–63	2 152	2 163	– 11
1963–64	2 782	2 373	+ 410
1964–65	2 651	2 905	– 253
1965–66	2 721	2 939	– 218
1966–67	3 024	3 045	– 21
1967–68	3 045	3 264	– 220
1968–69	3 374	3 469	– 94
1969–70	4 135	3 881	+ 254
1970–71	4 375	4 150	+ 225
1971–72	4 893	4 008	+ 885
1972–73	6 214	4 121	+2 093
1973–74	6 914	6 085	+ 829
1974–75	8 726	8 080	+ 646
1975–76	9 640	8 241	+1 399
1976–77	11 652	10 410	+1 241
1977–78	12 245	11 167	+1 078
1978–79	14 247	13 752	+ 495
1979–80	18 897	16 207	+2 093

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 June	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, which, however, may be subject to slight variation in individual cases.

STEEL WIRE ROPES

A wire rope is made up of a number of strands, each comprised of a combination of wires or wires and fibres laid over a core. This may be made of fibre or an independent wire rope core (IWRC).

The chief component parts of a steel wire rope are:

- The wires which are used to form the strands.
- The strands which are laid together to form the rope.
- The core which provides the foundation on which the rope strands are laid.

To describe a wire rope fully the following characteristics should be specified:

Description of item	Example
(a) Dimensions:	
Length	1000 mm
Diameter	26 mm
(b) Construction:	
Number of strands	6
Number of wires per strand	x 36
Arrangement of wires in strands	14/7 & 7/7/1
Lay: Direction and type	RHOL
Core	IWRC
Whether preformed or not preformed	Preformed
(c) Grade of wire:*	1770
(d) Lubrication: Petroleum jelly, Mytilus, Crater, Corbula, etc	Corbula

* Grade of wire is designated by a number which is equal to the wire tensile strength in megapascals. If a galvanized rope is required the prefix 'G' is added to the number; example G1770.

POINTS OF WIRE ROPE USAGE

Equipment

It is important for maximum economical, efficient and safe rope life that the equipment on which it operates be maintained in good working condition.

Before making or altering recommendations for new ropes, close inspection of the equipment and the working condi-

tions should be made. All steps should be taken to correct such items as:

1 Worn drum and sheave grooves which pinch and distort the rope – especially Lang's Lay rope.
2 Worn sheave bearings and faulty alignment between sheaves and drum which can lead to heavy abrasion of the rope between it and the sides of the sheave grooves.
3 Undue vibration or whipping of the rope which can lead to fatigue failures of the rope wires.
4 Obstructions in the path of the rope against which it may rub and cause excessive wear on the rope.
5 Lack of suitable lubrication of the rope and its core to prevent corrosion and reduce internal friction and wear between the wires and strands.

Contrary to the belief of many users, the lubricant applied during the manufacture of the rope is seldom sufficient to last out the life of the rope, and the rope lubricant should be replenished regularly right from the time of the rope's installation.

Storage, Handling and Fitting

The storage, handling and fitting of the rope prior to its installation should be checked to see that:

1 The rope is stored under dry conditions off the ground and free from corrosive fumes or moisture.
2 The rope is coiled on to or off the reel coil so that all tendency to form loops or kinks in the rope is avoided.
3 Where rope is stored for long periods under hot conditions the reel or coil is turned at intervals to prevent the lubricant from draining to the bottom of the reel or coil.
4 The rope is suitably seized with a marline, annealed wire or strand seizing before cutting the rope to prevent distortion of the lay and strands.
5 All end fittings and attachments are suitable for the work, properly fitted and maintained in good safe working order during the life of the rope.

ELECTRICITY

FUNDAMENTAL UNITS

Ampere is the unit in which electric current flow is measured.

Ohm is the unit in which resistance to the flow 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.

$$\text{watts} = \text{volts} \times \text{amperes}$$

Kilowatt hour For commercial purposes electrical energy is charged for 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 five cents –

$$\text{Cost} = \frac{60 \times 5 \times 10 \times 5\text{c}}{1000} = \$0.15$$

The normal voltage for household appliances is 240; for 3-phase motors, etc, 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 that 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 con-

ductor and that current-carrying conductors shall not be green. The colours red and black have been used to identify the current-carrying conductors. Recently, in conformity with overseas practice, the Statutory Electrical Authorities throughout Australia, agreed to accept an alternative system of colour coding.

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

At three-pin plugs and cord extension sockets the green or green/yellow earthing core must be connected to the earth terminal (marked E, EARTH or ⏚ and may in addition also be marked GREEN or with 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 also will inspect the installation for you if you suspect it is faulty.

DO inspect the main earth wire connection regularly. This wire will be connected to a water pipe or a rod driven into the ground. If it is damaged or disconnected have repairs carried out as a matter of urgency. If new water pipes are installed ensure that the plumber arranges for the earth wire to be properly reconnected. Remember that lack of a main earth connection amounts to lack of personal protection from electric shock.

FLEXIBLE CORDS

About one third of all electrical fatalities are associated with damaged, deteriorated, or incorrectly connected flexible cords. Two thirds of these are extension cords.

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. See *Flexible Cord Core Colours* notes above.

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 cords or have them made up by an electrician. The do-it-yourself approach might have fatal consequences.

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 cord extension socket should be used.

DO NOT use cords 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. With the exception of portable lamp standards and brackets 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 a 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 distance between the 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 find out from a licensed electrical person 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 electric 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 men 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 electric wires. Touching these wires may mean death. Be careful when painting or carrying out repairs near electric wires.

DO take extreme care when transporting boats with masts or when operating mobile cranes, tip trucks, or tall agricultural machinery and when upending long pipes in the vicinity of overhead power lines . . . look about and live.

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 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.

LPG (LIQUIFIED PETROLEUM GAS)

When used properly and sensibly LPG (liquified petroleum gas) is a safe, convenient source of energy for domestic, commercial, industrial, agricultural and automotive use. Information about LPG and LPG equipment is available from the Australian LPG Association (ALPGA), ICI House, 69 Macquarie Street, Sydney NSW 2000.

LPG is a generic term used to describe a group of closely related hydrocarbons derived from petroleum.

When LPG is refrigerated or compressed moderately at normal temperature it condenses to liquid form; when the pressure is released or the temperature increased it reverts back to gas. Thus it can be transported and stored as a liquid and burnt as a gas. Domestic containers such as cylinders and pressure tanks rely on pressure to condense the gas to liquid form.

The more commonly used tanks or cylinders when filled have liquid at the bottom and gas at the top. The gas at the top creates the pressure to keep the remaining gas in liquid form. Each time some gas at the top is drawn off, the pressure is reduced sufficiently to allow more liquid to revert to gas, thereby maintaining the pressure inside the tank. This process continues until the tank or cylinder is empty.

Tanks and cylinders are fitted with valves which incorporate a relief device, and it is important that the containers always be stored or transported in a vertical position so that the valve is in gas, not in liquid.

Various standards and codes for the safe and efficient use of LPG are published by the Standards Association of Australia and the ALPGA. State governments have regulations controlling LPG matters, either gazetting the codes of the SAA or ALPGA or including the requirements of these codes in their respective LPG regulations.

All LPG cylinders should be stamped to indicate they have been checked at a test station. Reinspection and restamping at a test station must be carried out every ten years. 3T81 stamped on a cylinder means it was tested March 1981 and by March 1991 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 should be carried out and checked by an authorised or licensed LPG installer.

Some additional safety hints:

DO NOT use damaged connectors or fittings.
DO NOT use a naked light or flame when looking for leaks —use detergent or soap solution.
DO NOT smoke when handling cylinders.
DO NOT drop or mishandle cylinders.
DO NOT over-fill cylinders.
DO NOT attempt ro remove valves from cylinders.
DO NOT use makeshift connections.
DO NOT block off fixed ventilation vents.

DO keep cylinders away from excessive heat.
DO check regularly for leaks.
DO keep cylinders and pipes rust-free.
DO turn off all valves and taps before replacing empty or not empty cylinders.

GAS MACHINE AND HAND CUTTING NOZZLES

Standard Nozzle

Plate thickness, mm	Nozzle size	Pressure		Speed
		Oxygen, kPa	Acet & LPG, kPa	Acet & LPG, mm/min
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

MANUAL METALLIC ARC WELDING

Small portable electric arc welding machines are popular with the handyman, farmer, home tradesman and hobbyist but are somewhat limited in flexibility for larger jobs. General purpose welding of steel sheet is well within the capability of this type of equipment and many general purpose electrodes are quite suitable.

The table below gives electrode recommendations for the following Lysaght steels:

- Hot rolled and cold rolled uncoated low carbon steel sheet.
- Hot dipped zinc-coated low carbon steel sheet.
- Aluminium/zinc alloy-coated low carbon steel sheet.
- Electro-galvanized low carbon steel sheet.

Sheet thickness, (mm)	AS 1552 electrode type	Electrode diameter, (mm)
1.6	E4112	1.75
2.5	E4112	2.5
3.0	E4112	2.5
4.0	E4112	3.25
5.0	E4112	3.25

Electrode type E4113 is a suitable alternative for most applications. Both types are available under various brand names.

If other electrode types are preferred for specific reasons, contact should be made with suppliers of welding consumables.

COPPER SHEET AND STRIP TO AS 1566

General

Common grades: High Conductivity, De-oxidized.

Finishes: Cold Rolled (Sheet and Strip), Hot Rolled (Plate over 12 mm thick).

Common Tempers: Half Hard, Soft.

Preferred Dimensions: To AS 2338.

TRADE SIZES

Sheet, all preferred thicknesses		Strip	
Width, mm	Length, mm	Preferred thickness, mm	Width, mm
600	1800	0.025 to 0.15	up to 300
900	1800	0.15 to 0.40	up to 600
1200	1800	0.40 to 0.50	up to 900
1200	2400	0.50 to 2.0	up to 1200

MASS PER UNIT AREA

Calculated on the mean density of copper taken as 8940 kg/m^3.

Preferred thickness, mm	Mass per square metre, kg	Preferred thickness, mm	Mass per square metre, kg
0.10	0.894	1.2	10.73
0.12	1.073	1.6	14.30
0.16	1.430	2.0	17.88
0.20	1.788	2.5	22.35
0.25	2.235	3.0	26.82
0.30	2.682	4.0	35.76
0.40	3.576	5.0	44.70
0.50	4.47	6.0	53.64
0.60	5.36	8.0	71.52
0.80	7.15	10.0	89.40
1.00	8.94		

SOLID DRAWN COPPER AND BRASS ROUND TUBES TO AS 1572 – FOR GENERAL ENGINEERING PURPOSES

COPPER AND 70/30 BRASS

PREFERRED SIZES

External diameter, mm	Mass per unit length, kg/m Wall thickness, mm											
	0.41	0.46	0.51	0.56	0.71	0.81	0.91	1.02	1.22	1.63	2.03	2.64
COPPER												
3.18	–	–	–	0.041	0.049	–	–	–	–	–	–	–
4.76	–	–	–	0.066	0.081	–	–	–	–	–	–	–
6.35	–	–	–	0.091	0.113	–	0.139	–	0.176	–	–	–
7.94	–	–	–	0.116	0.114	0.162	0.180	–	0.230	–	–	–
9.53	0.105	–	–	0.141	0.176	0.199	0.220	–	0.285	0.362	–	–
12.70	0.142	–	–	0.191	0.239	0.271	0.302	0.335	0.394	0.507	–	–
15.88	–	–	–	0.241	0.303	–	0.383	0.426	0.503	0.653	–	–
19.05	–	–	–	0.291	0.366	–	0.464	0.517	0.611	0.798	–	–
25.40	–	–	–	–	–	–	0.626	–	0.829	1.089	–	–
31.75	–	–	–	–	–	–	0.789	–	1.047	1.380	–	–
38.10	–	–	–	–	–	–	0.951	–	1.265	1.671	–	–
44.45	–	–	–	–	–	–	1.114	–	1.483	1.962	–	–
50.80	–	–	–	–	–	–	1.276	–	1.700	2.253	–	–
63.50	–	–	–	–	–	–	1.601	–	2.136	2.835	–	–
76.20	–	–	–	–	–	–	1.926	–	2.571	3.417	–	–
101.60	–	–	–	–	–	–	2.576	–	3.442	4.581	5.682	–
127.00	–	–	–	–	–	–	3.223	–	4.314	5.744	7.131	–
152.40	–	–	–	–	–	–	3.875	–	5.185	6.908	8.581	–

70/30 BRASS												
3.18	–	–	–	0.039	0.047	–	0.055	–	–	–	–	–
4.76	–	–	–	0.063	0.077	–	0.094	–	–	–	–	–
6.35	–	0.073	–	0.087	0.107	–	0.133	–	0.168	–	–	–
7.94	–	–	–	0.111	0.138	–	0.171	–	0.220	–	–	–
9.52	–	–	–	0.135	0.168	–	0.210	–	0.272	0.345	–	–
11.11	–	–	–	–	0.198	–	0.249	–	0.323	–	–	–
12.70	–	–	–	–	0.228	–	0.288	–	0.375	0.484	–	–
14.29	–	–	–	–	–	–	0.326	–	–	–	–	–
15.88	–	–	–	0.230	0.289	–	0.365	–	0.479	0.622	–	–
19.05	–	–	0.253	–	0.349	–	0.442	–	0.583	0.761	–	–
22.22	–	–	–	–	–	–	–	–	0.687	0.899	–	–
25.40	–	–	0.340	–	0.470	–	0.597	–	0.791	1.038	–	–
31.75	–	–	–	–	0.591	–	0.752	–	0.998	1.316	–	–
38.10	–	–	–	–	–	–	0.907	–	1.206	1.593	–	–
44.45	–	–	–	–	–	–	1.062	–	–	–	–	–
50.80	–	–	–	–	–	–	1.217	–	1.621	2.148	–	–
63.50	–	–	–	–	–	–	1.526	–	2.036	2.703	–	–
76.20	–	–	–	–	–	–	–	–	2.451	3.258	–	–
101.60	–	–	–	–	–	–	–	–	3.282	4.367	5.417	–
127.00	–	–	–	–	–	–	–	–	–	5.477	6.799	–
152.40	–	–	–	–	–	–	–	–	–	6.586	8.181	10.596

Mass (kg) per linear metre = (external diameter (mm) – wall thickness (mm)) × wall thickness (mm)

× { 0.028 11 for copper.
0.026 8 for 70/30 brass.

Slight variation from the above mass values may be expected in practice.

COPPER TUBES FOR WATER, GAS AND SANITATION TO AS 1432

MASS PER UNIT LENGTH

Type and Condition	Tube size, mm OD x thickness		Calculated mass per unit length, kg/m	Bursting pressure in annealed condition, kPa
	Actual	Nominal		
	12.70 x 1.22	15 x 1.2	0.394	38 430
	15.88 x 1.22	18 x 1.2	0.503	30 730
TYPE	19.05 x 1.42	20 x 1.4	0.704	29 820
A				
As drawn	25.40 x 1.63	25 x 1.6	1.089	25 670
or	31.75 x 1.63	32 x 1.6	1.380	20 540
annealed	38.10 x 1.63	40 x 1.6	1.671	17 110
	50.80 x 1.63	50 x 1.6	2.253	12 830
	9.53 x 0.91	10 x 0.9	0.220	38 240
	12.70 x 0.91	15 x 0.9	0.302	28 660
	15.88 x 1.02	18 x 1.0	0.426	25 690
	19.05 x 1.02	20 x 1.0	0.517	21 420
	25.40 x 1.22	25 x 1.2	0.829	19 210
	31.75 x 1.22	32 x 1.2	1.047	15 370
	38.10 x 1.22	40 x 1.2	1.265	12 810
TYPE	44.45 x 1.22	45 x 1.2	1.483	10 980
B	50.80 x 1.22	50 x 1.2	1.700	9 610
As Drawn				
or	63.50 x 1.22	65 x 1.2	2.136	7 690
annealed	76.20 x 1.63	80 x 1.6	3.417	8 560
	88.90 x 1.63	90 x 1.6	3.999	7 330
	101.60 x 1.63	100 x 1.6	4.581	6 420
	127.00 x 1.63	125 x 1.6	5.744	5 130
	152.40 x 2.03	150 x 2.0	8.581	5 330
	177.80 x 2.03	175 x 2.0	10.030	4 570
	203.20 x 2.03	200 x 2.0	11.479	4 000
	228.60 x 2.64	225 x 2.6	16.769	4 620

COPPER TUBES FOR WATER, GAS AND SANITATION TO AS 1432 (Cont)

Type and Condition	Tube size, mm OD x thickness		Calculated mass per unit length, kg/m	Bursting pressure in annealed condition, kPa
	Actual	Nominal		
TYPE C As drawn or annealed	9.53 x 0.71	10 x 0.7	0.176	29 830
	12.70 x 0.71	15 x 0.7	0.239	22 360
	15.88 x 0.91	18 x 0.9	0.383	22 920
	19.05 x 0.91	20 x 0.9	0.464	19 110
	25.40 x 0.91	25 x 0.9	0.626	14 330
TYPE D As drawn only	31.75 x 0.71	32 x 0.7	0.619	8 940
	38.10 x 0.91	40 x 0.9	0.915	9 550
	44.45 x 0.91	45 x 0.9	1.114	8 190
	50.80 x 0.91	50 x 0.9	1.276	7 170
	63.50 x 1.22	65 x 1.2	2.136	7 690
	76.20 x 1.22	80 x 1.2	2.571	6 400
	88.90 x 1.22	90 x 1.2	3.007	5 490
	101.60 x 1.22	100 x 1.2	3.442	4 800
	127.00 x1.42	125 x 1.4	5.103	4 470
	152.40 x 1.63	150 x 1.6	6.908	4 280

STANDARD LENGTHS

Tube form	Tube size	Length
Straights	Up to and including 50.8 mm	6 m
	Over 50.8 mm	5 or 6 m
Coils	Below 9 mm	30 m
	Over 9 mm up to 40 mm	18 m

BRASS AND COPPER RODS AND BARS TO AS 2338

STANDARD SIZES TO AS 2338 – ROUND, SQUARE, HEXAGON

MASS PER UNIT LENGTH

Calculated on the mean density of copper taken as 8940 kg/m^3 and brass as 8476 kg/m^3

ROUND

Diameter, mm	Mass per linear metre, kg		Diameter, mm	Mass per linear metre, kg	
	Brass	Copper		Brass	Copper
3	0.060	0.063	27	4.85	5.12
4	0.107	0.112	30	5.99	6.32
5	0.166	0.176	33	7.25	7.65
6	0.240	0.253	36	8.63	9.10
7	0.326	0.344	39	10.13	10.68
8	0.426	0.449	42	11.74	12.39
9	0.539	0.569	45	13.48	14.22
10	0.666	0.702	48	15.34	16.18
12	0.959	1.01	50	16.64	17.55
14	1.30	1.38	55	20.14	21.24
16	1.70	1.80	60	23.97	25.28
18	2.16	2.28	65	28.13	29.67
20	2.66	2.81	70	32.62	34.41
22	3.22	3.40	75	37.45	39.50
24	3.83	4.04	80	42.61	44.94

SQUARE

Side, mm	Mass per linear metre, kg		Side, mm	Mass per linear metre, kg	
	Brass	Copper		Brass	Copper
6	0.305	0.322	20	3.39	3.58
8	0.542	0.572	25	5.30	5.59
10	0.848	0.894	32	8.68	9.15
12	1.22	1.29	35	10.38	10.95
14	1.66	1.75	40	13.56	14.30
16	2.17	2.29	45	17.16	18.10
18	2.75	2.89	50	21.19	22.35

HEXAGON

Across flats, mm	Mass per linear metre, kg		Across flats, mm	Mass per linear metre, kg	
	Brass	Copper		Brass	Copper
3.2	0.075	0.079	24	4.23	4.46
4	0.118	0.124	30	6.61	6.97
5	0.184	0.194	36	9.51	10.03
5.5	0.222	0.234	46	15.53	16.38
7	0.360	0.379	55	22.21	23.42
8	0.470	0.496	65	31.02	32.71
10	0.734	0.774	75	41.29	43.55
13	1.24	1.31	85	53.04	55.94
17	2.12	2.24	95	66.25	69.87
19	2.65	2.80			

DRAWN COPPER BARS TO AS 1567

STANDARD RECTANGULAR SIZES TO AS 2338

MASS PER UNIT LENGTH

Calculated on the mean density of copper taken as 8940 kg/m³

Dimension, mm	Mass per linear metre, kg	Dimension, mm	Mass per linear metre, kg
12.5	0.279	25	1.41
16	0.358	31.5	1.77
20	0.447	40	2.25
2.5×25	0.559	50	2.82
31.5	0.704	**6.3**×63	3.55
40	0.894	80	4.51
60	1.12	100	5.63
63	1.41	125	7.04
		160	9.01
16	0.572		
20	0.715	50	4.47
25	0.894	63	5.63
31.5	1.13	**10**×80	7.15
4×40	1.43	100	8.94
50	1.79	125	11.18
63	2.25	160	14.30
80	2.86		
100	3.58	100	14.30
		16×125	17.88
		160	22.89

BRASS SHEET AND STRIP TO AS 1566

General

Common Grades: 63/37 (Basis Brass)
70/30 (Yellow or Cartridge Brass)
Common Tempers: Soft, Half Hard, Hard, Extra Hard
Preferred Dimensions: To AS 2338

TRADE SIZES

Sheet: All preferred thicknesses – 600 mm × 1800 mm
900 mm × 1800 mm

Strip: Subject to special inquiry.

MASS PER UNIT AREA

Calculated on the mean density of rolled **67/37 Brass** taken as 8440 kg/m³. Slight variations correspond to the composition of different alloys.

Table can also be used for 70/30 Brass and other copper alloys if the values listed are multiplied by the factors appearing in the footnote.

Preferred thickness, mm	Mass per square metre, kg	Preferred thickness, mm	Mass per square metre, kg
0.10	0.844	1.2	10.1
0.12	1.01	1.6	13.5
0.16	1.35	2.0	16.9
0.20	1.69	2.5	21.1
0.25	2.11	3.0	25.3
0.30	2.53	4.0	33.8
0.40	3.58	5.0	42.2
0.50	4.22	6.0	50.6
0.60	5.06	8.0	67.5
0.80	6.75	10.0	84.4
1.00	8.44		

To obtain value for	Multiply listed value by factor:
90/10 & 85/15 Gilding Metals	1.036
12% Nickel Silvers	1.018
18% Nickel Silvers	1.030
Engraving Brass	1.003
5% Phosphor Bronze	1.049
70/30 Brass	1.010

EXTRUDED FLAT BRASS SECTIONS TO AS 1567

STANDARD RECTANGULAR SIZES TO AS 2338

MASS PER UNIT LENGTH

Calculated on the mean density of 63/37 brass taken as 8440 kg/m³

Dimension, mm	Mass per linear metre, kg
10	0.135
1.6 × 12	0.162
16	0.216
10	0.169
2 × 12	0.203
20	0.338
10	0.253
12	0.304
16	0.405
3 × 20	0.506
25	0.633
30	0.760
40	1.01
50	1.27
10	0.338
12	0.405
16	0.540
20	0.675
25	0.844
4 × 30	1.01
40	1.35
50	1.69
50	2.03
80	2.70
100	3.38
10	0.422
20	0.844
5 × 25	1.06
30	1.27
40	1.69

Dimension, mm	Mass per linear metre, kg
10	0.51
12	0.61
16	0.81
20	1.01
25	1.27
6 × 30	1.52
40	2.03
50	2.53
60	3.04
80	4.05
100	5.06
10	0.68
12	0.81
16	1.08
8 × 25	1.69
30	2.03
40	2.70
60	4.05
12	1.01
16	1.35
20	1.69
25	2.11
10 × 30	2.53
40	3.38
50	4.22
60	5.06
80	6.75
100	8.44
16	1.62
20	2.03
25	2.53
30	3.04
12 × 40	4.05
50	5.06
60	6.07
80	8.10
100	10.13

Dimension, mm	Mass per linear metre, kg
20	2.70
25	3.38
16 × 30	4.05
40	5.40
60	8.10
100	13.50
25	4.22
30	5.06
40	6.75
20 × 50	8.44
60	10.13
80	13.50
100	16.88
30	6.33
40	8.44
25 × 50	10.55
60	12.66
80	16.88
100	21.10
40	10.13
50	12.66
30 × 60	15.19
80	20.26
100	25.32
50	16.88
40 × 60	20.26
80	27.01
100	33.76
60	25.32
50 × 80	33.76
100	42.20
80	40.51
60 × 100	50.64
80 × 100	67.52

ZINC AND ZINC SHEET

Hard zinc is available in sheets and coiled strip.

Standard thickness	0.70, 0.80 mm
Standard sheet size	1000 x 2400 mm
Standard coil length	Cut, 20 m Full, 500 kg
Standard coil width	300, 460, 580, 1000 mm

MASS (approximate values)

Sheet thickness, mm	Mass per unit area, kg/m²	Mass per 1000 x 2400 mm sheet, kg
0.70	5.12	12.3
0.80	5.67	13.6

Coil thickness,	Mass per unit length, kg/m			
	Coil width, mm			
mm	300	460	580	1000
0.70	1.5	2.3	3.0	5.0
0.80	1.7	2.6	3.3	5.6

SOFT ZINC FLASHING

Soft zinc flashing is 99.9 per cent zinc, making it more malleable than hard zinc. It can be readily shaped or dressed to follow the contours of roofing sheets.

Soft zinc flashing is available 0.70 mm thick in 6 m coils 230, 300, 460 and 580 mm wide. Approximate mass per 6 m coil:

230 mm – 7 kg
300 mm – 9 kg
460 mm – 14 kg
580 mm – 18 kg

Zinc flashing is suitable for use with Zincalume steel.

ALUMINIUM ALLOY SHEET

MASS PER UNIT AREA

Values shown are theoretical and based on the density of commercially pure aluminium (2710 kg/m^3). Actual values may differ slightly within the permissible manufacturing tolerances.

Thickness, mm	Mass per unit area, kg/m^2	Thickness, mm	Mass per unit area, kg/m^2
0.16	0.434	1.4	3.794
0.20	0.542	1.6	4.336
0.25	0.678	1.8	4.878
0.30	0.813	2.0	5.420
0.40	1.084	2.2	5.962
0.45	1.220	2.5	6.775
0.50	1.355	2.8	7.588
0.55	1.491	3.0	8.130
0.60	1.626	3.5	9.485
0.70	1.897	4.0	10.84
0.80	2.168	4.5	12.19
0.90	2.439	5.0	13.55
1.00	2.710	5.5	14.90
1.2	3.252	6.0	16.26

TINPLATE (INCLUDING TIN SHEET AND BLACKPLATE)

For tinplate ordering, pricing and calculations the international term or unit *sita* is preferred. Sita is derived from the initial letters of System International Tinplate Area. One sita is equal to 100 square metres.

Tinplate is usually ordered by the package or by the tonne. One package contains 100 sheets irrespective of thickness.

THICKNESSES AVAILABLE (MILLIMETRES):

0.20	0.25	0.31	0.38
0.21	0.26	0.33	0.43
0.22	0.28	0.35	0.50
0.24	0.30	0.36	0.55

Widths and lengths are produced in even millimetre increments only.

MONEL 400 AND NICKEL ALLOYS

ROUND AND HEXAGON ROD AND BAR

Theoretical values are shown for Monel 400, density 8830 kg/m^3.

To obtain theoretical values for nickel alloys, multiply the tabulated Monel kg/m^3 figure by the factor shown:

	Density, kg/m^3	Factor
Monel K-500	8460	0.958
Nickel 200	8890	1.007
Incoloy 800	7950	0.900
Alloy 904L	7980	0.903
Incoloy 825	8140	0.922
Inconel 600	8420	0.954

Round

Size, mm	kg/m	Size, mm	kg/m	Size, mm	kg/m	Size, mm	kg/m
5	0.173	28	5.44	70	34.0	180	225
6	0.250	34	6.24	75	39.0	200	277
8	0.444	32	7.10	80	44.4	220	336
10	0.694	35	8.5	90	56.2	240	399
12	0.999	40	11.1	100	69.4	260	469
14	1.36	45	14.0	110	83.9	280	544
16	1.78	50	17.3	120	99.9	300	624
18	2.25	55	21.0	130	117	400	1100
20	2.77	60	25.0	140	136	450	1400
22	3.36	65	29.3	160	178	500	1731
25	4.33						

Hexagon

Size, mm	kg/m	Size, mm	kg/m	Size, mm	kg/m
15.24	1.77	28.00	5.97	42.42	13.76
18.00	2.49	30.48	7.10	47.24	17.11
20.83	3.32	33.02	8.33	52.07	20.68
25.65	5.03	37.59	10.80		

STEEL RECTANGULAR SECTIONS

Mass per Unit Length (kg/m) of Flat Rolled Plate, Sheet, Coil and Bar

SEE TABLE ON NEXT TWO PAGES.

Mass per unit length table on the following two pages is theoretical only. Calculations are based on a mass for carbon steel of 7850 kg/m^3 and are rounded off.

To obtain values for intermediate widths to 5 mm increments, select width combinations from the table to equal the width required and sum their respective mass values.

eg, to obtain the mass per linear metre for a section 11 mm thick x 1275 mm wide

millimetres	kilograms per linear metre	
11 x 1000	weighs	86.4
11 x 200	weighs	17.3
11 x 75	weighs	6.48
∴ 11 x 1275	weighs	110.18

The value for any thickness or width may be obtained from the following formula:

Mass per linear metre (kg/m)

$$kg/m = \frac{t \times W \times 7850}{1\,000\,000}$$

where:

t = thickness (mm)
W = width (mm)

STEEL RECTANGULAR SECTIONS

Mass Per Unit Length, kg/m

Width, mm	Thickness, mm													Width, mm
	1	2	3	4	5	6	7	8	9	10	11	12	13	
5	0.0393	0.0785	0.118	0.157	0.196	0.236	0.275	0.314	0.353	0.393	0.432	0.471	0.510	5
10	0.0785	0.157	0.236	0.314	0.392	0.471	0.550	0.628	0.707	0.785	0.864	0.942	1.02	10
15	0.118	0.236	0.353	0.471	0.589	0.707	0.824	0.942	1.06	1.18	1.30	1.41	1.53	15
20	0.157	0.314	0.471	0.628	0.785	0.942	1.10	1.26	1.41	1.57	1.73	1.88	2.04	20
25	0.196	0.393	0.589	0.785	0.981	1.18	1.37	1.57	1.77	1.96	2.16	2.36	2.55	25
30	0.236	0.471	0.707	0.942	1.18	1.41	1.65	1.88	2.12	2.36	2.59	2.83	3.06	30
35	0.275	0.550	0.824	1.10	1.37	1.65	1.92	2.20	2.47	2.75	3.02	3.30	3.57	35
40	0.314	0.628	0.942	1.26	1.57	1.88	2.20	2.51	2.83	3.14	3.45	3.77	4.08	40
45	0.353	0.707	1.06	1.41	1.77	2.12	2.47	2.83	3.18	3.53	3.89	4.24	4.59	45
50	0.393	0.785	1.18	1.57	1.96	2.36	2.75	3.14	3.53	3.93	4.32	4.71	5.10	50
55	0.432	0.864	1.30	1.73	2.16	2.59	3.02	3.45	3.89	4.32	4.75	5.18	5.61	55
60	0.471	0.942	1.41	1.88	2.36	2.83	3.30	3.77	4.24	4.71	5.18	5.65	6.12	60
65	0.510	1.02	1.53	2.04	2.55	3.06	3.57	4.08	4.59	5.10	5.61	6.12	6.63	65
70	0.550	1.10	1.65	2.20	2.75	3.30	3.85	4.40	4.95	5.50	6.04	6.59	7.14	70
75	0.589	1.18	1.77	2.36	2.94	3.53	4.12	4.71	5.30	5.89	6.48	7.07	7.65	75
80	0.628	1.26	1.88	2.51	3.14	3.77	4.40	5.02	5.65	6.28	6.91	7.54	8.16	80
85	0.667	1.33	2.00	2.67	3.34	4.00	4.67	5.34	6.01	6.67	7.34	8.01	8.67	85
90	0.707	1.41	2.12	2.83	3.53	4.24	4.95	5.65	6.36	7.07	7.77	8.48	9.18	90
95	0.746	1.49	2.24	2.98	3.73	4.47	5.22	5.97	6.71	7.46	8.20	8.95	9.69	95
100	0.785	1.57	2.36	3.14	3.93	4.71	5.50	6.28	7.07	7.85	8.64	9.42	10.2	100
200	1.57	3.14	4.71	6.28	7.85	9.42	11.0	12.6	14.1	15.7	17.3	18.8	20.4	200
300	2.36	4.71	7.07	9.42	11.8	14.1	16.5	18.8	21.2	23.6	25.9	28.3	30.6	300
400	3.14	6.28	9.42	12.6	15.7	18.8	22.0	25.1	28.3	31.4	34.5	37.7	40.8	400
500	3.93	7.85	11.8	15.7	19.6	23.6	27.5	31.4	35.3	39.3	43.2	47.1	51.0	500
600	4.71	9.42	14.1	18.8	23.6	28.3	33.0	37.7	42.4	47.1	51.8	56.5	61.2	600
700	5.50	11.0	16.5	22.0	27.5	33.0	38.5	44.0	49.5	55.0	60.4	65.9	71.4	700
800	6.28	12.6	18.8	25.1	31.4	37.7	44.0	50.2	56.5	62.8	69.1	75.4	81.6	800
900	7.07	14.1	21.2	28.3	35.3	42.4	49.5	56.5	63.6	70.7	77.7	84.8	91.8	900
1000	7.85	15.7	23.6	31.4	39.3	47.1	55.0	62.8	70.7	78.5	86.4	94.2	102	1000
2000	15.7	31.4	47.1	62.8	78.5	94.2	110	126	141	157	173	188	204	2000

LYSAGHT REFEREE

Width, mm	Thickness, mm													Width, mm
	14	15	16	17	18	19	20	21	22	23	24	25	26	
5	0.550	0.589	0.628	0.667	0.707	0.746	0.785	0.824	0.864	0.903	0.942	0.981	1.02	5
10	1.10	1.18	1.26	1.33	1.41	1.49	1.57	1.65	1.73	1.81	1.88	1.96	2.04	10
15	1.65	1.77	1.88	2.00	2.12	2.24	2.36	2.47	2.59	2.71	2.83	2.94	3.06	15
20	2.20	2.36	2.51	2.67	2.82	2.98	3.14	3.30	3.45	3.61	3.77	3.93	4.08	20
25	2.75	2.94	3.14	3.34	3.53	3.73	3.93	4.12	4.32	4.51	4.71	4.91	5.10	25
30	3.30	3.53	3.77	4.00	4.24	4.47	4.71	4.95	5.18	5.42	5.65	5.89	6.12	30
35	3.85	4.12	4.40	4.67	4.95	5.22	5.50	5.77	6.04	6.32	6.59	6.87	7.14	35
40	4.40	4.71	5.02	5.34	5.65	5.97	6.28	6.59	6.91	7.22	7.54	7.85	8.16	40
45	4.95	5.30	5.65	6.01	6.36	6.71	7.07	7.42	7.77	8.12	8.48	8.83	9.18	45
50	5.50	5.89	6.28	6.67	7.06	7.46	7.85	8.24	8.64	9.03	9.42	9.81	10.2	50
55	6.04	6.48	6.91	7.34	7.77	8.20	8.64	9.07	9.50	9.93	10.4	10.8	11.2	55
60	6.59	7.07	7.54	8.01	8.48	8.95	9.42	9.89	10.4	10.8	11.3	11.8	12.2	60
65	7.14	7.65	8.16	8.67	9.18	9.69	10.2	10.7	11.2	11.7	12.2	12.8	13.3	65
70	7.69	8.24	8.79	9.34	9.89	10.4	11.0	11.5	12.1	12.6	13.2	13.7	14.3	70
75	8.24	8.83	9.42	10.0	10.5	11.2	11.8	12.4	13.0	13.5	14.1	14.7	15.3	75
80	8.79	9.42	10.0	10.7	11.3	11.9	12.6	13.2	13.8	14.4	15.1	15.7	16.3	80
85	9.34	10.0	10.7	11.3	12.0	12.7	13.3	14.0	14.7	15.3	16.0	16.7	17.3	85
90	9.89	10.6	11.3	12.0	12.7	13.4	14.1	14.8	15.5	16.2	17.0	17.7	18.4	90
95	10.4	11.2	11.9	12.7	13.4	14.2	14.9	15.7	16.4	17.2	17.9	18.6	19.4	95
100	11.0	11.8	12.6	13.3	14.1	14.9	15.7	16.5	17.3	18.1	18.8	19.6	20.4	100
200	22.0	23.6	25.1	26.7	28.2	29.8	31.4	33.0	34.5	36.1	37.7	39.3	40.8	200
300	33.0	35.3	37.7	40.0	42.4	44.7	47.1	49.5	51.8	54.2	56.5	58.9	61.2	300
400	44.0	47.1	50.2	53.4	56.5	59.7	62.8	65.9	69.1	72.2	75.4	78.5	81.6	400
500	55.0	58.9	62.8	66.7	70.7	74.6	78.5	82.4	86.4	90.3	94.2	98.1	102	500
600	65.9	70.7	75.4	80.1	84.8	89.5	94.2	98.9	104	108	113	118	122	600
700	76.9	82.4	87.9	93.4	98.9	104	110	115	121	126	132	137	143	700
800	87.9	94.2	100	107	113	119	126	132	138	144	151	157	163	800
900	98.9	106	113	120	127	134	141	148	155	162	170	177	184	900
1000	110	118	126	133	141	149	157	165	173	181	188	196	204	1000
2000	220	236	251	267	283	298	314	330	345	361	377	393	408	2000

ROUND AND SQUARE STEEL BAR AND ROD

Mass per metre and length per tonne

Mass calculations are based on a density for steel of 7850 kg/m^3

Thickness or dia, mm	Rounds		Squares	
	kg/m	m/t	kg/m	m/t
10	0.616	1622	0.785	1274
12	0.887	1126	1.13	884.6
14	1.21	827.5	–	–
16	1.58	633.6	2.01	497.6
18	1.99	500.6	–	–
20	2.46	405.5	3.14	318.5
22	2.98	335.1	–	–
24	3.55	281.6	–	–
25	–	–	4.91	203.8
27	4.49	222.5	–	–
30	5.55	180.2	–	–
33	6.71	148.9	–	–
36	7.99	125.2	–	–
39	9.38	106.6	–	–
40	–	–	12.6	79.6
42	10.9	91.9	–	–
45	12.5	80.1	–	–
48	14.2	70.4	–	–
50	15.4	64.9	–	–
56	19.3	51.7	–	–
60	22.2	45.1	–	–
65	26.0	38.4	–	–
70	30.2	33.1	–	–
75	34.7	28.8	–	–
80	39.5	25.3	–	–
90	49.9	20.0	–	–
100	61.7	16.2	–	–

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 Brick Development Research Institute (Melbourne), Calsil Limited (most States) and the Cement and Concrete Association of Australia (most States).

DESIGN

The design of masonry structures is regulated by Australian Codes and Standards and Building Regulations of State Government. 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 dimensions of bricks and blocks are 10 mm less than nominal dimensions to allow for a standard 10 mm 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 SAA Code.

Damp-proof Courses Damp-proof courses should be provided in accordance with recognized practice.

External Finish If single leaf external walls are to be constructed they should be painted with a flexible 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.

For calcium silicate bricks 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 uses approximately one cubic metre of mortar. To make up 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 600 mm apart both vertically and horizontally. Some situations, however, do require special tying. For information refer to the appropriate SAA Code.

BRICKWORK DIMENSIONS

BASIC BRICK TYPE	BRICK SIZE, mm
Standard	230 × 110 × 76
Modular	290 × 90 × 90

Bricks fulfil the dimensional co-ordination requirement to fit a 600 mm grid in all directions.

Traditional Standard Brick

Size: 230 × 110 × 76 mm

No of bricks per course	Wall length, mm	Opening size, mm	No of courses	Height of bkwk, mm
1	230	250	1	86
1-½	350	370	2	172
2	470	490	3	257
2-½	590	610	4	343
3	710	730	5	429
3-½	830	850	6	514
4	950	970	7	600
4-½	1070	1090	8	686
5	1190	1210	9	772
5-½	1310	1330	10	857
6	1430	1450	11	943
6-½	1550	1570	12	1029
7	1670	1690	13	1114
7-½	1790	1810	14	1200
8	1910	1930	15	1286
8-½	2030	2050	16	1372
9	2150	2170	17	1457
9-½	2270	2290	18	1543
10	2390	2410	19	1629
10-½	2510	2530	20	1714
11	2630	2650	21	1800
11-½	2750	2770	22	1886
12	2870	2890	23	1972
12-½	2990	3010	24	2057
13	3110	3130	25	2143
13-½	3230	3250	26	2229
14	3350	3370	27	2314
14-½	3470	3490	28	2400
15	3590	3610	29	2486
15-½	3710	3730	30	2572
16	3830	3850	31	2657
16-½	3950	3970	32	2743
17	4070	4090	33	2829
17-½	4190	4210	34	2914
18	4310	4330	35	3000
18-½	4430	4450	36	3086
19	4550	4570	37	3172
19-½	4670	4690	38	3257
20	4790	4810	39	3343
			40	3429

BRICKWORK DIMENSIONS (Cont)

Modular Brick

MODULAR BRICK
Size: 290 × 90 × 90 mm

No of bricks per course	Wall length, mm	Opening size, mm	No of courses	Height of bkwk, mm
1	290	310	1	100
1-1/2	390	410	2	200
1-3/4	490	510	3	300
2	590	610	4	400
2-1/2	690	710	5	500
2-3/4	790	810	6	600
3	890	910	7	700
3-1/2	990	1010	8	800
3-3/4	1090	1110	9	900
4	1190	1210	10	1000
4-1/2	1290	1310	11	1100
4-3/4	1390	1410	12	1200
5	1490	1510	13	1300
5-1/2	1590	1610	14	1400
5-3/4	1690	1710	15	1500
6	1790	1810	16	1600
6-1/2	1890	1910	17	1700
6-3/4	1990	2010	18	1800
7	2090	2110	19	1900
7-1/2	2190	2210	20	2000
7-3/4	2290	2310	21	2100
8	2390	2410	22	2200
8-1/2	2490	2510	23	2300
8-3/4	2590	2610	24	2400
9	2690	2710	25	2500
9-1/2	2790	2810	26	2600
9-3/4	2890	2910	27	2700
10	2990	3010	28	2800
10-1/2	3090	3110	29	2900
10-3/4	3190	3210	30	3000
11	3290	3310	31	3100
11-1/2	3390	3410	32	3200
11-3/4	3490	3510	33	3300
12	3590	3610	34	3400
12-1/2	3690	3710	35	3500
12-3/4	3790	3810	36	3600
13	3890	3910	37	3700
13-1/2	3990	4010	38	3800
13-3/4	4090	4110	39	3900
14	4190	4210	40	4000

BLOCKWORK DIMENSIONS

Note that wall panels are 10 mm shorter and openings 10 mm longer than figures below.

No of blocks	Length, mm (based on 400 mm long units)				Height, mm (based on 200 mm high units)	
	Full Blocks	+ Fractional blocks			No of courses	Height
		¼	½	¾		
1	400	500	600	700	1	200
2	800	900	1000	1100	2	400
3	1200	1300	1400	1500	3	600
4	1600	1700	1800	1900	4	800
5	2000	2100	2200	2300	5	1000
6	2400	2500	2600	2700	6	1200
7	2800	2900	3000	3100	7	1400
8	3200	3300	3400	3500	8	1600
9	3600	3700	3800	3900	9	1800
10	4000	4100	4200	4300	10	2000
11	4400	4500	4600	4700	11	2200
12	4800	4900	5000	5100	12	2400
13	5200	5300	5400	5500	13	2600
14	5600	5700	5800	5900	14	2800
15	6000	6100	6200	6300	15	3000
16	6400	6500	6600	6700	16	3200
17	6800	6900	7000	7100	17	3400
18	7200	7300	7400	7500	18	3600
19	7600	7700	7800	7900	19	3800
20	8000	8100	8200	8300	20	4000

CONCRETE

Concrete information The Cement & Concrete Association of Australia is a national, non-profit organization sponsored by the cement industry. Publications 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 upon the quality of materials used, the standard of workmanship in placing and upon the care with which the concrete is *cured*.

CONCRETE CONSTRUCTION

Ready Mixed Concrete

The easiest way of obtaining good quality concrete is to purchase it ready mixed. Ready mixed concrete is generally specified by strength grade (characteristic compressive strength at 28 days in MPa) and workability (slump).

Ready mixed concrete

Use	Strength Grade, MPa	Slump, mm	Other requirements
Ordinary domestic projects; eg driveways, paths, slab-on-ground floors.	20	100	—
Industrial floors	30	80	—
Elements exposed to rain with low pollution	30	80	maximum w/c* 0.60. min cement content 280 kg/m^3. min cover to reinforcement 30 mm.
Elements exposed to rain with moderate pollution	35	80	maximum w/c* 0.55. min cement content 300 kg/m^3. min cover to reinforcement 40 mm.
Elements exposed to high atmospheric pollution located within 5 km of coast	40	80	maximum w/c* 0.5. min cement content 330 kg/m^3. min cover to reinforcement 50 mm.
Elements in specific highly aggressive environments (eg marine conditions) and chemical attack	Obtain specialist advice		

* w/c = ratio of mass of total water to mass of cement in concrete mix.

Site Mixed Concrete

Use	Concrete mix proportions				
	Nominal mix proportions by volume, cement: sand: course aggregate	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 drives 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

* When ordering sand allow 15–20% extra to the above figure for losses and bulking of sand.

Materials

Cement Portland cement Type A (Normal). Other types are available but are used for special applications. Masonry cement should not be used to make concrete. Blended cements (Types FA and SA) may be used, but allowance should be made for a slower gain of strength and the longer *curing* period required. Available in multi-layer paper bags:

1 bag = 40 kg
25 bags = 1 t

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 20–10 mm 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 a hand or power operated 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 must be controlled by mass or volume batching. When volume batching, proportions must 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.

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 design strength, ensures the surface is as hard as possible and minimizes the tendency to surface cracking.

Curing is most simply done by covering or encasing the element 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 a minimum of three days.

Reinforcement

Concrete is strong in compression but weak in tension. Steel reinforcing bars are therefore used 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. Once determined the steel 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 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 sufficient cover (minimum 25 mm) to protect it against corrosion.

Formwork

The quality and rigidity of the framework will be 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.

Placing

The concrete should be placed 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. For deep sections (over 200 mm) compac-

tion should preferably be carried out using an immersion vibrator.
Concrete should be placed within half to three-quarters of an hour of mixing, depending on the weather.

Finishing of Horizontal Surfaces

Many surface finishes and textures are possible. The type of surface finish should be chosen with regard to it use.

Use	Concrete finish
Steep driveways. Paving requiring high skid resistance.	Coarse brooming or grooving
Surfaces to receive quarry or ceramic tiles	Screeded
Non-slip areas	Light brooming
Surfaces to be carpeted	Wood float
Smooth, clean areas. Surfaces to be covered with glued resilient coverings (eg vinyl sheet and tiles).	Mechanical trowel or hand steel trowel

SLAB-ON-GROUND FLOORS

Site Considerations

Slab-on-ground floors are suitable for use on flat sites or, by using cut and fill techniques, on sites with moderate slopes (up to 1 in 5). For more steeply sloping sites split level or suspended floors (such as Bondek structural decking) should be considered.
Foundation material should be checked. Stable materials (eg rock, sand, sandy clay, salty clay) are straightforward 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 an expert. Properly designed slabs are suited for use on expansive soils and those with low bearing capacity.

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.

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 a quality pigmented membrane of minimum thickness 0.2 mm. All joints and penetrations should be sealed with pressure sensitive tape.
Design of the slab and reinforcing details must conform to local building regulations.
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. With slab-on-ground, gardens adjacent to the slab edge should be watched as it is important for these not to be built up above floor level.

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.

RECTANGULAR MESHES

Standard Sheets – 6 m × 2.4m = 14.4 m²

Ref No	Standard unit	Longitudinal wires Size mm	Pitch, mm	Cross wires Size, mm	Pitch, mm	Mass per sheet, kg
F 1218	Sheet	12.5 @	100	8 @	200	173
F 1118	Sheet	11.2 @	100	8 @	200	144
F 1018	Sheet	10 @	100	8 @	200	121
F 918	Sheet	9 @	100	8 @	200	103
F 818	Sheet	8 @	100	8 @	200	88
F 718	Sheet	7.1 @	100	8 @	200	75
F 928	Sheet	9 @	200	8 @	250	62
F 828	Sheet	8 @	200	8 @	250	54

SQUARE MESHES

Standard Sheets – 6 m × 2.4 m = 14.4 m²
Standard Rolls – 60 m × 2.4 m = 144 m²

Ref No	Standard unit	Longitudinal wires Size, mm	Pitch, mm	Cross wires Size, mm	Pitch, mm	Mass per sheet or roll, kg
F 81	Sheet	8 @	100	8 @	100	116
F 102	Sheet	10 @	200	10 @	200	92
F 92	Sheet	9 @	200	9 @	200	75
F 82	Sheet	8 @	200	8 @	200	59
F 72	Sheet	7.1 @	200	7.1 @	200	47
F 62	Sheet	6.3 @	200	6.3 @	200	37
F 52	Sheet	5 @	200	5 @	200	23
F 52	Roll	5 @	200	5 @	200	231
F 42	Sheet	4 @	200	4 @	200	15
F 42	Roll	4 @	200	4 @	200	148

TRENCH MESH for slab-on-ground and strip footings

Standard lengths – 5.1 mm in NSW, 6 m in all other States

Ref No	Std strip width, number of wires	Longitudinal wires Size, mm	Pitch, mm	Cross wires Size, mm	Pitch, mm	Mass per length kg 5.1 m	6.0 m
F8TM	3	8 @	100	4 @	300	6	7
	4	8 @	100	4 @	300	8	10
	5	8 @	100	4 @	300	11	13

DEFORMED STEEL REINFORCING BARS FOR CONCRETE

All details for Steel Reinforcing Bars for Concrete are contained in Australian Standard 1302.

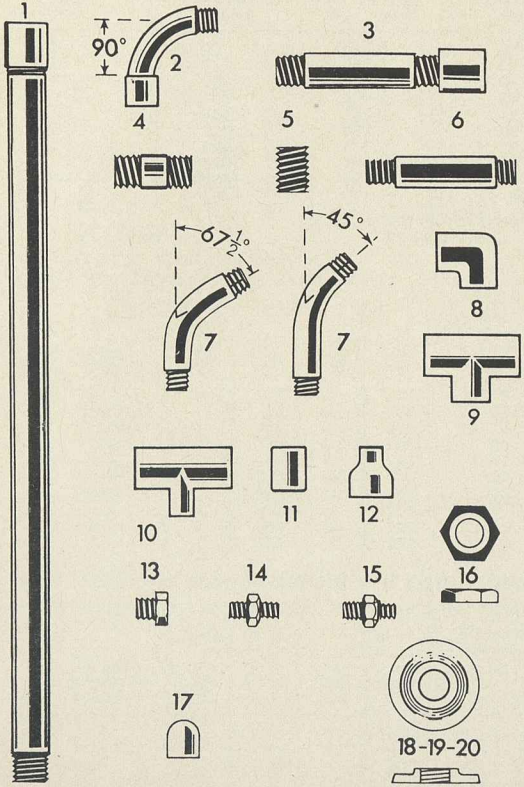
STANDARD REINFORCING BAR

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	1.579	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	7.991	1020	1017.9
40*	9.864	1260	1256.6
50*	15.413	1960	1963.5

† Available as plain round
* Not normally available

TUBEMAKERS OF AUSTRALIA LIMITED,
TUBELINE STEEL FITTINGS
(A unit of Steel Pipe Division)

SCREWED AND SOCKETED STEEL PIPES AND FITTINGS



STEEL PIPES AND FITTINGS

Range of Galvanized and Ungalvanized Types manufactured

	Pipe size designation	8 NB	10 NB	15 NB	20 NB	25 NB	32 NB	40 NB	50 NB	65 NB	80 NB	100 NB	125 NB	150 NB
	PIPES													
1	Pipe pieces up to 600 mm long	X	X	X	X	X	X	X	X	X	X	X	X	X
	TUBULARS													
2	Bends (90°)	X	X	X	X	X	X	X	X	X	X	X	X	X
3	Longscrews	–	–	X	X	X	X	X	X	X	X	X	–	–
4	Barrel Nipples	X	X	X	X	X	X	X	X	X	X	–	–	–
5	Plain Nipples	–	–	X	X	X	X	X	X	X	X	–	–	–
6	Pieces not socketed (100 mm-600 mm)	–	–	X	X	X	X	X	X	–	–	–	–	–
7	Springs not socketed	–	–	X	X	X	X	X	X	X	X	X	–	–
	OTHER FITTINGS													
8	Elbows	X	X	X	X	X	X	X	X	X	X	X	X	X
9	Tees	X	X	X	X	X	X	X	X	X	X	X	X	X
10	Tees, Reducing	–	–	–	X	X	X	X	X	X	X	X	–	X
11	Sockets	X	X	X	X	X	X	X	X	X	X	X	X	X
12	Sockets, Reducing	–	–	X	X	X	X	X	X	X	X	X	–	–
13	Bushes	–	–	X	X	X	X	X	X	–	–	–	–	–
14	Hexagon Nipples	X	X	X	X	X	X	X	X	–	–	–	–	–
15	Hexagon Nipples, Reducing	–	X	X	X	X	X	X	X	–	–	–	–	–
16	Backnuts	–	X	X	X	X	X	X	X	–	–	–	–	–
17	Caps	–	–	X	X	X	X	X	X	–	–	–	–	–
18	Flanges, Table "D"	–	–	–	X	X	X	X	X	X	X	X	X	X
19	Flanges, Table "E"	–	–	–	X	X	X	X	X	X	X	X	X	X
20	Flanges, Table "H"	–	–	–	X	X	X	X	X	X	X	X	X	X

TUBEMAKERS OF AUSTRALIA LIMITED, STEEL PIPE DIVISION

Plain End or Screwed and Socketed Steel Pipes

Pipe size designation	OD, mm	Type	Wall thickness, mm	** Mass PE, kg/m
8 NB	13.5	Medium	2,3	0.635
		Heavy	2.9	0.758
10 NB	17.2	Medium	2.3	0.845
		Heavy	2.9	1.02
15 NB	21.3	Medium	2.6	1.20
		Heavy	3.2	1.43
		Extra Heavy	3.6	1.57
20 NB	26.9	Light*	2.3	1.40
		Medium	2.6	1.56
		Heavy	3.2	1.87
		Extra Heavy*	4.0	2.26
25 NB	33.7	Light*	2.6	1.99
		Medium	3.2	2.41
		Heavy	4.0	2.93
		Extra Heavy*	4.5	3.24
32 NB	42.4	Light*	2.6	2.55
		Medium	3.2	3.09
		Heavy	4.0	3.79
		Extra Heavy*	4.9	4.53
40 NB	48.3	Light*	2.9	3.25
		Medium	3.2	3.56
		Heavy	4.0	4.37
		Extra Heavy*	5.4	5.71
50 NB	60.3	Light*	2.9	4.11
		Medium	3.6	5.03
		Heavy	4.5	6.19
		Extra Heavy*	5.4	7.31
65 NB	76.1	Light*	3.2	5.75
		Medium	3.6	6.44
		Heavy	4.5	7.95
		Extra Heavy*	5.9	10.20
80 NB	88.9	Light*	3.2	6.76
		Medium	4.0	8.38
		Heavy	4.9	10.20
		Extra Heavy*	5.9	12.10
90 NB	101.6	Medium	4.0	9.63
		Heavy	4.9	11.70
100 NB	114.3	Medium	4.5	12.20
		Heavy	5.4	14.50
125 NB	139.7	Medium	4.9	16.30
		Heavy	5.4	17.90
150 NB	165.1	Medium	4.9	19.40
		Heavy	5.4	21.30

* Not available screwed and socketed.

** kg/m of screwed and socketed pipe is marginally increased by the socket screwed to each pipe length.

LARGE DIAMETER STEEL PIPES

Plain end or Bevel end

OD, mm	Wall thickness, mm	Mass, kg/m	OD, mm	Wall thickness, mm	Mass, kg/m
168.3	4.8	19.4	323.9	6.4	50.1
168.3	6.4	25.6	323.9	9.5	73.7
168.3	7.1	28.2			
			355.6	6.4	55.1
219.1	4.8	25.4	355.6	9.5	81.1
219.1	6.4	33.6			
219.1	8.2	42.6	406.4	6.4	63.1
			406.4	9.5	93.0
273.1	4.8	31.8			
273.1	6.4	42.1	457.0	6.4	71.1
273.1	9.3	60.5	457.0	9.5	105

TUBEMAKERS OF AUSTRALIA LIMITED, SUPPLY DIVISION

MALLEABLE PIPE FITTINGS

Fitting	Pipe size designation																					
	8		10		15		20		25		32		40		50		65		80		90		100		125		150	
	NB		NB		NB		NB		NB		NB		NB		NB		NB		NB		NB		NB		NB	
Backnuts	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Bends, M & F	X	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	–	–	–	–	X	–
Bends, F & F	–	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	–	–	–	–	–	–
Bends, M & F 45°	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	–
Bushes	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Caps	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Crosses	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	X	–
Elbows, F & F	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Elbows, M & F	X	–	–	–	X	X	X	X	X	X	X	X	X	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Elbows, Three-way	–	–	–	–	–	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	X	–
Elbows, 45°	–	–	–	–	–	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Elbows, Reducing	–	–	–	–	–	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	X	–
Flanges	–	–	–	–	–	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	X	–
Flanges, Oval	–	–	–	–	–	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Hexagon Nipples	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Hex Nipples, Reducing	X	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Plugs	–	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Sockets	–	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	X	–
Sockets, Reducing	–	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Tees	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	X	–
Tees, Reducing	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Tees, Four-way	–	–	–	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	X	X	–	–	–	–
Unions, FS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	–	–	–	–	–	–
Unions, BS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	–	–	–	–	–	–	–

RECTANGULAR HOLLOW SECTIONS

Tubeline is the brand name of RHS made by the Steel Pipe Division of Tubemakers of Australia Limited. These sections are manufactured to either AS 1163 or AS 1450 specification.

Guidance on the safe use of RHS may be found in AS 1250, AS 1511, AS 1554, AS 1170, AS 1538 and AS 1418.

Size Range: Serial sizes, mm
Squares – 13 x 13 to 254 x 254
Rectangles – 38 x 19 to 254 x 152

Standard Lengths: 6.5 m – Up to and including 32 x 32
8.0 m – 38 x 38 up to 254 x 254

Special lengths may be available on request.

Finish:

Mild steel. Grade 250 – No oil or paint (NOP)
– Black with temporary rust preventative
– Red oxide painted
– Galvanized

High strength steel, Grade 350 – Refer manufacturer

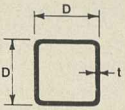
Mechanical Properties

Grade designation	Minimum yield strength, MPa	Minimum tensile strength, MPa
C200, H200	200	320
C250, H250	250	350
C350, H350	350	450

Corner Radii (t = section thickness)

Maximum outside radius – 3t
Minimum inside radius – 0.8t

RECTANGULAR HOLLOW SECTIONS
SQUARES



STANDARD SIZES AND MASS

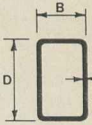
Serial size designation	Section D x D, mm	Wall thickness, mm	Mass kg/m	Mass m/t	External surface area, m^2	Area of section, mm^2
13 x 13	12.7 x 12.7	1.8	0.550	1820	0.0446	70.1
16 x 16	15.9 x 15.9	1.8	0.731	1370	0.0574	93.2
19 x 19	19.1 x 19.1	1.8	0.911	1100	0.0702	116
		2.0	0.992	1010	0.0695	126
25 x 25	25.4 x 25.4	2.0	1.39	721	0.0947	177
		2.6	1.72	580	0.0927	220
		3.2	1.95	512	0.0879	249
32 x 32	31.8 x 31.8	2.0	1.79	559	0.120	228
		2.6	2.24	445	0.118	286
38 x 38	38.1 x 38.1	2.0	2.28	438	0.145	291
		2.6	2.76	362	0.143	352
		3.2	3.23	310	0.139	412
		4.0	3.85	260	0.135	491
51 x 51	50.8 x 50.8	2.6	3.79	264	0.194	484
		3.2	4.51	222	0.189	574
		4.0	5.45	184	0.186	694
		4.9	6.42	156	0.182	817
64 x 64	63.5 x 63.5	2.6	4.83	207	0.245	616
		3.2	5.78	173	0.240	737
		4.0	7.04	142	0.237	897
		4.9	8.37	119	0.233	1070
		6.3	10.2	97.6	0.227	1310
76 x 76	76.2 x 76.2	2.6	5.87	170	0.296	748
		3.2	7.06	142	0.291	899
		4.0	8.64	116	0.288	1100
		4.9	10.30	96.9	0.284	1320
		6.3	12.80	78.4	0.278	1630
89 x 89	88.9 x 88.9	3.6	9.29	108	0.340	1180
		4.9	12.3	81.5	0.335	1560
		6.3	15.3	65.5	0.329	1950
102 x 102	101.6 x 101.6	4.0	11.8	84.6	0.389	1510
		4.9	14.2	70.3	0.385	1810
		6.3	17.8	56.2	0.379	2270
		9.5	25.0	39.9	0.366	3190

RECTANGULAR HOLLOW SECTIONS
SQUARES (Cont)

STANDARD SIZES AND MASS

Serial size designation	Section D × D, mm	Wall thickness, mm	Mass		External surface area, m^2	Area of section, mm^2
			kg/m	m/t		
127 × 127	127.0 × 127.0	4.9	18.1	55.1	0.487	2310
		6.3	22.8	43.8	0.481	2910
		9.5	32.6	30.7	0.467	4160
152 × 152	152.4 × 152.4	4.9	22.0	45.4	0.589	2810
		6.3	27.8	35.9	0.583	3550
		9.5	40.2	24.9	0.569	5120
203 × 203	203.2 × 203.2	6.3	37.9	26.4	0.786	4830
		9.5	55.3	18.1	0.772	7050
254 × 254	254.0 × 254.0	6.3	47.9	20.9	0.989	6110
		9.5	70.5	14.2	0.975	8980

RECTANGULAR HOLLOW SECTIONS
RECTANGLES



STANDARD SIZES AND MASS

Serial size designation	Section D × D, mm	Wall thickness, mm	Mass		External surface area, m^2/m	Area of section, mm^2
			kg/m	m/t		
38 × 19	38.1 × 19.1	2.0	1.59	630	0.108	202
38 × 25	38.1 × 25.4	2.0	1.79	560	0.120	228
		2.6	2.24	446	0.118	286
51 × 25	50.8 × 25.4	2.0	2.28	438	0.145	291
		2.6	2.76	362	0.143	352
		3.2	3.23	310	0.139	412
64 × 38	63.5 × 38.1	2.6	3.79	264	0.194	484
		3.2	4.51	222	0.189	574
		4.0	5.45	184	0.186	694
76 × 38	76.2 × 38.1	2.6	4.31	232	0.220	550
		3.2	5.14	194	0.215	655
		4.0	6.24	160	0.211	795

RECTANGULAR HOLLOW SECTIONS
RECTANGLES (Cont)

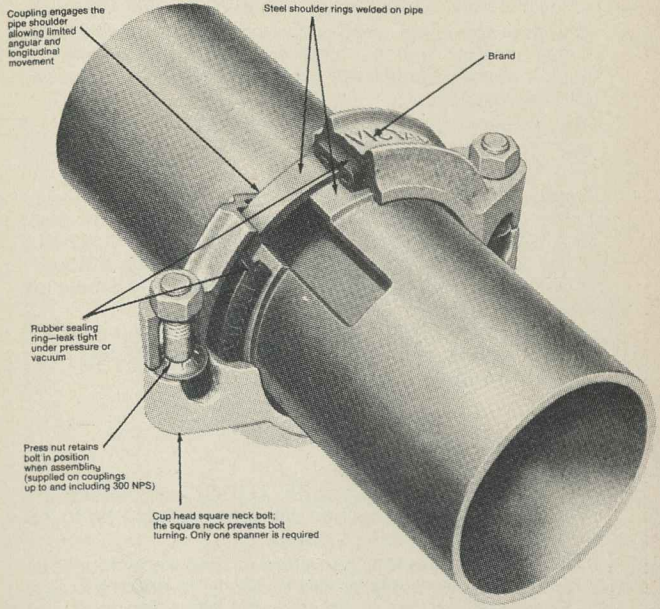
STANDARD SIZES AND MASS

Serial size designation	Section D x D, mm	Wall thickness, mm	Mass kg/m	Mass m/t	External surface area, m^2/m	Area of section, mm^2
76 x 51	76.2 x 50.8	2.6	4.83	207	0.245	616
		3.2	5.78	173	0.240	737
		4.0	7.04	142	0.237	897
		4.9	8.37	119	0.233	1070
		6.3	10.2	97.6	0.227	1310
102 x 51	101.6 x 50.8	2.6	5.87	170	0.296	748
		3.2	7.06	142	0.291	899
		4.0	8.64	116	0.288	1100
		4.9	10.3	96.9	0.284	1320
		6.3	12.8	78.4	0.278	1630
102 x 76	101.6 x 76.2	3.6	9.29	108	0.340	1180
		4.9	12.3	81.5	0.335	1560
		6.3	15.3	65.5	0.329	1950
127 x 51	127.0 x 50.8	3.6	9.29	108	0.340	1180
		4.9	12.3	81.5	0.335	1560
		6.3	15.3	65.5	0.329	1950
127 x 64	127.0 x 63.5	4.0	11.0	90.7	0.364	1410
		4.9	13.3	75.4	0.360	1690
		6.3	16.5	60.5	0.354	2110
127 x 76	127.0 x 76.2	4.9	14.2	70.3	0.385	1810
		6.3	17.8	56.2	0.379	2270
152 x 76	152.4 x 76.2	4.9	16.2	61.8	0.436	2060
		6.3	20.3	49.3	0.430	2590
152 x 102	152.4 x 101.6	4.9	18.1	55.1	0.487	2310
		6.3	22.8	43.8	0.481	2910
		9.5	32.6	30.7	0.467	4160
203 x 102	203.2 x 101.6	4.9	22.0	45.4	0.589	2810
		6.3	27.8	35.9	0.583	3550
		9.5	40.2	24.9	0.569	5120
203 x 152	203.2 x 152.4	6.3	32.9	30.4	0.684	4190
		9.5	47.8	20.9	0.670	6090
254 x 152	254.0 x 152.4	6.3	37.9	26.4	0.786	4830
		9.5	55.3	18.1	0.772	7050

THE VICTAULIC PIPING SYSTEM with Shouldered Steel Pipe

- Dredging, fire protection, sewage disposal/treatment, water services, mining – compressed air lines, construction site services, plant processing, oil field and petroleum piping, shipbuilding.

For full details and data sheets, contact nearest Tubemakers of Australia Limited office.



The System

The Victaulic system is simple in design. It consists of a self-sealing rubber ring embracing two pipe ends and a coupling which encloses the ring while engaging shoulders on the pipe ends.

The coupling accurately centralises the self-sealing ring and keeps it firmly in position to prevent leaks and protect it from external damage. It engages the pipes positively and prevents separation; a small amount of end play is provided between the coupling and the pipe ends.

The Victaulic joint is leakproof under pressure or vacuum even when the pipeline is only partly full or under vibration.

The small space occupied by the joint, the ease with which it can be fitted into confined spaces, together with the quick and easy coupling of pipe lengths make the system uniquely versatile.

The system provides for limited expansion and contraction and accommodates some longitudinal and angular movement.

For irrigation, dewatering of construction sites, and temporary installations, the Victaulic piping system in most instances does not require the design and supervision of a piping engineer or inspection by a statutory authority provided the working pressures shown on the couplings are not exceeded.

Because of the high stored energy in compressed gases, any gas or air system over 1030 kPa should be designed by a piping engineer.

VICTAULIC PIPE

Specification

Steel pipe for most pressure applications where the Victaulic system is employed will be manufactured to AS 1074. Other sizes may be ordered.

The pipe end diameters permitted in these specifications may necessitate rounding and/or sizing to make the pipe ends suitable for the Victaulic steel shoulder rings. For Victaulic piping, the pipe end mean diameter measured with a circumferential tape (or other effective averaging device) should be ± 1 mm of the nominal outside diameter.

Dimensions

Victaulic pipe is normally supplied in 6.5 m lengths. Longers lengths available to order.

Pipe dimensions, mm			Mass per unit length, kg/m	
Nominal size	OD	Wall thickness	Black	Galvanized
50	60.3	2.3	3.32	3.50
		2.9	4.14	4.31
		3.6	5.06	5.22
80	88.9	2.3	4.96	5.23
		3.2	6.81	7.06
		4.0	8.42	8.65
100	114.3	2.6	7.23	7.57
		3.2	8.84	9.16
		4.5	12.26	12.54
		5.4	14.57	14.83
150	165.1	2.6	10.53	11.02
		3.2	12.89	13.35
		4.9	19.47	19.86
		5.4	21.38	21.75
	168.3	4.8	19.45	19.86
		6.4	25.65	25.99
		7.1	28.32	28.63
200	219.1	4.8	25.58	26.11
		6.4	33.78	34.23
		8.2	42.86	43.21
250	273.1	4.8	32.02	32.69
		6.4	42.35	42.91
		9.3	60.76	61.13
300	323.9	6.4	50.41	51.08
		9.5	73.95	74.38
350	355.6	6.4	55.49	56.23
		9.5	81.46	81.92
400	406.4	6.4	63.56	64.40
		9.5	93.41	93.94
450	457.0	6.4	71.64	72.58
		9.5	105.36	105.95

TUBEMAKERS OF AUSTRALIA LIMITED, B T M DIVISION

PRECISION STEEL TUBING

Production Range

Cold drawn seamless – CFS
Drawn welded – CEW
Electric resistance welded – ERW

CIRCULAR STEEL TUBE

Steel Quality	Standard range, OD, mm			Standard range, wall thickness, mm		
	CFS	CEW	ERW	CFS	CEW	ERW
K1020 K1010	25.4-165.1 6.4-88.9			0.9-9.5 0.9-9.5		
Low carbon K1020		6.4-127 51-203.2			0.9-4.9 1.4-8	
Bright Semi-bright			12.7-88.9 12.7-88.9			0.7-2 1.2-5.4

NON-CIRCULAR STEEL TUBE

BTM Non-Circular Section Tube is described by Section Numbers which, in most instances, also describe the section dimensions in millimetres. The full description includes the following suffixes and should be used for all inquiries and orders:

R denotes round corner radius
N denotes normal or standard corner radius
S denotes sharp corner radius

SQUARES		SQUARES	
Section number	Dimension, mm	Section number	Dimension, mm
313N	12.7 × 12.7	327R	31.8 × 31.8
1616N	16.0 × 16.0	346S	31.8 × 31.8
1919R	19.0 × 19.0	3535S	35.0 × 35.0
1919N	19.0 × 19.0	3838S	38.0 × 38.0
1919S	19.0 × 19.0	4141N	41.0 × 41.0
312N	22.2 × 22.2	5050N	50.0 × 50.0
2525N	25.0 × 25.0	380N	60.3 × 60.3
351N	25.4 × 25.4	6565N	65.0 × 65.0
3030N	30.0 × 30.0		

RECTANGLES		RECTANGLES	
Section number	Dimension, mm	Section number	Dimension, mm
456N	25.4 × 12.7	5020S	50.0 × 20.0
482N	25.4 × 19.0	5025N	50.0 × 25.0
465N	31.8 × 12.7	473R	50.8 × 22.2
440N	31.8 × 22.2	444N	50.8 × 31.8
3519N	35.0 × 19.0	434R	50.8 × 41.3
446S	38.0 × 25.4	427N	57.0 × 28.6
4020S	40.0 × 20.0	472R	63.5 × 28.6
419N	44.5 × 25.4	7034N	70.0 × 34.0
417S	44.5 × 35.0	7051N	70.0 × 51.0
443N	47.6 × 23.8	449R	76.2 × 38.0
5010S	50.0 × 10.0	436R	76.2 × 44.5

OVALS		FLAT SIDED OVALS	
Section number	Dimension, mm	Section number	Dimension, mm
118	31.8 × 17.5	223	50.8 × 15.9
125	19.0 × 12.7	228	20.6 × 8.7
135	60.8 × 28.6	238	31.8 × 16.0
138	45.0 × 14.5		
111	71.4 × 20.9		
130	111.8 × 19.0		

The standard wall thickness range for ERW non-circular tubes is 0.9 mm to 2.0 mm.

Other thicknesses can be produced outside this range subject to negotiation.

ELECTRIC RESISTANCE WELDED GALVANIZED STEEL TUBE (GALTUBE)

CIRCULAR STEEL TUBE

Outside diameter range 16 mm to 50 mm.

NON CIRCULAR STEEL TUBE

Section number	Dimension, mm	Section number	Dimension, mm
1616	16.0 × 16.0	346S	31.8 × 31.8
1919	19.0 × 19.0	4141N	41.0 × 41.0
351N	25.4 × 25.4	5050N	50.0 × 50.0

TUBEMAKERS OF AUSTRALIA LIMITED, CAST IRON PIPE DIVISION

DUCTILE IRON PIPE – AS 2280, Class K9

Tyton flexible joint

Ductile iron pipe has replaced grey cast iron pipe.

SPECIFICATION

Nom bore, mm	OD mm	Nom wall thick, mm	Unlined		Cement lined		Nominal working pressure MPa *
			ID, mm	Mass per length, kg/5.5 m	ID, mm	Mass per length, kg/5.5 m	
80	95.5	6.0	83.5	68	77.5	83	4
100	121.9	6.1	109.7	91	103.7	111	4
150	177.3	6.3	164.7	138	158.7	167	4
200	232.2	6.4	219.4	188	209.4	232	4
225	259.1	6.6	245.9	217	235.9	267	4
250	286.0	6.8	272.4	246	262.4	302	4
300	345.4	7.2	331.0	314	317.0	408	4
375	426.2	7.9	410.4	436	396.4	552	2.5
450	507.0	8.6	489.8	560	475.8	710	2.5
500	560.3	9.0	542.3	648	528.3	814	2.5
600	667.0	9.9	647.2	849	627.2	1113	2.5

* Working pressure BS CP2010, Part 3-1972. The pipeline internal design pressure should be taken as the greater of the following:

1. the maximum sustained operating pressure (sometimes known as the maximum working pressure) plus surge pressure; or
2. the maximum static pressure plus surge pressure

Works hydraulic proof test pressure – 80-300 mm nom bore 5 MPa
375-600 mm nom bore 4 MPa

BUNDY TUBING COMPANY (AUSTRALIA) PTY LTD

BUNDYWELD TUBING

Copper brazed, double-walled steel tubing, in plain (coppered) finish, alternatively lead/tin alloy coated externally.

Standard Range

Outside diameter, mm	Thickness, mm
4.75	0.51, 0.71
6.35, 7.94, 9.53	0.71, 0.89
12	0.71
12.7	0.71, 0.89

Intermediate tube sizes can be produced by cold drawing. Tooling is available for 3.18, 3.97, 4, 5, 5.56, 7.14, 11.11, 12 mm outside diameters.

Bundyweld for Diesel Fuel Injection Tubing

ASTM A254, SAE J527.

Outside diameter, mm	Inside diameter, mm
Standard sizes 6	1.5, 2.0
Non-Standard 5.5 8, 10	1.5 3.0

DC ELECTRICWELD TUBING

Single-wall steel tubing in bare metal finish, alternatively lead/tin alloy coated externally, to specification SAE J526.

Standard Range

Outside diameter, mm	Thickness, mm
6.35, 7.94	0.71

VINIDEX TUBEMAKERS PTY LIMITED

PVC PIPES AND FITTINGS

Further information
and supplies from:

- Manufacturer and Vinidex Sales Offices in each State.
- Major Building and Hardware Stores and Plumbing Supply Houses.

Pressure Pipes

Standard length – 6 m
Solvent cement joint – nominal size 15 to 300 mm
"Polydex" rubber ring joint – nominal size 50 to 300 mm
Pipes and fittings manufactured to AS 1477

Stormwater Drainage Pipes and Fittings

Sizes available – 90 to 300 mm
Fittings available include –
Elbows, Tees, Reducers, Y Junctions and Downpipe Adaptors
Manufactured to AS 1254

Sewer Pipes and Fittings

Sizes available – 100 to 300 mm
Pipe and Fittings manufactured to AS 1260

Sizes, Classes and Pressure Ratings at 20°C

Nom pipe size	Mean OD, mm	CLASS 4.5 Pressure Rating 45 metre head/0.45 MPa			CLASS 6 Pressure Rating 60 metre head/0.6 MPa			CLASS 9 Pressure Rating 90 metre head/0.9 MPa		
		ID, mm	Wall thick-ness, mm	Mass, kg/m	ID, mm	Wall thick-ness, mm	Mass, kg/m	ID, mm	Wall thick-ness, mm	Mass, kg/m
25	33.5							30.6	1.47	0.220
32	42.2							38.6	1.83	0.344
40	48.3				45.4	1.42	0.313	44.2	2.06	0.443
50	60.4				56.8	1.78	0.484	55.2	2.57	0.692
65	75.4				70.9	2.21	0.746	69.0	3.20	1.07
80	88.9	85.0	1.96	0.796	83.8	2.57	1.04	81.4	3.76	1.49
100	114.3	109.3	2.49	1.31	107.7	3.30	1.71	104.7	4.80	2.46
125	140.2	134.2	3.02	1.95	132.2	4.01	2.57	128.4	5.89	3.71
150	168.3	161.0	3.63	2.81	158.6	4.80	3.68	154.2	7.04	5.32
200	219.1	209.7	4.70	4.76	206.7	6.20	6.23	200.9	9.12	9.01

Sizes, Classes and Pressure Ratings at 20°C

Nom pipe size	Mean OD,	CLASS 12 Pressure Rating 120 metre head/1.2 MPa			CLASS 15 Pressure Rating 150 metre head/1.5 MPa			CLASS 18 Pressure Rating 180 metre head/1.8 MPa		
		ID,	Wall thick-ness,	Mass,	ID,	Wall thick-ness,	Mass,	ID,	Wall thick-ness,	Mass,
	mm	mm	mm	kg/m	mm	mm	kg/m	mm	mm	kg/m
15	21.4				18.3	1.55	0.140	17.9	1.75	0.162
20	26.8	23.7	1.52	0.18	23.0	1.88	0.219	22.3	2.21	0.252
25	33.5	29.7	1.93	0.284	28.9	2.34	0.338	28.1	2.74	0.391
32	42.2	37.5	2.39	0.442	36.4	2.92	0.534	35.4	3.43	0.618
40	48.3	42.8	2.72	0.574	41.6	3.33	0.693	40.4	3.91	0.804
50	60.4	53.6	3.4	0.89	52.1	4.11	1.08	50.6	4.88	1.26
65	75.4	67.0	4.17	1.38	65.1	5.13	1.68	63.2	6.07	1.95
80	88.9	79.1	4.90	1.92	76.8	6.05	2.33	74.6	7.14	2.71
100	114.3	101.8	6.27	3.17	98.8	7.75	3.86	96.0	9.17	4.50
125	140.2	124.9	7.67	4.77	121.3	9.47	5.81	117.5	11.2	6.79
150	168.3	149.9	9.19	6.857	145.5	11.4	8.37	141.4	13.4	9.75
200	219.1	195.3	11.9	11.64	189.5	14.8	14.23	184.2	17.5	16.58

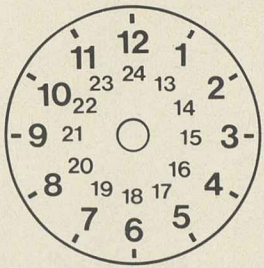
RELATIONSHIP BETWEEN STEEL SHEET AND PLATE METRIC THICKNESSES AND BIRMINGHAM GAUGE (BG)

Inch equiv. to mm	Thickness as inch fraction (nearest)	**Thickness, mm**	BG No (nearest)	Inch equiv. to BG No
0.3937	3/8	**10.0**	0	0.3964
0.3543		**9.0**	1	0.3532
0.3150	5/16	**8.0**	2	0.3147
0.2756		**7.0**	3	0.2804
0.2632	1/4	**6.0**	4	0.2500
0.2165		**5.5**	5	0.2225
0.1969	3/16	**5.0**	6	0.1981
0.1772		**4.5**	7	0.1764
0.1575	5/32	**4.0**	8	0.1570
0.1378		**3.5**	9	0.1398
0.1181	1/8	**3.0**	10	0.1250
0.1102		**2.8**	11	0.1113
0.0984	3/32	**2.5**	12	0.0991
0.0866		**2.2**	13	0.0882
0.0787	5/64	**2.0**	14	0.0785
0.0709		**1.8**	15	0.0699
0.0630	1/16	**1.6**	16	0.0625
0.0551		**1.4**	17	0.0556
0.0472	3/64	**1.2**	18	0.0495
0.0433		**1.1**	19	0.0440
0.0394		**1.0**	20	0.0392
0.0354		**0.90**	21	0.0349
0.0315	1/32	**0.80**	22	0.0313
0.0276		**0.70**	23	0.0278
0.0236		**0.60**	24	0.0248
0.0217		**0.55**	25	0.0220
0.0197		**0.50**	26	0.0196
0.0177		**0.45**	27	0.0175
0.0157	1/64	**0.40**	28	0.0156
0.0138		**0.35**	29	0.0139
0.0118		**0.30**	30	0.0123
0.0110		**0.28**	31	0.0110
0.0098		**0.25**	32	0.0098
0.0087		**0.22**	33	0.0087
0.0079		**0.20**	34	0.0077
0.0071		**0.18**	35	0.0069
0.0063		**0.16**	36	0.0061
0.0055		**0.14**	37	0.0054
0.0047		**0.12**	38	0.0048
0.0043		**0.11**	39	0.0043
0.0039		**0.10**	40	0.0039

24-HOUR CLOCK TIME SYSTEM

Following a world-wide trend, the 24-hour clock system, used by the armed services and other government authorities, is gradually being adopted for increased use, particularly in public transport timetables.

The system, like all systems, is not perfect. There are, for instance, differing opinions on whether 12 midnight should be expressed as 2400 hours or 0000 hours. For practical purposes the detail below is based on the system most likely to be commonly used.



am		pm	
0001	12.01 am	**1201**	12.01 pm
0030	12.30 am	**1230**	12.30 pm
0100	1 am	**1300**	1 pm
0200	2 am	**1400**	2 pm
0300	3 am	**1500**	3 pm
0400	4 am	**1600**	4 pm
0500	5 am	**1700**	5 pm
0600	6 am	**1800**	6 pm
0700	7 am	**1900**	7 pm
0800	8 am	**2000**	8 pm
0900	9 am	**2100**	9 pm
1000	10 am	**2200**	10 pm
1100	11 am	**2300**	11 pm
1145	11.45 am	**2345**	11.45 pm
1200	12 noon	**2400**	12 midnight

Examples:

0542 = 5.42 am 1613 = 4.13 pm 2235 = 10.35 pm

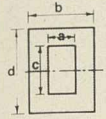
PROPERTIES OF SECTIONS

A = Area of Section

I = Second Moment of Area

r = Radius of Gyration = $\frac{I}{C}$

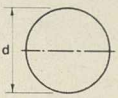
Z = Modulus of Section = $\sqrt{\frac{I}{A}}$



$$A = bd - ac$$

$$I = \frac{bd^3 - ac^3}{12}$$

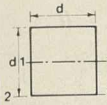
$$r = \sqrt{\frac{bd^3 - ac^3}{12(bd - ac)}}$$



$$A = \frac{\pi d^2}{4} = 0.7854d^2$$

$$I = \frac{\pi d^4}{64} = 0.0491d^4$$

$$r = \frac{d}{4}$$



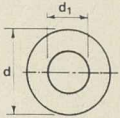
$$A = d^2$$

$$I_1 = \frac{d^4}{12}$$

$$I_2 = \frac{d^4}{3}$$

$$r_1 = 0.2887d$$

$$r_2 = 0.5774d$$

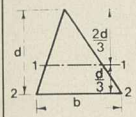


$$A = \frac{\pi(d^2 - d_1^2)}{4}$$

$$I = \frac{\pi(d^4 - d_1^4)}{64}$$

$$= 0.0491(d^4 - d_1^4)$$

$$r = \frac{1}{4}\sqrt{d^2 + d_1^2}$$



$$A = \frac{bd}{2}$$

$$I_1 = \frac{bd^3}{36}$$

$$I_2 = \frac{bd^3}{12}$$

$$r_1 = 0.236d$$

$$r_2 = 0.408d$$

CONVERSION FACTORS

Factors listed are based on Australian Standard 1376 'Conversion Factors' and where not exact have been rounded to six significant figures. Exact values printed in bold type.

To convert from	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	16 387.1
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**

CONVERSION FACTORS (Cont)

Factors listed are based on Australian Standard 1376 'Conversion Factors' and where not exact have been rounded to six significant figures. Exact values printed in bold type.

To convert from	to	multiply by
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 4**
inch	micrometre	**25 400.00**
inch	millimetre	**25.4**
inch mercury	kilopascal	3.386 38
inch water gauge	kilopascal	0.248 642
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 282.481 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**

CONVERSION FACTORS (Cont)

Factors listed are based on Australian Standard 1376 'Conversion Factors' and where not exact have been rounded to six significant figures. Exact values printed in bold type.

To convert from	to	multiply by
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	**6.451 6**
square inch	square millimetre	**645.16**
square mile	square kilometre	2.589 99
square yard	square metre	0.836 127
superficial foot	cubic metre	0.002 360
ton	tonne	1.016 05
ton, freight (40 ft^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 = diameter$^2 \times 0.7854$.
Area of sector of circle = length of arc x half radius.
Area of segment of circle = area of sector, less area of triangle.
Side of square of area equal to circle = 0.8862 diameter of circle.
Diameter of circle equal in area to square = 1.1284 side of square.

Sphere Surface area = 3.1416 x diameter^2.
Volume = 0.5236 diameter^3.

Areas generally.
Square, rectangle, rhombus or thromboid = base x height.
Triangle = half base x perpendicular height.
Trapezoid = half sum of two parallel sides x 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 x length of one side x number of sides.
Parabola = base x height x $\frac{2}{3}$.
Ellipse = long axis x short axis x 0.7854.

Cubes a = length of one side, volume = a^3, surface area = $6a^2$.

Rectangular Prism Volume = area of base x height = bl x h. Total surface area = 2(bl + lh + bh).

Regular Prism Volume = $\frac{1}{2}$n x r x a x h, where n = number of sides, r = radius of inscribed circle, a = length of side.

Cylinder (Right Circular) Volume = 0.7854 x diameter^2 x height. Lateral surface area = 3.1416 x diameter x height. Total surface area = 3.1416 (diameter x height) + 1.5708 diameter^2.

Any Prism or Cylinder Volume = h x area of base. Lateral surface area = length of cylinder x perimeter of normal section.

Regular Pyramid or Cone Volume = $\frac{1}{3}$ (area of base x height). Lateral surface area of regular figure = $\frac{1}{2}$ (perimeter of base x slant height).

Any Pyramid or Cone. Volume = $\frac{1}{3}$ (area of base x distance from vertex to plane of base).

Frustum of any Pyramid or Cone Volume = 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.

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	7.0686	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	59.690	69	3739.3	216.77
20	314.16	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	94.248	80	5026.6	251.33
31	754.77	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	295.31
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	$\sqrt{n}$	$\sqrt[3]{n}$
1	1	1	1.000	1.000
2	4	8	1.414	1.260
3	9	27	1.732	1.442
4	16	64	2.000	1.587
5	25	125	2.236	1.710
6	36	216	2.449	1.817
7	49	343	2.646	1.913
8	64	512	2.828	2.000
9	81	729	3.000	2.080
10	100	1 000	3.162	2.154
11	121	1 331	3.317	2.224
12	144	1 728	3.464	2.289
13	169	2 197	3.606	2.351
14	196	2 744	3.742	2.410
15	225	3 375	3.873	2.466
16	256	4 096	4.000	2.520
17	289	4 913	4 123	2.571
18	324	5 832	4.243	2.621
19	361	6 859	4.359	2.668
20	400	8 000	4.472	2.714
21	441	9 261	4.583	2.759
22	484	10 648	4.690	2.802
23	529	12 167	4.796	2.844
24	576	13 824	4.899	2.884
25	625	15 625	5.000	2.924
26	676	17 576	5.099	2.962
27	729	19 683	5.196	3.000
28	784	21 952	5.292	3.037
29	841	24 389	5.385	3.072
30	900	27 000	5.477	3.107
31	961	29 791	5.568	3.141
32	1 024	32 768	5.657	3.175
33	1 089	35 937	5.745	3.208
34	1 156	39 304	5.831	3.240
35	1 225	42 875	5.916	3.271
36	1 296	46 656	6.000	3.302
37	1 369	50 653	6.083	6.332
38	1 444	54 872	6.164	3.362
39	1 521	59 319	6.245	3.391
40	1 600	64 000	6.325	3.420
41	1 681	68 921	6.403	3.448
42	1 764	74 088	6.481	3.476
43	1 849	79 507	6.557	3.503
44	1 936	85 184	6.633	3.530
45	2 025	91 125	6.708	3.557
46	2 116	97 336	6.782	3.583
47	2 209	103 823	6.856	3.609
48	2 304	110 592	6.928	3.634
49	2 401	117 649	7.000	3.659

n	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$
50	2 500	125 000	7.071	3.684
51	2 601	132 651	7.141	3.708
52	2 704	140 608	7.211	3.733
53	2 809	148 877	7.280	3.756
54	2 916	157 464	7.348	3.780
55	3 025	166 375	7.416	3.803
56	3 136	175 616	7.483	3.826
57	3 249	185 193	7.550	3.849
58	3 364	195 112	7.616	3.871
59	3 481	205 379	7.681	3.893
60	3 600	216 000	7.746	3.915
61	3 721	226 981	7.810	3.936
62	3 844	238 328	7.874	3.958
63	3 969	250 047	7.937	3.979
64	4 096	262 144	8.000	4.000
65	4 225	274 625	8.062	4.021
66	4 356	287 496	8.124	4.041
67	4 489	300 763	8.185	4.062
68	4 624	314 432	8.246	4.082
69	4 761	328 509	8.307	4.102
70	4 900	343 000	8.367	4.121
71	5 041	357 911	8.426	4.141
72	5 184	373 248	8.485	4.160
73	5 329	389 017	8.544	4.179
74	5 476	405 224	8.602	4.198
75	5 625	421 875	8.660	4.217
76	5 776	438 976	8.718	4.236
77	5 929	456 533	8.775	4.254
78	6 084	474 552	8.832	4.273
79	6 241	493 039	8.888	4.291
80	6 400	512 000	8.944	4.309
81	6 561	531 441	9.000	4.327
82	6 724	551 368	9.055	4.344
83	6 889	571 787	9.110	4.362
84	7 056	592 704	9.165	4.380
85	7 225	614 125	9.220	4.397
86	7 396	636 056	9.274	4.414
87	7 569	658 503	9.327	4.431
88	7 744	681 472	9.381	4.448
89	7 921	704 969	9.434	4.465
90	8 100	729 000	9.487	4.481
91	8 281	753 571	9.539	4.498
92	8 464	778 688	9.592	4.514
93	8 649	804 357	9.644	4.531
94	8 836	830 584	9.695	4.547
95	9 025	857 375	9.747	4.563
96	9 216	884 736	9.798	4.579
97	9 409	912 673	9.849	4.595
98	9 604	941 192	9.899	4.610
99	9 801	970 299	9.950	4.626
100	10 000	1 000 000	10.00	4.642

TRIGONOMETRICAL RATIOS

Angle		Chord	Sine	Tangent	Co-tangent	Cosine			
Degrees	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	78
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	0.9659	1.218	1.3090	75
16	0.2793	0.278	0.2756	0.2867	3.4874	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
22	0.3840	0.382	0.3746	0.4040	2.4751	0.9272	1.118	1.1868	68
23	0.4014	0.399	0.3907	0.4245	2.3559	0.9205	1.104	1.1694	67
24	0.4189	0.416	0.4067	0.4452	2.2460	0.9135	1.089	1.1519	66
25	0.4363	0.433	0.4226	0.4663	2.1445	0.9063	1.075	1.1345	65
26	0.4538	0.450	0.4384	0.4877	2.0503	0.8988	1.060	1.1170	64
27	0.4712	0.467	0.4540	0.5095	1.9626	0.8910	1.045	1.0996	63
28	0.4887	0.484	0.4695	0.5317	1.8807	0.8829	1.030	1.0821	62
29	0.5061	0.501	0.4848	0.5543	1.8040	0.8746	1.015	1.0647	61
30	0.5236	0.518	0.5000	0.5774	1.7321	0.8660	1.000	1.0472	60
31	0.5411	0.534	0.5150	0.6009	1.6643	0.8572	0.985	1.0297	59
32	0.5585	0.551	0.5299	0.6249	1.6003	0.8480	0.970	1.0123	58
33	0.5760	0.568	0.5446	0.6494	1.5399	0.8387	0.954	0.9948	57
34	0.5934	0.585	0.5592	0.6745	1.4826	0.8290	0.939	0.9774	56
35	0.6109	0.601	0.5736	0.7002	1.4281	0.8192	0.923	0.9599	55
36	0.6283	0.618	0.5878	0.7265	1.3764	0.8090	0.908	0.9425	54
37	0.6458	0.635	0.6018	0.7536	1.3270	0.7986	0.892	0.9250	53
38	0.6632	0.651	0.6157	0.7813	1.2799	0.7880	0.877	0.9076	52
39	0.6807	0.668	0.6293	0.8098	1.2349	0.7771	0.861	0.8901	51
40	0.6981	0.684	0.6428	0.8391	1.1918	0.7660	0.845	0.8727	50
41	0.7156	0.700	0.6561	0.8693	1.1504	0.7547	0.829	0.8552	49
42	0.7330	0.717	0.6691	0.9004	1.1106	0.7431	0.813	0.8378	48
43	0.7505	0.733	0.6820	0.9325	1.0724	0.7314	0.797	0.8203	47
44	0.7679	0.749	0.6947	0.9657	1.0355	0.7193	0.781	0.8029	46
45°	0.7854	0.765	0.7071	1.0000	1.0000	0.7071	0.765	0.7854	45°
			Cosine	Co-tangent	Tangent	Sine	Chord	Radians	Degrees
								Angle	

TEMPERATURE CONVERSION TABLE

The numbers in BLUE TYPE refer to the temperature either in degrees Celsius or Fahrenheit which it is desired to convert into the other scale. If converting from Fahrenheit degrees to Celsius degrees the equivalent temperature will be found in the left column, while if converting from degrees Celsius to degrees Fahrenheit, the answer will be found in the column on the right.

°C		°F	°C		°F	°C		°F	°C		°F	°C		°F
-40	-40	-40	90.6	195	383	338	640	1184	599	1110	2030	860	1580	2876
-37.2	-35	-31	93.3	200	392	343	650	1202	604	1120	2048	866	1590	2894
-34.4	-30	-22	96.1	205	401	349	660	1220	610	1130	2066	871	1600	2912
-31.7	-25	-13	98.9	210	410	354	670	1238	616	1140	2084	877	1610	2930
-28.9	-20	-4	100	212	413.6	360	680	1256	621	1150	2102	882	1620	2948
-26.1	-15	5	104	220	428	366	690	1274	627	1160	2120	888	1630	2966
-23.3	-10	14	110	230	446	371	700	1292	632	1170	2138	893	1640	2984
-20.6	- 5	23	116	240	464	377	710	1310	638	1180	2156	899	1650	3002
-17.8	0	32	121	250	482	382	720	1328	643	1190	2174	904	1660	3020
-15.0	5	41	127	260	500	388	730	1346	649	1200	2192	910	1670	3038
-12.2	10	50	132	270	518	393	740	1364	654	1210	2210	916	1680	3056
-9.4	15	59	138	280	536	399	750	1382	660	1220	2228	921	1690	3074
-6.7	20	68	143	290	554	404	760	1400	666	1230	2246	927	1700	3092
-3.9	25	77	149	300	572	410	770	1418	671	1240	2264	932	1710	3110
-1.1	30	86	154	310	590	416	780	1436	677	1250	2282	938	1720	3128
1.7	35	95	160	320	608	421	790	1454	682	1260	2300	943	1730	3146
4.4	40	104	166	330	626	427	800	1472	688	1270	2318	949	1740	3164
7.2	45	113	171	340	644	432	810	1490	693	1280	2336	954	1750	3182
10.0	50	122	177	350	662	438	820	1508	699	1290	2354	960	1760	3200
12.8	55	131	182	360	680	443	830	1526	704	1300	2372	966	1770	3218

15.6	60	140	188	370	698	449	840	1544	710	1310	2390	971	1780	3236
18.3	65	149	193	380	716	454	850	1562	716	1320	2408	977	1790	3254
21.1	70	158	199	390	734	460	860	1580	721	1330	2426	982	1800	3272
23.9	75	167	204	400	752	466	870	1598	727	1340	2444	998	1810	3290
26.7	80	176	210	410	770	471	880	1616	732	1350	2462	993	1820	3308
29.4	85	185	216	420	788	477	890	1634	738	1360	2480	999	1830	3326
32.2	90	194	221	430	806	482	900	1652	743	1370	2498	1004	1840	3344
35.0	95	203	227	440	824	488	910	1670	749	1380	2516	1010	1850	3362
37.8	100	212	232	450	842	493	920	1688	754	1390	2534	1016	1860	3380
40.6	105	221	238	460	860	499	930	1706	760	1400	2552	1021	1870	3398
43.3	110	230	243	470	878	504	940	1724	766	1410	2570	1027	1880	3416
46.1	115	239	249	480	896	510	950	1742	771	1420	2588	1032	1890	3434
48.9	120	248	254	490	914	516	960	1760	777	1430	2606	1038	1900	3452
51.7	125	257	260	500	932	521	970	1778	782	1440	2624	1043	1910	3470
54.4	130	266	266	510	950	527	980	1796	788	1450	2642	1049	1920	3488
57.2	135	275	271	520	968	532	990	1814	793	1460	2660	1054	1930	3506
60.0	140	284	277	530	986	538	1000	1832	799	1470	2678	1060	1940	3524
62.8	145	293	282	540	1004	543	1010	1850	804	1480	2696	1066	1950	3542
65.6	150	302	288	550	1022	549	1020	1868	810	1490	2714	1071	1960	3560
68.3	155	311	293	560	1040	554	1030	1886	816	1500	2732	1077	1970	3578
71.1	160	320	299	570	1058	560	1040	1904	821	1510	2750	1082	1980	3596
73.9	165	329	304	580	1076	566	1050	1922	827	1520	2768	1088	1990	3614
76.7	170	338	310	590	1094	571	1060	1940	832	1530	2786	1093	2000	3632
79.4	175	347	316	600	1112	577	1070	1958	838	1540	2804			
82.2	180	356	321	610	1130	582	1080	1976	843	1550	2822			
85.0	185	365	327	620	1148	588	1090	1994	849	1560	2840			
87.8	190	374	332	630	1166	593	1100	2012	854	1570	2858			

$$^{\circ}C = \frac{5}{9}(^{\circ}F - 32)$$

CONVERSION FORMULAE

$$^{\circ}F = \frac{9}{5}\,^{\circ}C + 32$$

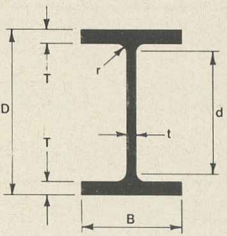
STRUCTURAL STEEL

Structural steels are covered by AS 1204, 'Structural Steels – Ordinary Weldable Grades'. The regular 'normal strength' steel that is widely available from distributors and stockists is Grade 250.

It is produced in a range of shapes and sections, including Universal Sections, Taper Flange Beams, Channels, Equal and Unequal Angles.

The entire range is detailed in AS 1131, 'Dimensions of Hot-Rolled Structural Steel Sections', and includes large and heavy members mostly used only in fully-engineered structures. The tables here list the dimensions of some lighter sections.

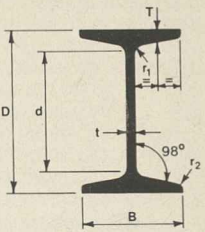
UNIVERSAL SECTIONS



DIMENSIONS

Designation	Mass per unit length, kg/m	Depth of section D, mm	Flange		Web thickness t, mm	Radius root r, mm	Depth between fillets d, mm	Area of section, mm²
			Width B, mm	Thickness T, mm				
410 UB 54	53.7	403	178	10.9	7.6	10.2	361	6840
360 UB 45	44.7	352	171	9.7	6.9	10.2	312	5700
310 UB 40	40.4	304	165	10.2	6.1	8.9	266	5150
250 UB 31	31.4	252	146	8.6	6.1	7.6	219	4000
200 UB 25	25.4	203	133	7.8	5.8	7.6	172	3230
100 UC 15	14.8	97	99	7.0	5.0	10.0	63	1890

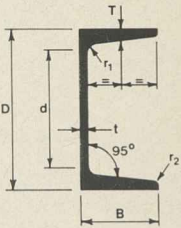
TAPER FLANGE BEAMS



DIMENSIONS

Nominal size, mm	Mass per unit length, kg/m	Depth of section D, mm	Flange		Web thickness t, mm	Radii		Depth between fillets d, mm	Area of section, mm²
			Width B, mm	Thickness T, mm		Root r_1 mm	Toe r_2 mm		
178×89	22	178	89	10.1	6.4	10.4	5.1	134	2850
152×76	18	152	76	9.6	5.8	9.4	4.6	112	2280
127×64	13	127	64	8.8	5.1	8.4	4.1	91	1710
102×45	7	102	44	6.1	4.3	6.9	3.3	75	948

CHANNELS



DIMENSIONS

Nominal size D×B, mm	Mass per unit length, kg/m	Thickness		Centre of area Cy, mm	Area of section, mm	Radii	
		Web t, mm	Flange T, mm			Root r_1 mm	Toe r_2 mm
203×76	24	7.1	11.2	21.3	3040	12	3
178×76	21	6.6	10.3	22.0	2660	12	3
152×76	18	6.4	9.0	22.1	2280	12	2
127×64	15	6.4	9.2	19.4	1900	11	2
102×51	10	6.1	7.6	15.1	1330	9	2
76×38	6.7	5.1	6.8	11.9	855	8	2

Advice on the use of structural steel can be obtained from the Australian Institute of Steel Construction, PO Box 434, Milsons Point, NSW 2061. AISC also publishes a number of books on steel and steel design, including a useful publication for home builders 'How to Use Steel in Homes'. This booklet gives advice in non-technical language on the selection of steel beams, columns, lintels etc in domestic construction. Information on steel beams commonly used in home building has been extracted from the booklet and appears in a condensed form in the next few pages.

Acknowledgement is made of the assistance given by the AISC in the preparation and updating of this section on structural steels, and for use of BHP tabular data.

SAFE LOAD TABLES

The Simplified Beam Load tables list the safe distributed load that can be carried by Universal Sections and Taper Flange Beams when used as simply-supported beams over various spans. In using these tables the following points should be carefully noted.

(i) the tables are for Grade 250 steel.

(ii) loads are given as safe distributed loads, ie spread evenly along the beam, and are expressed in kilonewtons. 1 kilogram imposes a load of 9.81 newtons; 1 tonne imposes a load of 9.81 kilonewtons.

(iii) it is important that beams should be long enough to have adequate support or 'landing'. As a rule-of-thumb, the length of support at each end should be no less than the width of the flange, B.

(iv) beams used as crane runways or for any hoisting purpose are subject to point loads and dynamic loading conditions. **These situations call for special design rules and the tables must NOT be used to select such members.**

(v) the tables are intended to help in selecting beams to span openings in domestic and similar forms of construction where full engineering designs are not warranted. Where there are more complex conditions the services of a structural engineer should be sought.

SIMPLIFIED BEAM LOAD TABLES

(BY COURTESY AISC)

NORMAL STRENGTH STEEL (GRADE 250)

	Designation	Mass per metre, kg	Safe distributed loads in kilonewtons Spans in metres 2	2.5	3	3.5	4	5	6	7	8	Maximum centres of lateral restraints, m*
UNIVERSAL SECTIONS	410 UB 54	53.7	SEE NOTE				315	251	209	158	120	2.42
	360 UB 45	44.7				266	233	185	141	102	77	2.39
	310 UB 40	40.4				219	191	143	98	71	53	2.36
	250 UB 31	31.4		193	160	137	117	74	50	36	27	2.10
	200 UB 25	25.4	158	126	105	81	62	39	26	19		1.97
	100 UC 15	14.8	33	21	14	10	8					1.88
TAPER FLANGE BEAMS	mm											
	178×89	22	115	92	70	51	39	24	16			1.35
	152×76	18	76	58	40	29	22					1.61
	127×64	13	48	30	21	15	11					1.07
	102×45	7	16	10	7							0.70

NOTE – For these short spans the load given to the right of the heavy line should not be exceeded without the advice of an Engineer.

* LATERAL RESTRAINT Beams that directly support floor systems (concrete or timber) and are firmly connected to them can be regarded as being fully laterally restrained. Other beams should have their top flanges restrained laterally at not more than the centres tabulated.

STEEL BEAMS IN HOME BUILDING

Steel beams are commonly used in home building to provide a safe and economic means of spanning wide openings. These condensed notes and tables have been extracted from a booklet 'How to Use Steel in Homes' published by, and obtainable from, the Australian Institute of Steel Construction, PO Box 434, Milsons Point, NSW 2061. For proper use of this information, reference should be made to the supporting data published in the booklet.

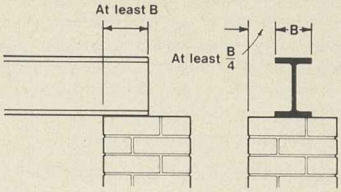
DESIGN LOADS

Loading due to wind is a complex matter which is beyond the scope of this simplified publication, and whenever wind load (especially wind suction) is a consideration the advice of a structural engineer should be sought. Wind load is always an important consideration in roof structures, and may be a critical factor in light sheet roofs, especially those of low pitch. Wind load will not normally be a consideration for floor beams.

In some parts of Australia there may be a need to design for special loading circumstances such as those caused by cyclones, earthquake, mine subsidence, etc. All of these situations require the expertise of a structural engineer.

WARNING – CRANE BEAMS used as crane runways, or for any hoisting purpose, are subject to point loads and dynamic loading conditions. These situations call for special design rules and for detailed analysis. Therefore this method must not be used to select such members.

END SUPPORT



A sufficient area of end support is necessary so that the bearing pressure on the supporting medium is kept within safe limits. As a general rule-of-thumb the support length at each end of the beam should be no less than the width B of the member.

In addition to providing adequate support length, brick piers should project on either side of the bottom flange of the steel beam by a distance at least equal to B/4.

TABLE 1 – SELECTION CODES FOR STEEL BEAM TYPES

Selection code no.	Universal section	Taper flange beam	Rectangular hollow section
	Designation	Nominal size, mm	Size, mm, D x B
1	310 UB 40		
2	250 UB 31		
3	200 UB 25		203 x 152
4		178 x 89	203 x 102
5		152 x 76	152 x 76
6	100 UC 15		127 x 76

Refer to Referee pages as appropriate for further dimensions of Universal Sections, Taper Flange Beams and Rectangular Hollow Sections.

TABLE 2 – STEEL BEAM SELECTION TABLE
(Laterally restrained beams only)
(Selection Code No in coloured type)

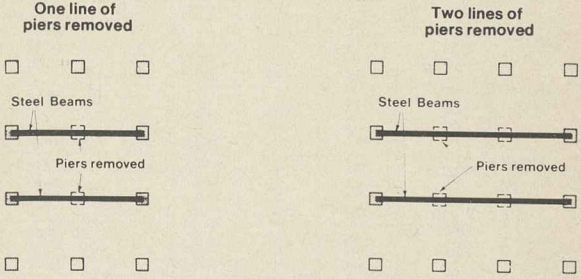
Total super-imposed load	Spacing of beams, m	Span of beams, m			
		3	4	5	6
5 kPa Typical of a domestic concrete floor up to 125 mm thick carrying normal design live load of 1.5 kPa.	2	5	3	2	1
	3	4			
	4		2	1	–
2 kPa Typical of a domestic timber framed floor carrying normal design live load of 1.5 kPa.	2	6	5	4	3
	3	5	4	3	2
	4				
	5		3	2	1
1 kPa Typical of a domestic roof system of mass up to 50 kg/m², plus an allowance of 0.5 kPa for downward wind load and access load. 1 kPa = 1 kN/M²	2	6	6	4	4
	3		5		3
	4				

EXAMPLE OF BEAM SELECTION

It is planned to construct an extra room underneath an existing house by removing some of the brick piers supporting the main floor. These piers are positioned at 1.8 m centres both ways, and the floor is of conventional timber construction. There are no load-bearing partitions on the floor above within the area concerned.

What size of steel beam is need if (a) one line of piers is to be removed (b) two lines of piers are to be removed?

2 kPa loading is typical for conventional timber floor.



One line of piers removed

Span of beam = 2 × 1.8 m = 3.6 m

Spacing of beams = spacing of piers = 1.8 m

From Table 2 read off code number **5** under 4 m span and 2 m spacing – Thus the required section (from Table 1) is:

152 × 76 taper flange beam

alternatively: 152 × 76 × 4.9 rectangular hollow section

Two lines of piers removed

Span of beam = 3 × 1.8 m = 5.4 m

Spacing of beams = spacing of piers = 1.8 m

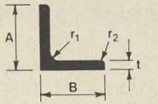
From Table 2 read off code number **3** under 6 m span and 2 m spacing – Thus the required section (from Table 1) is:

200 UB 25 universal beam

alternatively: 203 × 152 × 6.3 rectangular hollow section

EQUAL ANGLES

PROPERTIES AND DIMENSIONS



Nominal size A × B, mm	Thickness t		Radii		Mass per unit length, kg/m	Area of section, mm^2
	Nominal, mm	Actual, mm	Root r_1 mm	Toe r_2 mm		
203 × 203	25	25.3	15.2	4.8	76.0	9680
	22	22.1	15.2	4.8	67.1	8540
	19	18.9	15.2	4.8	57.9	7380
	16	15.8	15.2	4.8	48.7	6200
	13	12.7	15.2	4.8	39.6	5040
152 × 152	19	19.0	12.2	4.8	42.7	5450
	16	15.8	12.2	4.8	36.1	4590
	13	12.6	12.2	4.8	29.1	3700
	10	9.4	12.2	4.8	22.0	2810
127 × 127	16	15.8	10.7	4.8	29.7	3780
	13	12.6	10.7	4.8	24.0	3060
	10	9.5	10.7	4.8	18.3	2330
	8	8.0	10.7	4.8	15.5	1970
102 × 102	13	12.6	9.1	4.8	18.9	2410
	10	9.4	9.1	4.8	14.4	1840
	8	7.8	9.1	4.8	12.1	1540
	6.5	6.4	9.1	4.8	9.88	1260
89 × 89	10	9.4	8.4	4.8	12.5	1590
	8	7.9	8.4	4.8	10.6	1350
	6.5	6.3	8.4	4.8	8.49	1080
76 × 76	10	9.4	7.6	4.8	10.6	1350
	8	7.8	7.6	4.8	8.93	1140
	6.5	6.2	7.6	4.8	7.16	912
	5	4.8	7.6	4.8	5.56	708
64 × 64	10	9.5	6.9	2.4	8.78	1120
	8	7.9	6.9	2.4	7.45	948
	6.5	6.2	6.9	2.4	5.96	759
	5	4.8	6.9	2.4	4.64	591
57 × 57	8	7.8	6.6	2.4	6.55	835
	6.5	6.2	6.6	2.4	5.35	682
	5	4.6	6.6	2.4	4.01	511
51 × 51	8	7.8	6.1	2.4	5.80	739
	6.5	6.3	6.1	2.4	4.77	608
	5	4.6	6.1	2.4	3.58	456
	3	3.2	6.1	2.4	2.50	318
44 × 44	6.5	6.1	5.8	2.4	4.02	512
	5	4.7	5.8	2.4	3.13	399
	3	3.2	5.8	2.4	2.17	277
38 × 38	6.5	6.3	5.3	2.4	3.50	446
	5	4.7	5.3	2.4	2.68	341
	3	3.2	5.3	2.4	1.85	236

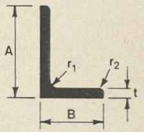
EQUAL ANGLES (Cont)

PROPERTIES AND DIMENSIONS

Nominal size A × B, mm	Thickness t		Radii		Mass per unit length, kg/m	Area of section, mm²
	Nominal, mm	Actual, mm	Root r_1 mm	Toe r_2 mm		
32 × 32	6.5	6.2	5.1	2.4	2.83	361
	5	4.6	5.1	2.4	2.16	275
	3	3.1	5.1	2.4	1.49	190
25 × 25	6.5	6.4	4.6	2.4	2.23	284
	5	4.7	4.6	2.4	1.72	219
	3	3.2	4.6	2.4	1.19	152
Bedstead Angles						
44 × 44	3	3.2	1.5	2.4	2.12	270
38 × 38	3	3.2	1.5	2.4	1.80	230

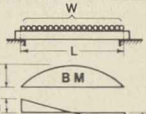
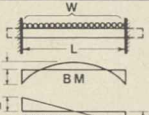
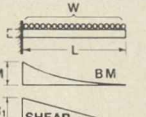
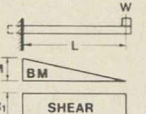
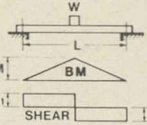
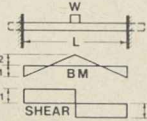
UNEQUAL ANGLES

PROPERTIES AND DIMENSIONS



Nominal size A × B, mm	Thickness t		Radii		Mass per unit length, kg/m	Area of section, mm²
	Nominal, mm	Actual, mm	Root r_1 mm	Toe r_2 mm		
152 x 102	13	12.6	10.7	4.8	24.0	3060
	10	9.5	10.7	4.8	18.3	2330
152 x 89	16	15.7	10.4	4.8	28.0	3570
	13	12.6	10.4	4.8	22.8	2900
	10	9.4	10.4	4.8	17.3	2200
	8	7.8	10.4	4.8	14.4	1840
127 x 26	13	12.6	9.1	4.8	18.9	2410
	10	9.4	9.1	4.8	14.4	1840
	8	7.8	9.1	4.8	12.1	1540
	6.5	6.4	9.1	4.8	9.87	1260
102 x 76	10	9.4	8.4	4.8	12.5	1590
	8	7.9	8.4	4.8	10.6	1350
	6.5	6.4	8.4	4.8	8.59	1090
76 x 51	8	7.9	6.9	2.3	7.45	949
	6.5	6.2	6.9	2.3	5.96	759
	5	4.8	6.9	2.3	4.62	589
64 x 51	8	7.8	6.6	2.3	6.56	835
	6.5	6.2	6.6	2.3	5.36	682
	5	4.6	6.6	2.3	4.01	511

BEAM LOADING

System of Loading	Max B M	Diagram	Shear Reactions	Max Deflection
Uniformly loaded. Ends supported.	$M = \frac{WL}{8}$		$R_1 = \frac{W}{2}$ $R_2 = \frac{W}{2}$	$\frac{WL^3}{76.8EI}$
Uniformly loaded. Ends fixed.	$M_1 = \frac{WL}{12}$ $M_2 = \frac{WL}{24}$		$R_1 = \frac{W}{2}$ $R_2 = \frac{W}{2}$	$\frac{WL^3}{384EI}$
Uniformly loaded. One end fixed, other free.	$M = \frac{WL}{2}$		$R_1 = W$ $R_2 = 0$	$\frac{WL^3}{8EI}$
Load concentrated at free end. One end fixed, other free.	$M = WL$		$R_1 = W$	$\frac{WL^3}{3EI}$
Load concentrated at centre. Ends supported.	$M = \frac{WL}{4}$		$R_1 = \frac{W}{2}$ $R_2 = \frac{W}{2}$	$\frac{WL^3}{48EI}$
Load concentrated at centre. Ends fixed.	$M_1 = \frac{WL}{8}$ $M_2 = \frac{WL}{8}$		$R_1 = \frac{W}{2}$ $R_2 = \frac{W}{2}$	$\frac{WL^3}{192EI}$

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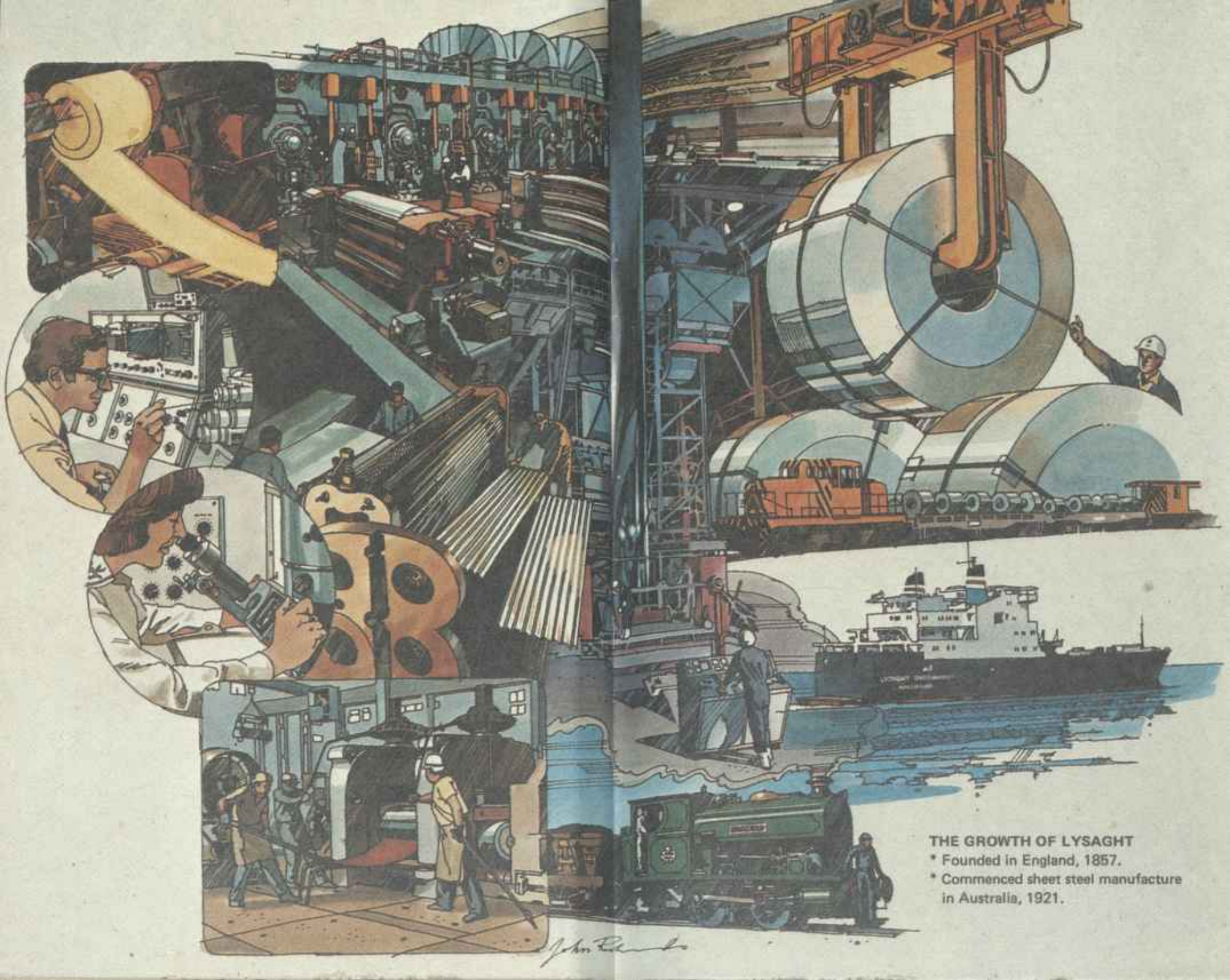

THE GROWTH OF LYSAGHT

* Founded in England, 1857.
* Commenced sheet steel manufacture in Australia, 1921.