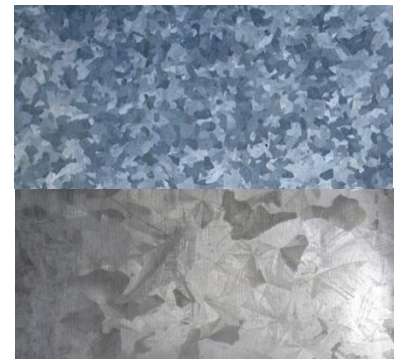


11.0 Procurement of Corrugated Galvanised Iron (CGI) sheeting

Corrugated galvanised iron (CGI) sheets are steel sheet metal that has been continuous-sheet galvanised (although called 'iron' and often referred to as 'tin sheets', they are in fact made of steel). Continuous-sheet galvanising involves running sheets through a bath of molten zinc. The zinc provides a protective layer to prevent the steel sheets rusting. The zinc's crystalline structure typically leaves a distinctive pattern on the surface, called 'spangle'. Continuous-sheet galvanising results in thinner layers of zinc than 'hot-dip galvanising', but does allow high control of thickness.



Characteristic 'spangle' of galvanising.
Images: toasto.com & TextureX-com

Sheets are corrugated to provide stiffness. This allows very thin steel to span between supports, such as roof purlins, without sagging.

Selection of sheets

In selecting the specification of CGI sheets you need to consider:

- **The speed and scale of delivery** required. In emergency situations it may be appropriate to provide sheets of lower cost and quality so that they can be provided quickly to as many people as possible. In this case sheets can be re-used for recovery of durable shelter, but will likely only last a few years.
- **The durability** required. For permanent, lasting construction thicker sheets and thicker galvanising is necessary. The environmental conditions are important in this consideration. Salty coastal air and industrial pollution will significantly increase corrosion and reduce lifespan. To increase durability sheets may also be coated in plastic, or painted.
- **The strength** required. For areas with high wind speeds the thickness of the sheets is important because thinner sheets are likely to be ripped from the roof by high winds. For areas with significant snowfall the thickness is important because snow is heavy and may break thinner sheets. Thinner sheets also require more frequent support from the structure (more purlins and fixings).
- **The cost**, numbers of sheets required per household and numbers of households to be reached.
- **The profile** of the sheets. The larger, or deeper, the corrugations, the stiffer the sheet and the longer it can span between supports and the more weight it can support.

The strength and durability of CGI sheeting depends upon both the thickness of the base steel sheets and the thickness, quality and consistency of the zinc galvanising layer.

The following pages have guidance on selecting an appropriate specification for the sheets and a protocol for quality assurance to ensure you actually receive the correct specification.



Thickness of ungalvanised steel sheets

The thickness of galvanised and ungalvanised steel sheets can be specified in different ways, and different countries use different measures. To avoid confusion, this guidance note uses actual ungalvanised steel thicknesses. These can easily be cross-referenced to tables of different gauges (see annex).

Sheet thickness	Recommended use
Less than 0.32mm	Do not use in any circumstances
0.32mm	Only for emergency use in areas where wind speeds are low and snow fall is low. Can be rolled for easy transportation or carrying. Durability is limited.
0.35 to 0.45mm	Only for emergency use in areas where wind speeds are low and snow fall is low. Durability is limited.
0.45 to 0.60mm	Recommended for use in areas with high wind speeds or snow fall. Suitable for longer-term use.
More than 0.60mm	Very durable sheets suitable for long-term use, but will be expensive and heavy and require additional structure to support. Not recommended for non-engineered buildings.

Thickness of galvanising layer

Weight, gsm	Thickness, mm	Equivalent designations	Likely durability of zinc coating ¹	Notes
120	0.017mm	17µm, 0.7mils, Z120, G78	Inland: < 10 years Coastal or polluted areas: < 5 years	Minimum thickness, only appropriate for emergency response & post-disaster recovery programmes. Below codified standards for external use.
250	0.035	35µm, 1.4mils, Z250, G90	Rural inland : > 50 years Urban inland: 17-50 years Coastal or polluted areas: < 10 years	Appropriate for durable construction in non-corrosive environments. Minimum codified standard.
> 250	> 0.035	-	In highly polluted areas or coastal areas with high salinity this is appropriate for durable construction. If you increase the galvanising above 250gsm you must increase the base steel thickness to greater than 1.5mm to benefit.	

1. From EN ISO 1461:2009 and American Galvanizers Association and Galvanizers Association of Australia guidance.

Typical combinations of sheet and coating thickness

Environment: Situation	Dry or temperate, inland	Temperate coastal or tropical inland	Tropical coastal	Urban, polluted
Emergency, maximum reach, minimum cost	0.35mm with 120gsm coating 0.385mm total, 2.99kg/m ²		0.35mm with 250gsm coating 0.42mm total, 3.25kg/m ²	
Durable, no special loading	0.45mm with 120gsm coating 0.484mm total, 3.77kg/m ²		0.45mm with 250gsm coating 0.52mm total, 4.03kg/m ²	
Durable, high wind or high snow fall	0.50mm with 120gsm coating 0.534mm total, 4.17kg/m ²		0.50mm with 250gsm coating 0.57mm total, 4.43kg/m ²	

NB. Weights are for area of flat sheets.



Profile

Many profiles of CGI are available. The most commonly used in many countries has corrugations that are 76mm wide and 19mm high. This should be the default selection unless there are good reasons for a different profile.

For repairs to existing structures, or if people have already obtained some CGI from other sources, it is important to ensure the profiles match otherwise they cannot be used together.

Use the information above and the CARE CGI weight & thickness calculator spread sheet to choose an appropriate thickness and galvanising thickness.

Quality assurance procedure

The following procedure is recommended for quality assurance:

1. Use the selection information on the previous page, and the CARE CGI Weight & Thickness Calculator spread sheet so you know what weight and thicknesses you require – or pick an appropriate specification from the table of typical combinations.
2. Visit the chosen supplier(s) to take measurements of their sheets and confirm the match the chosen specification. Test one of the sheets as follows:
 - a. Measure the galvanising layer thicknesses using a magnetic gauge to confirm the average thickness of zinc is sufficient.
 - b. Measure the total thickness of the sheets using calipers to confirm it is sufficient.
 - c. Weigh the selected sheet of the correct thickness and dimensions to confirm the total weight. Make sure you weigh exactly the same sheet that you carried out tests a. and b. on.
3. Confirm how the sheets will be packaged and transported and how many sheets will be included per bundle or pallet, and hence calculate the weight of a bundle or pallet.
4. At each delivery select a random sample of sheets for inspection. Perform the tests before accepting the delivery. If possible it is also good practice to test each batch at the point of manufacture before dispatch. (See below for detailed instructions on the tests)
 - a. Weigh the selected sheets, bundles or pallets to confirm they match the specification.
 - b. Perform a visual inspection of the sheets to confirm adequate quality of galvanising.
 - c. Perform an adherence test with a stout knife.

<i>Delivery or batch size</i>	<i>Number of sheets to test</i>
1-3	All
4-500	3
501-1200	5
1201-3200	8
3201-10000	13
10001 +	20



How to assess quality

When procuring CGI sheets there are several ways to assess the quality of the sheets:

- **Visual inspection:** the galvanized coating should be smooth, continuous (without loose flakes) and free from large surface imperfections and inclusions (items or lumps trapped in the galvanising layer). Differences how shiny the sheet is and the colour of galvanized coatings do not significantly affect corrosion resistance and the presence or absence or size of spangle has no effect on coating performance.
- **Adherence test:** Use the point of a stout knife to apply fairly significant pressure to the coating, in a prying manner. The knife may make a small cut or mark in the coating, but if the coating flakes off in front of the knife the adherence is not adequate. Do not do this test at edges or corners, and do not attempt to scrape or whittle the coating off.
- **Magnetic testing of coating thickness:** Magnetic thickness gauges can be used to give coating thickness readings at specific points. Gauges either work by measuring the force needed to pull a magnet off the surface or by measuring the magnetic field (flux density) at the surface. Several readings should be taken so that uniformity as well as average thickness can be checked. Gauges give reliable thickness readings but must be correctly calibrated. Manufacturer's instructions must be followed precisely. Accurate readings cannot be obtained near edges.



Adherence test
Image; American Galvanizers Association

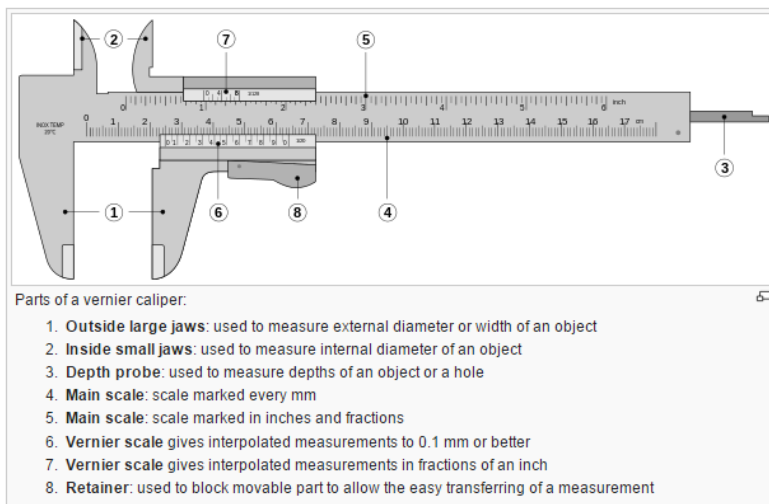


From left to right: pen style magnetic pull-off gauge; banana style magnetic pull-off gauge; digital magnetic induction gauge.

Pencil-style gauges are pocket-sized and portable but less accurate and require skill to use, so are not recommended unless used by experienced personnel. Multiple readings are essential. Banana-style gauges are more accurate and don't require repeated re-calibration. Digital gauges are most accurate and easy to use.

- **Weight:** You can weigh individual sheets or whole bundles or pallets to check that the weight matches with the specified material thicknesses. An accurate spring scale is appropriate for doing this in the field. Ensure you allow for the weight of pallets, ropes, straps or chains used to lift the sheets and scale is correctly calibrated.
- **Physical measurement of overall thickness:** Using accurate Vernier calipers the overall thickness of sheets can be measured. To use calipers you need to know how to read a Vernier Scale.





Vernier Calipers. Image: [Creative Commons 2.5](#): Joaquim Alves Gaspar, modified by ed g2s

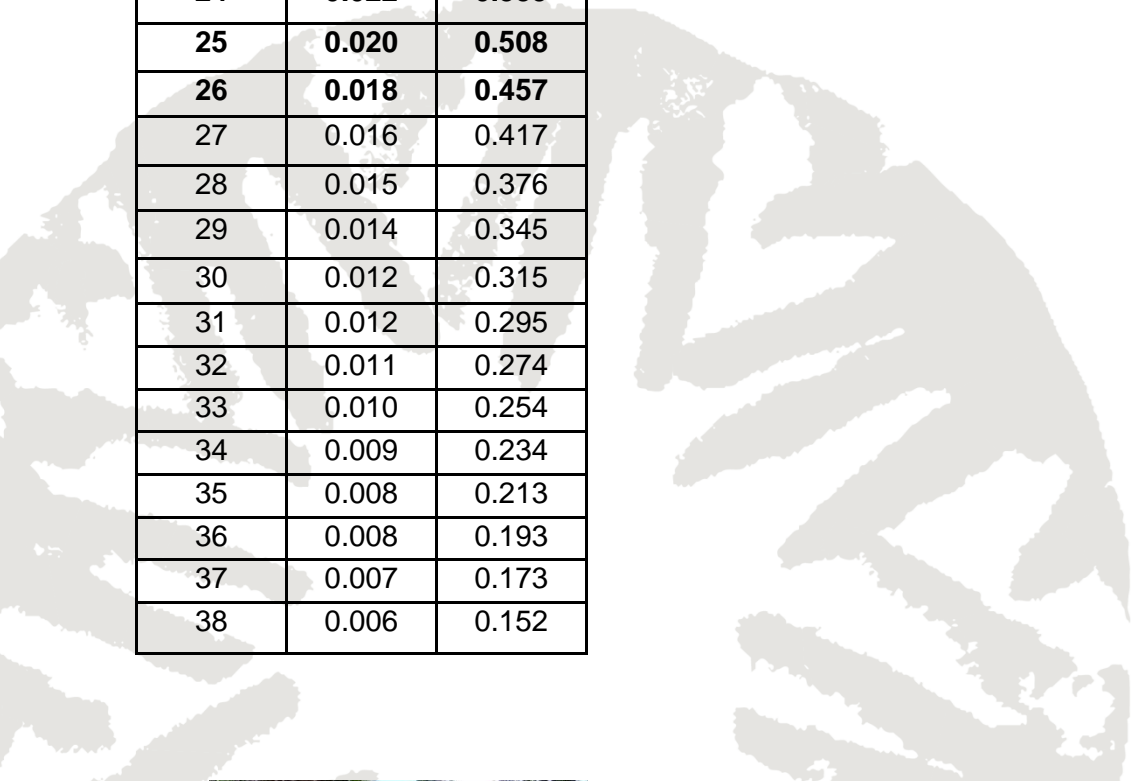


ANNEX: Steel gauges and thicknesses

Historically steel thicknesses were specified by means of a number of different types of ‘gauges’, but this is now being changed to actual measurements in mm in many places. The different measures are:

- Actual thickness, in mm or inches
- Galvanised Steel Gauge (GSG): A gauge of the total thickness of galvanised steel sheets, including both base steel and zinc coating. The higher the gauge, the thinner the sheet. This is the thickness measure traditionally used for galvanised sheeting (and is also used in the IFRC Procurement Catalogue). Modern manufacturing processes allow better control of coating thickness, and thinner coatings, so galvanised steel gauge is not widely used any more.
- Standard Wire Gauge (SWG): A gauge of the thickness of ungalvanised steel. The higher the gauge, the thinner the steel.
- Manufacturer’s Standard Gauge (MSG): identical to the Standard Wire Gauge.
- American Wire Gauge (AWG): An alternative to SWG used in the USA, for ungalvanised steel. The higher the gauge, the thinner the steel.
- Birmingham Wire Gauge (BWG):

Standard Wire Gauge = Manufacturer’s Standard Gauge		
SWG	Inches	mm
20	0.036	0.914
21	0.032	0.813
22	0.028	0.711
23	0.024	0.610
24	0.022	0.559
25	0.020	0.508
26	0.018	0.457
27	0.016	0.417
28	0.015	0.376
29	0.014	0.345
30	0.012	0.315
31	0.012	0.295
32	0.011	0.274
33	0.010	0.254
34	0.009	0.234
35	0.008	0.213
36	0.008	0.193
37	0.007	0.173
38	0.006	0.152



American Wire Gauge		
AWG	Inches	mm
19	0.036	0.912
20	0.032	0.812
21	0.029	0.723
22	0.025	0.644
23	0.023	0.573
24	0.020	0.511
25	0.018	0.455
26	0.016	0.405
27	0.014	0.361
28	0.013	0.321
29	0.011	0.286
30	0.010	0.255
31	0.009	0.227
32	0.008	0.202
33	0.007	0.180
34	0.006	0.160
35	0.006	0.143

