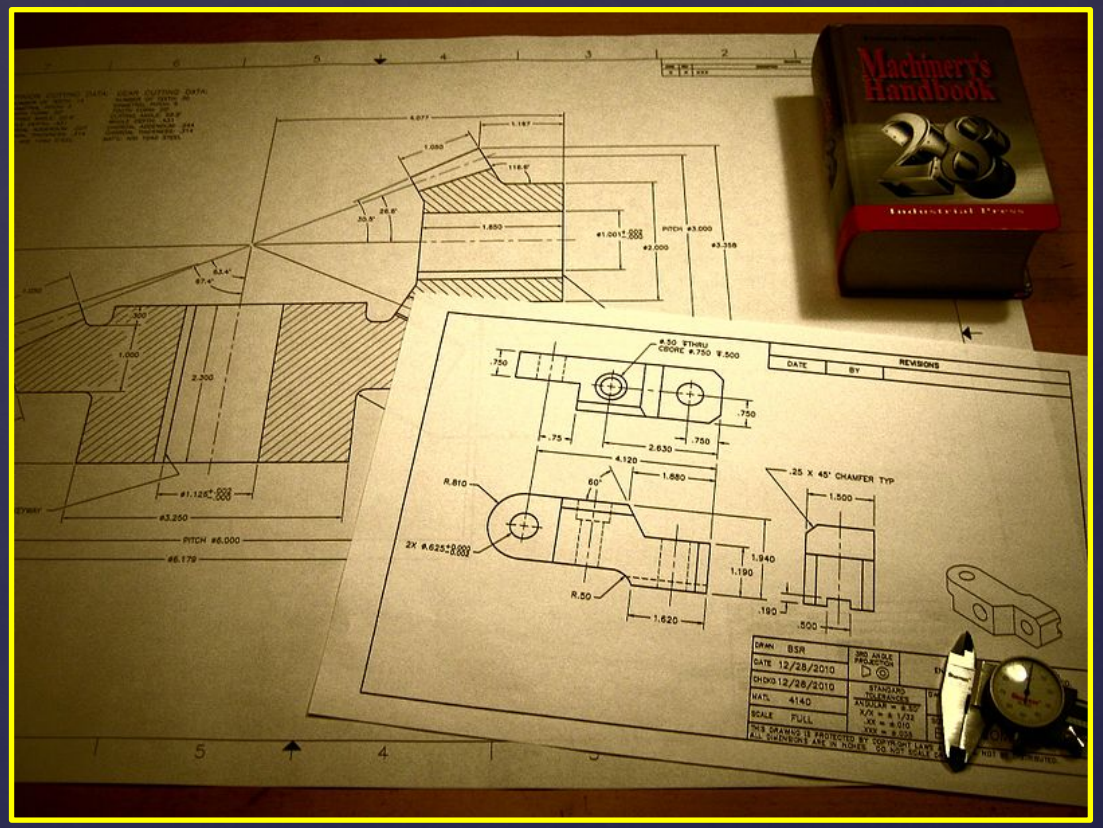
Engineering Drawings: Detail Drawings

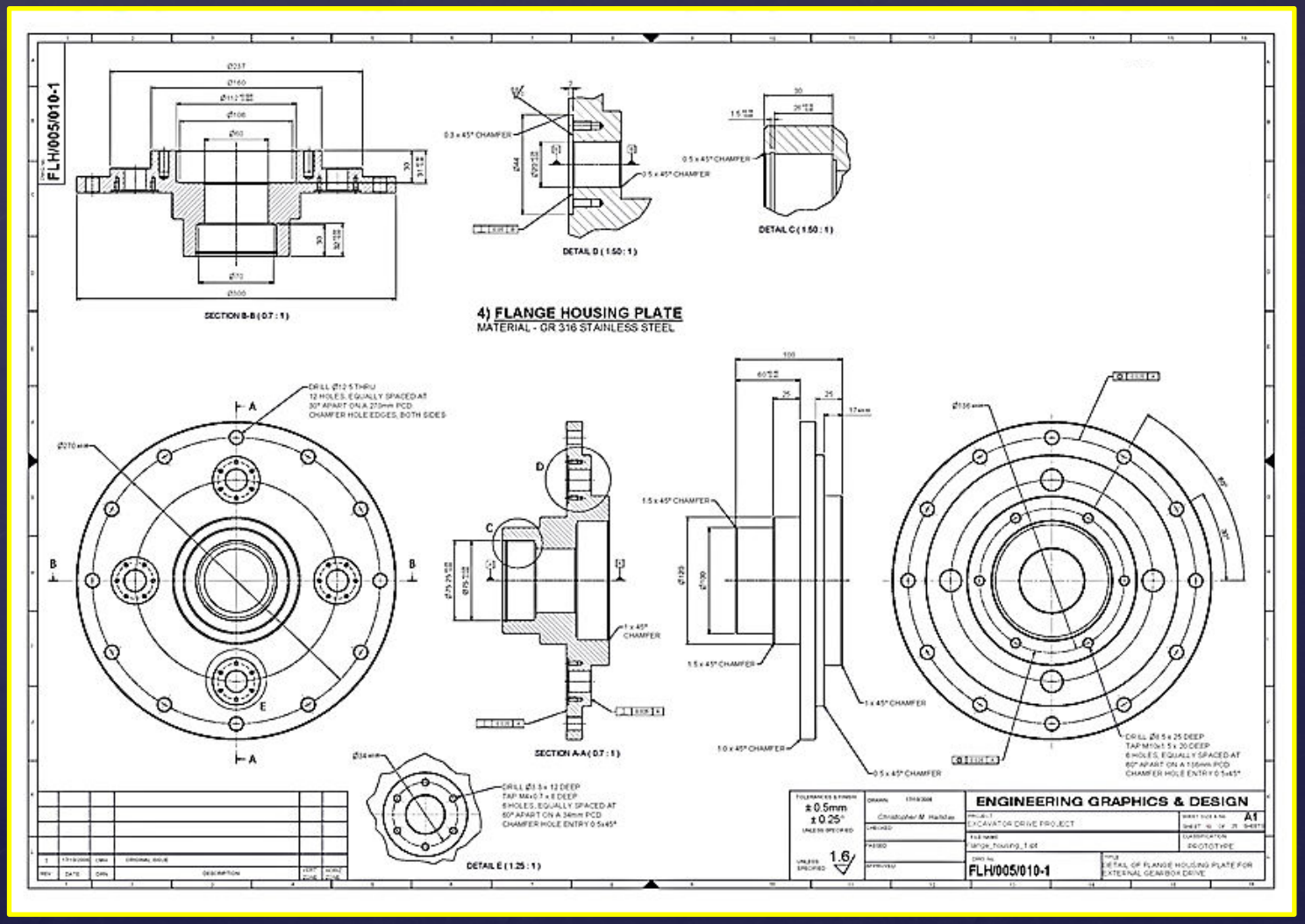


A short lecture on Detail Drawings as per the Australian Standard AS1100

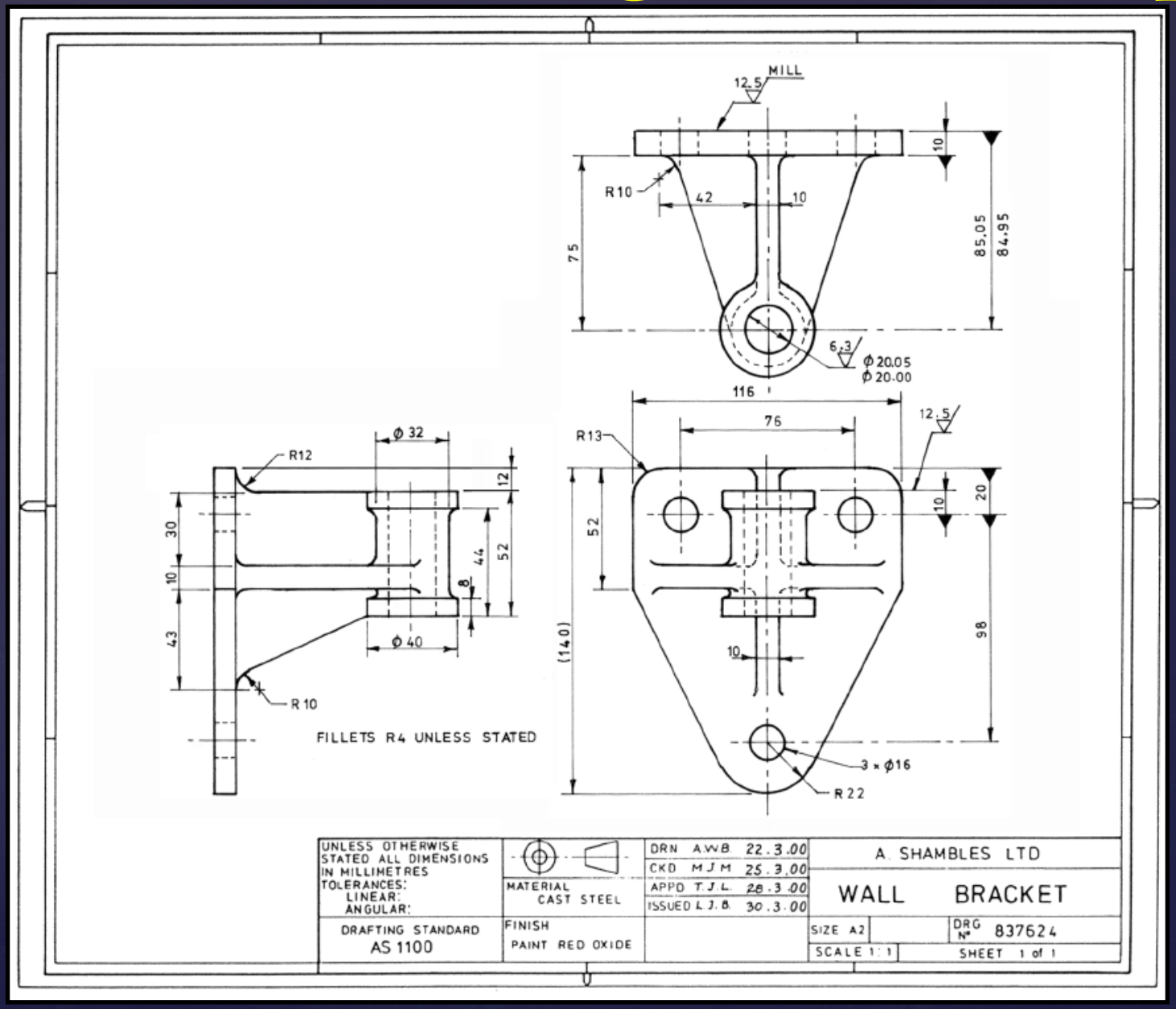
By Paul Briozzo

What is a Detail Drawing ?

An Engineering Detail Drawing contains the key points to enable the manufacture or description of a single component that defines and communicates part of a complete design to other interested parties.



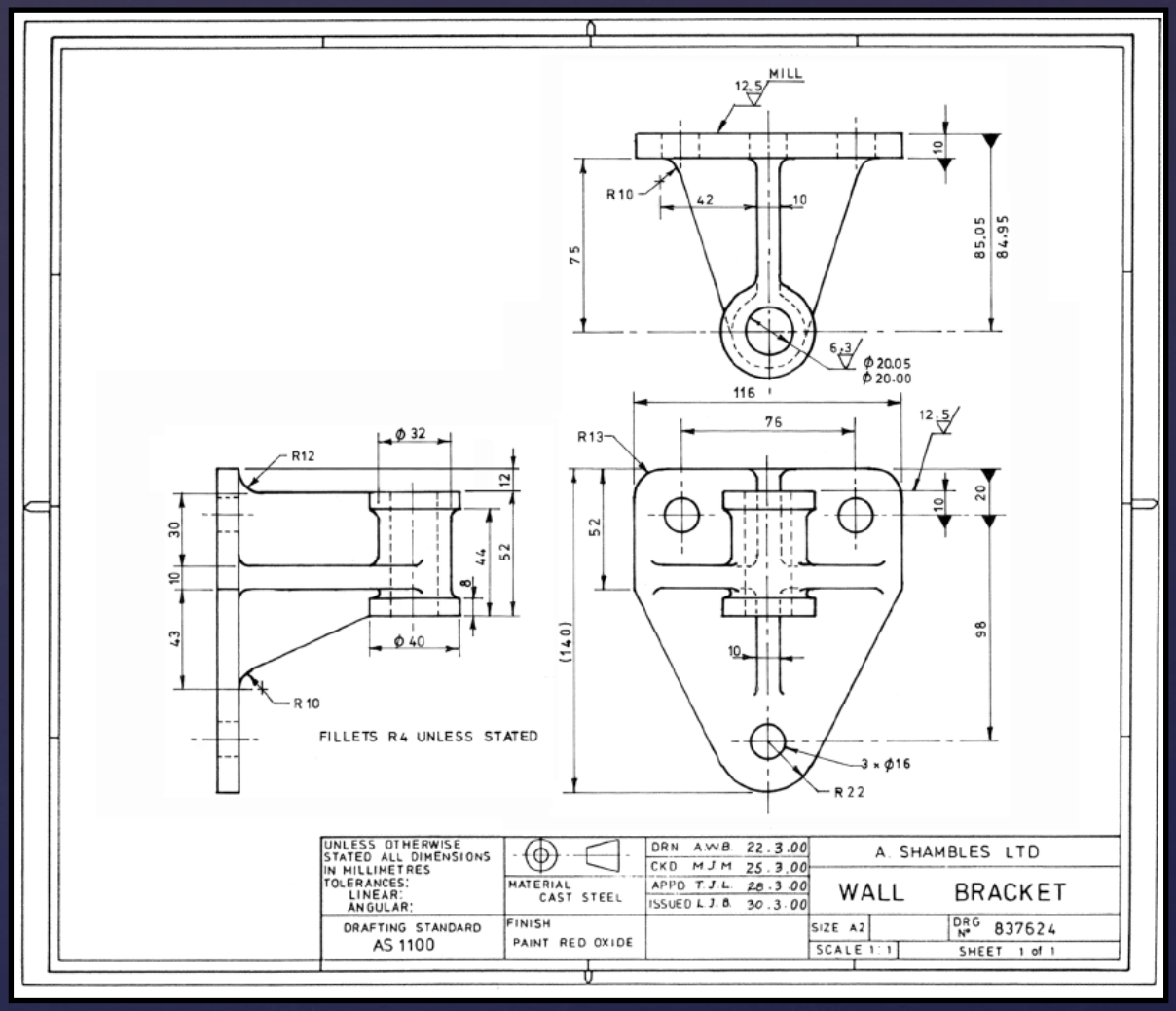
Detail Drawing: An Example



Detail Drawings must provide sufficient information to enable the manufacture a part.

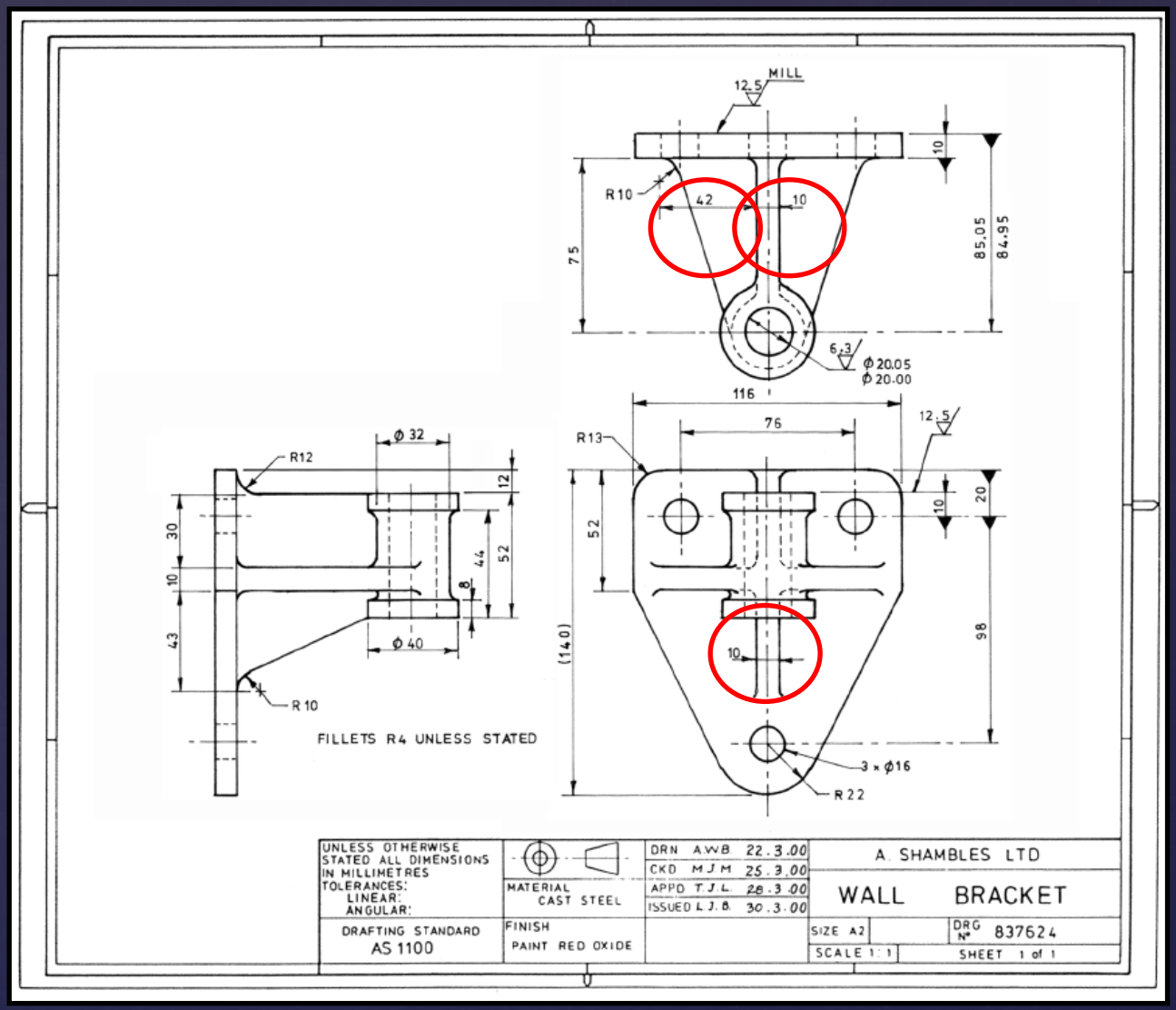
- Enough orthogonal views : enough views to adequate describe the component.
- Dimensions : Must be evenly distributed, structured and not duplicated.
- Scale : Drawing must state the scale used to fit the component onto the drawing sheet.
- The type of projection : Third Angle Projection is mandatory in ENGG1960.
- Drafting Standard (AS1100) : This is effectively covered in prescribed texts.
- The name or title of drawing : What is the name of the component ?
- The drawing number : What is the number (in-house system) of the component ?
- Dimensional units used : mm, m, inches, feet etc.
- Tolerances : What are the manufacturing tolerances for each part of the component.
- Surface texture (or roughness) : How smooth/rough each part of the component has to be.
- Treatments (coatings, tempers etc.) : Does the component need protective coatings ?
- Reference to assembly drawing : What does my component fit into ?
- Material : What material is the component manufactured from ?
- Drafter (who drew it), Checker (who checked it), Approver (who approved it) and dates
- Zones : Where on the drawing are you referring to ?
- Revision : What has been revised and why and what revision is this drawing ?
- Sheet Size : A4, A3, A2, A1 or A0
- Company : School of AMME, University of Sydney
- Sheets Reference (eg. Sheet 1 of 3) : When more than one sheet is required.

Enough Orthogonal Views



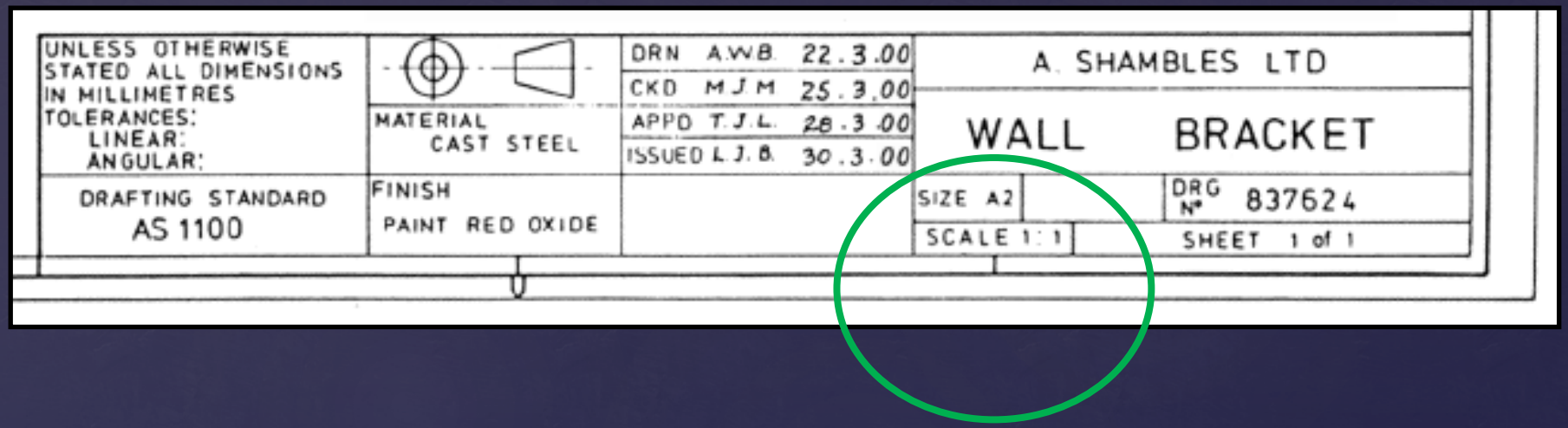
Wall Bracket drawing shows three regular views. Could have been done with two regular views and a sectional view replacing the end elevation.

Dimensions



Wall Bracket drawing shows dimensioning reasonably well located with the exception of the plan view which has three dimensions located within the view.

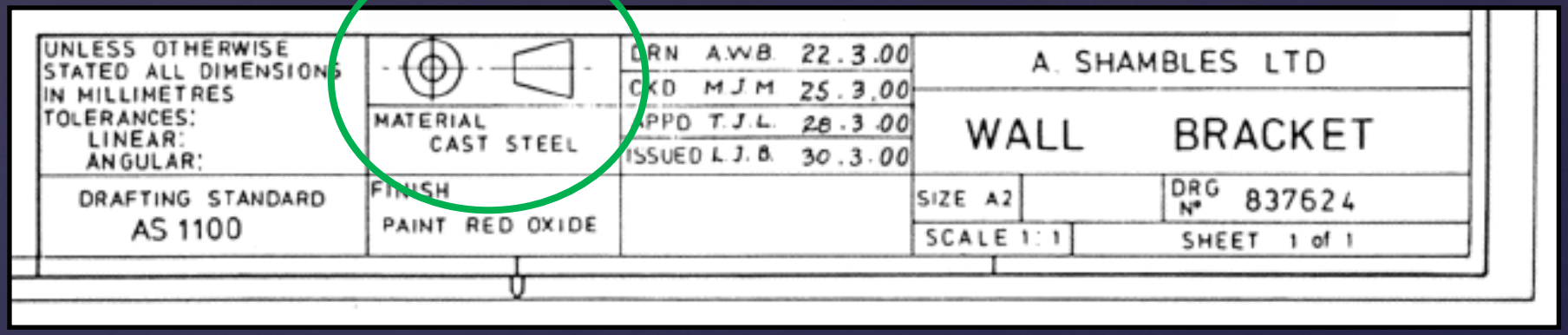
Scale



Wall Bracket drawing shows the scale to which the drawing is drawn within the title block as is required by AS1100. The scale in this case is 1:1 or "Full Size" other preferred scales in the metric system are:

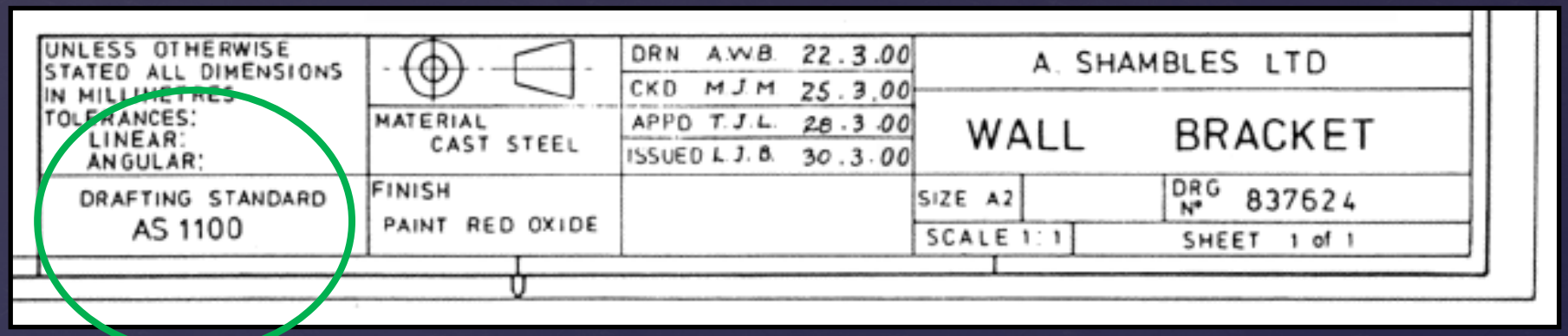
For enlargement: 2:1, 5:1, 10:1, 20:1, 50:1
For reduction: 1:2 (half size), 1:2.5, 1:5, 1:10, 1:20, 1:50,
1:100, 1:200, 1:500
1:1000, 1:2000, 1:5000, 1:10 000

The Type of Projection (3rd Angle)



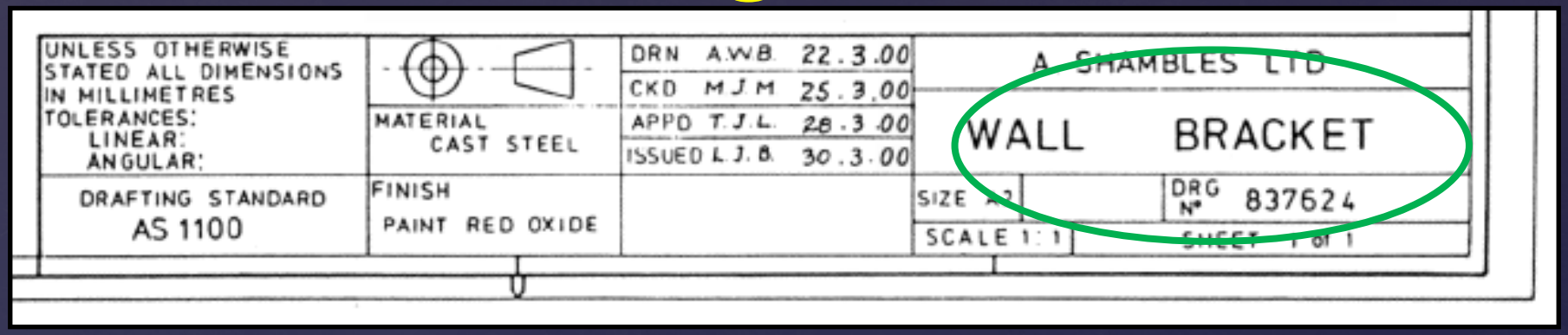
Wall Bracket drawing shows the Third Angle Projection Symbol within the title block. The symbol is sometimes located outside of the title block. The conical cylinder represents the orientation of views that should be reflected in your drawings.

Drafting Standard AS 1100



The Wall Bracket drawing shows the Drafting Standard used within the title block. AS1100 is the drawing standard that is used within Australia. It defines every aspect of the drawing. AS1100 provides a standard that (if followed by all companies), allows for a clarity, understanding and uniformity across all drawings generated nation wide.

Name or Title of Drawing / Drawing Number

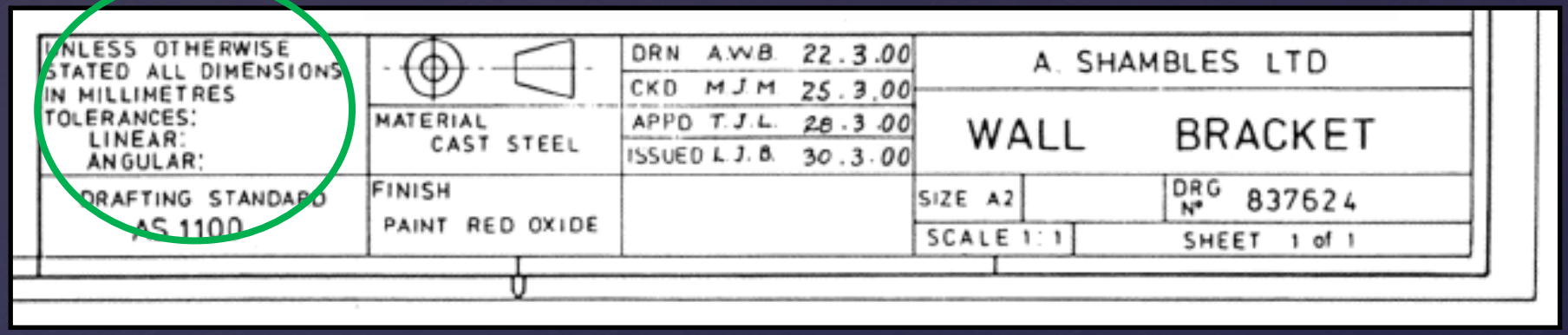


The drawing shows its name, WALL BRACKET within the title block. The name or title of the drawing is the name by which (in this case) the detail drawing is commonly referred to by many parties involved. This name is not unique.

The drawing number (abbreviated to DRG Nº) is the part number which is often used to locate or recognise the part within a database. This number is unique.

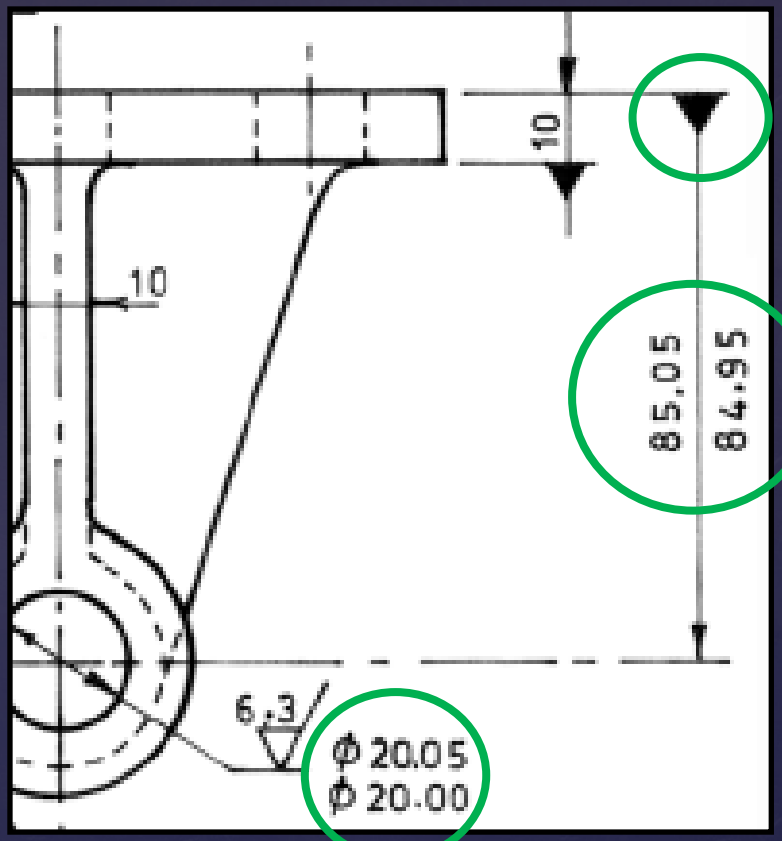
There may be many parts that are named “WALL BRACKET”. However, the number of the drawing must be unique.

Dimensional Units Used



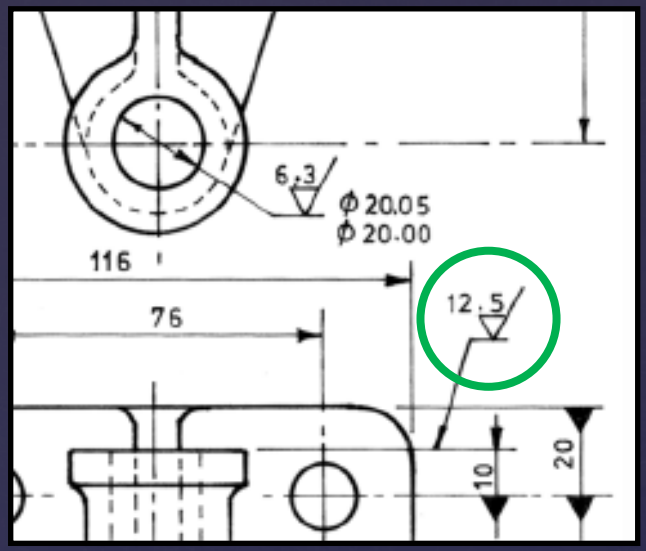
The units used throughout the drawing. In this case millimetres are used. However other metric or imperial units may be used. E.g. microns, metres, inches or feet. Centimeters are not used in Engineering Drawings.

Tolerances

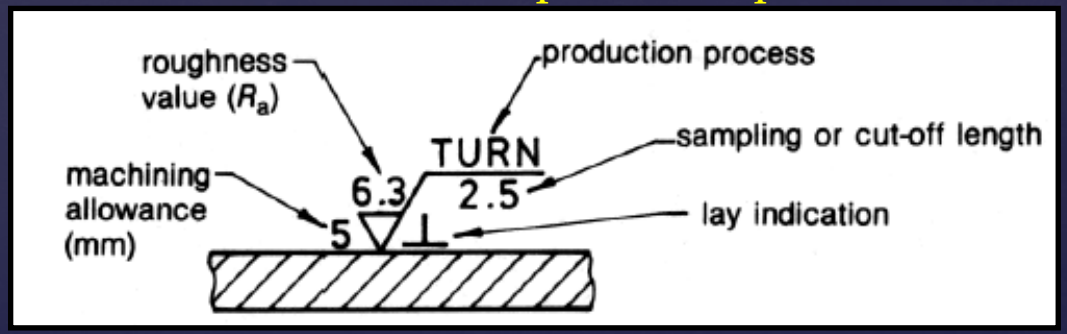


Tolerance can be defined as the difference between the maximum and minimum limits of size. In this view, two tolerances are shown. One tolerance can be seen from the back of the Wall Bracket to the centre of the hole. The black triangle on the end of the dimension line infers that this is a datum surface. The other tolerance refers to the hole diameter.

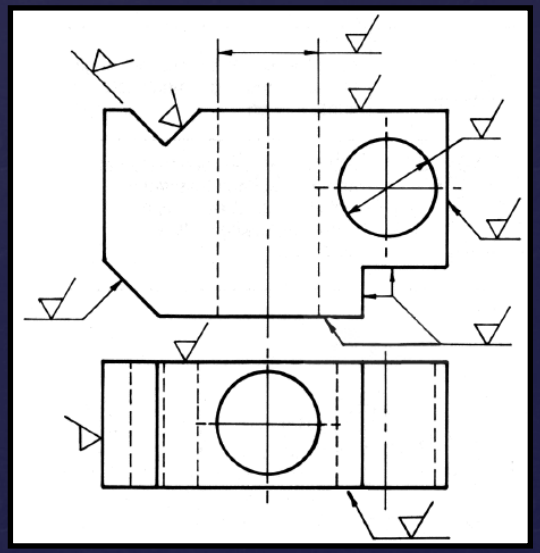
Surface Texture or Roughness



Symbols which indicate the surface texture of roughness that a component or a particular feature of a component requires must be inserted.



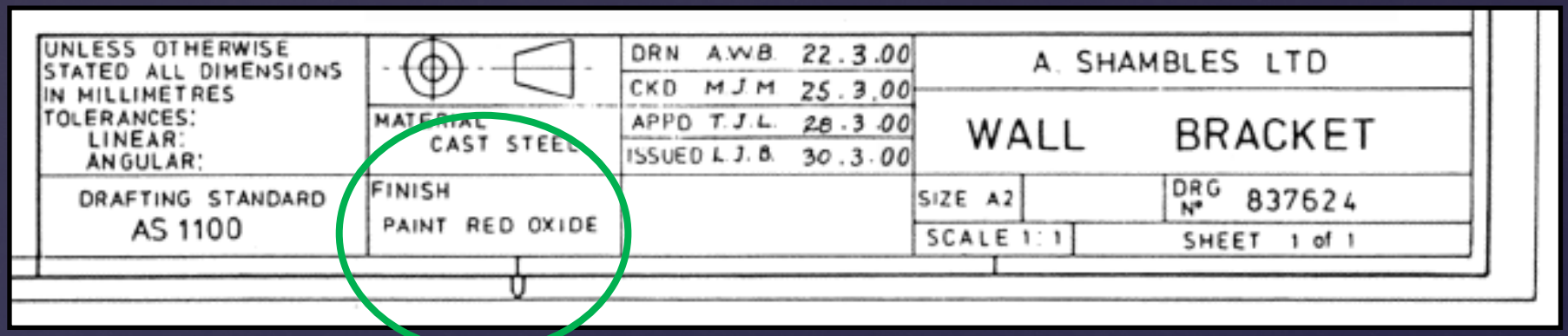
The surface texture symbol should be located so that it can be read from the bottom or right hand side of the drawing.



Standard Roughness Values

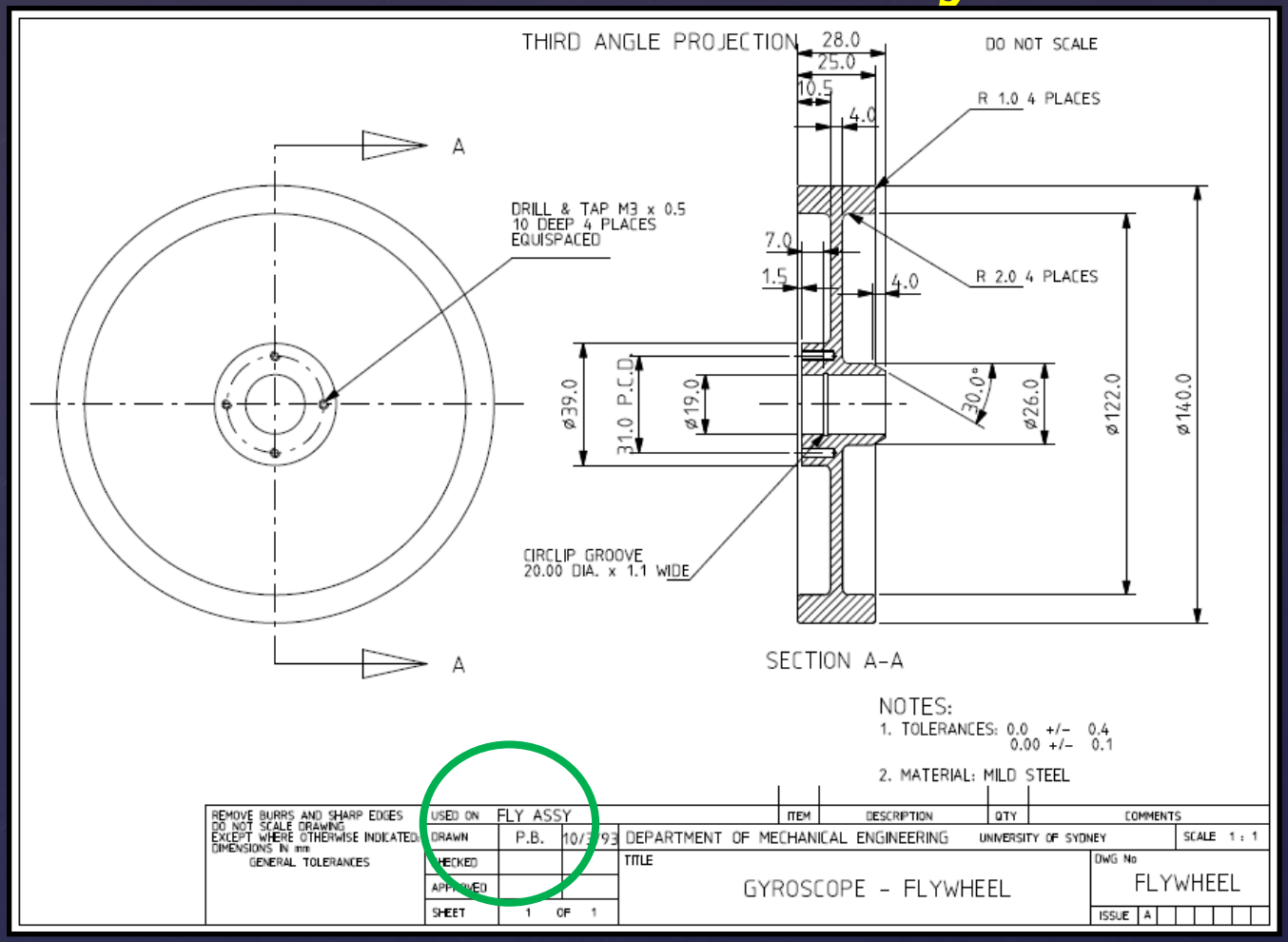
R_a VALUE (µm)		PROCESS AND APPLICATION
0.025 or 0.025 and 0.05 or 0.05	very fine quality surface finishes, costly to produce	This very smoothly finished surface is produced by fine honing, lapping, buffing or super-finishing machines. It is costly to produce and seldom required. It has a highly polished appearance, depending on the production process, and is normally used on precision instruments such as gauges, laboratory equipment and finely made tools.
0.1 or 0.1		This is similar to the finer grades of finish and has much the same application. Very refined surfaces have this high degree of finish. It is produced by honing, lapping and buffing methods and is costly to produce.
0.2 or 0.2		This fine surface is produced by honing, lapping and buffing methods. This texture could be specified on precision gauge and instrument work, and on high speed shafts and bearings where lubrication is not dependable.
0.4 or 0.4		This fine quality surface can be produced by precision cylindrical grinding, coarse honing, buffing and lapping methods. It is used on high speed shafts, heavily loaded bearings and other applications where smoothness is desirable for the proper functioning of a part.
0.8 or 0.8	medium quality finishes, used where reasonable surfaces are required	This first-class machine finish can be easily produced on cylindrical, surface and centreless grinders but requires great care on lathes and milling machines. It is satisfactory for bearings and shafts carrying light loads and running at medium to slow speeds. It may be used on parts where stress concentration is present. It is the finest finish that it is economical to produce; below this costs rise rapidly.
1.6 or 1.6		This good machine finish can be maintained on production lathes and milling machines using sharp tools, fine feeds and high cutting speeds. It is used when close fits are required but is unsuitable for fast rotating members. It may be used as a bearing surface when motion is slow and loads are light. This surface can be achieved on extrusions, rolled surfaces, die castings and permanent mould castings in controlled production.
3.2 or 3.2		This medium commercial finish is easily produced on lathes, milling machines and shapers. A finish commonly used in general engineering machining operations, it is economical to produce and of reasonable appearance. It is the roughest finish recommended for parts subjected to slow speeds, light loads, vibration and high stress, but it should not be used for fast rotating shafts. This finish may also be found on die castings, extrusions, permanent mould castings and rolled surfaces.
6.3 or 6.3	rough finishes, used where quality surfaces are unimportant	This coarse production finish is obtained by taking coarse feeds on lathes, millers, shapers, boring and drilling machines. It is acceptable when tool marks have no bearing on performance or quality. This texture can also be found on the surfaces of metal moulded castings, forgings, extruded and rolled surfaces, and can be produced by rough hand filing or disc grinding.
12.5 or 12.5		This surface is produced from heavy cuts and coarse feeds by milling, turning, shaping, boring, disc grinding and snagging. It can also be obtained by sand casting, saw cutting, chipping, rough forging and oxy cutting. This finish is rarely specified and is used only where it is not seen or its appearance is unimportant, e.g. on machinery, jigs and fixtures.
25		This very rough finish is produced by sand casting, torch and saw cutting, chipping and rough forgings. Machining operations are not required as this finish is suitable as found, e.g. on large machinery.

Surface Treatments (coatings, tempers etc.)



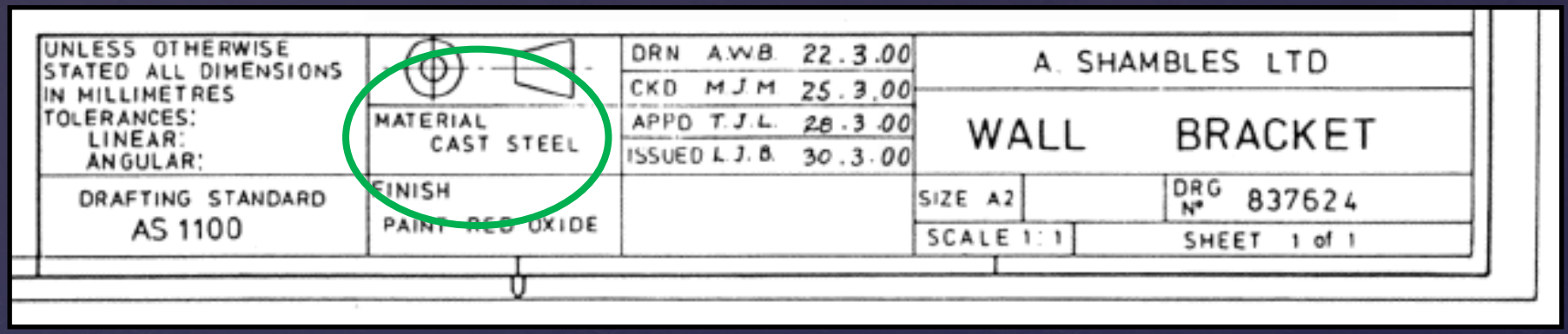
The treatment or coating that the component is finished to is stated in the title block. If the process is a company or military standard that is often followed e.g. the aircraft industry, NASA, The Australian Army, then reference to a standard data sheet is made.

Reference to Assembly Drawings



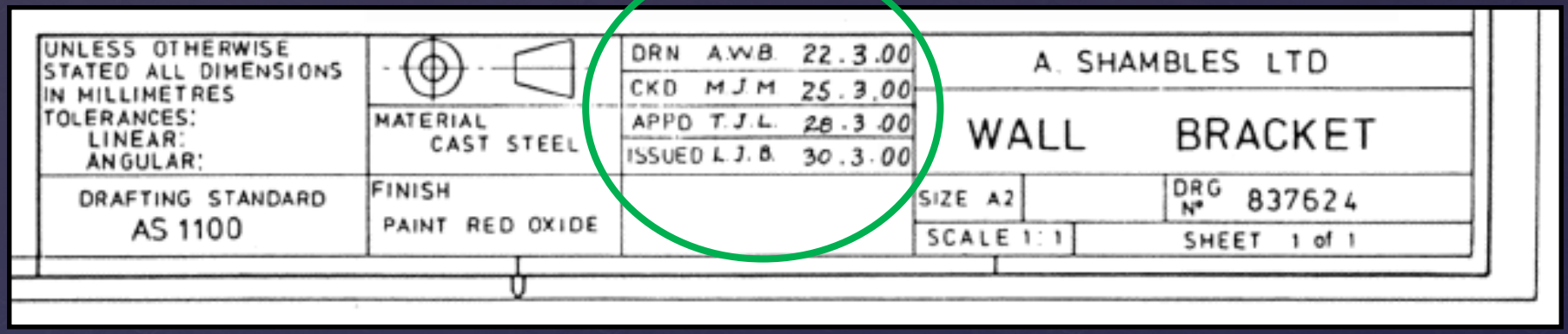
Detail drawings seldom describe the intent of an engineering design. An engineering design is usually defined by many individual detail drawings which combine to form an assembly drawing. The name and or drawing number of the assembly drawing in which the detail drawing is “called up” or “used on” is stated in the title block.

Material



Engineering designs are highly dependant on the material from which they are manufactured. Clearly this is something that must be stated in the drawing as it vital information that must be passed on to the manufacturer of the part and many other parties. This information is normally stated in the title block. If the information is extensive a separate note located in the drawing or a separate data sheet may be used.

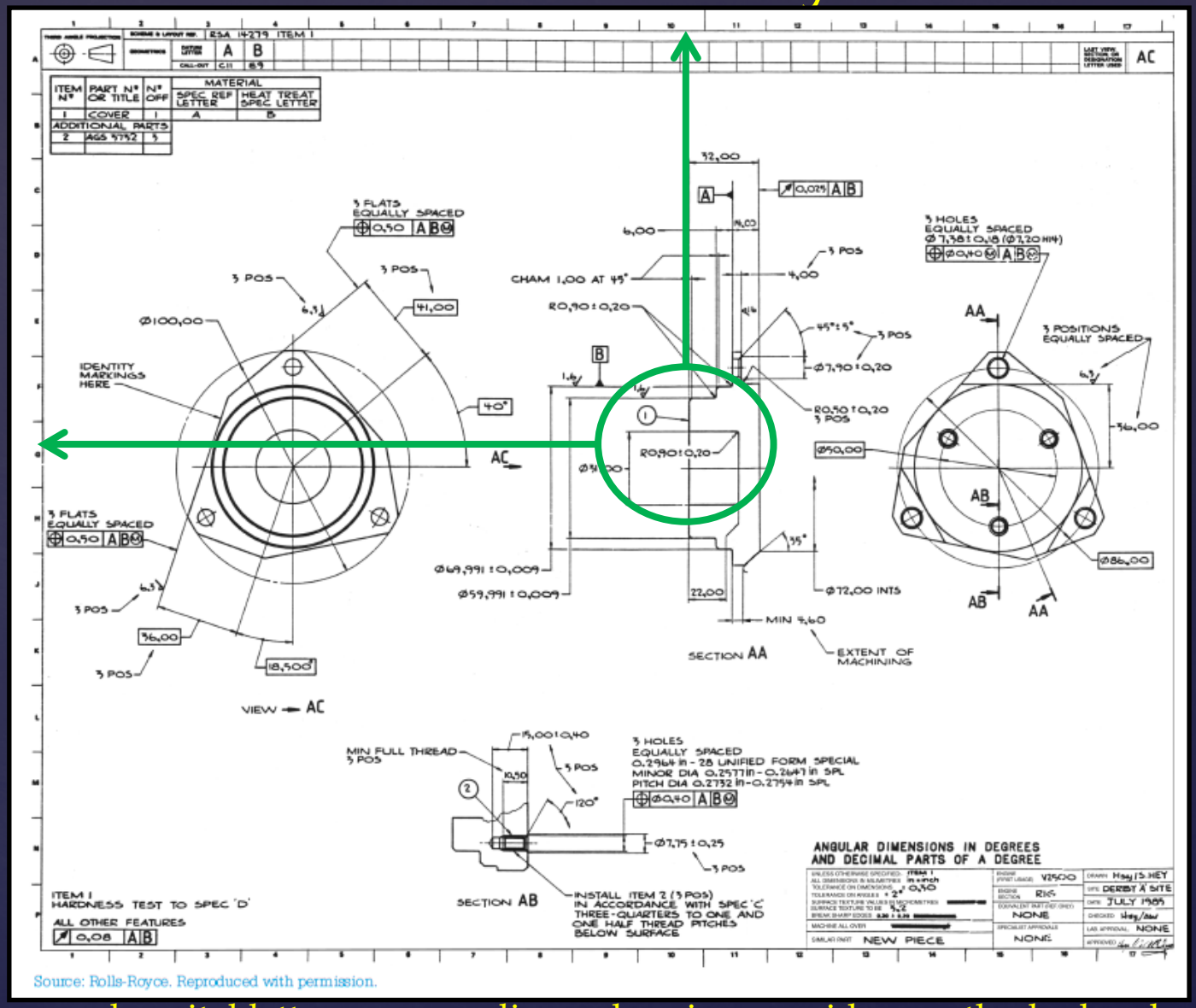
Names and Dates



Engineering designs are the work of many people within an organisation. The initials or names indicate who was responsible for the various duties. In the above title block, DRN indicate who was responsible for drafting the drawing. The initials CKD indicate who checked the drawing. Usually this task is completed by a highly experienced drafter or the chief drafter in a drawing office. The initials APPD indicate who approved the drawing. This signatory is usually the project engineer who overseas the entire project. The title "ISSUED" is the final approval which would be signed off by a senior or chief engineer.

These signatures carry responsibilities and dictate accountability.

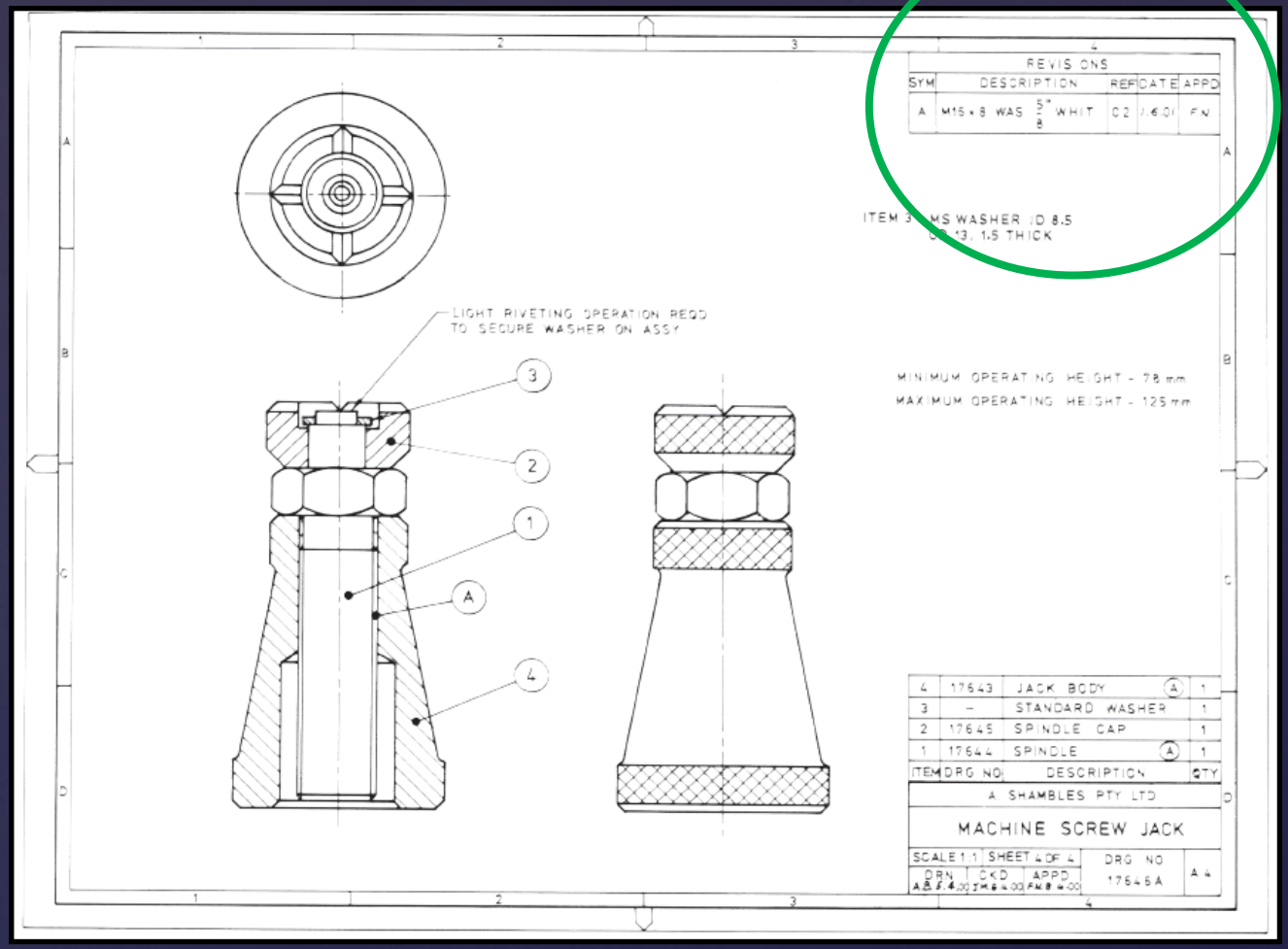
Zone Reference System



Source: Rolls-Royce. Reproduced with permission.

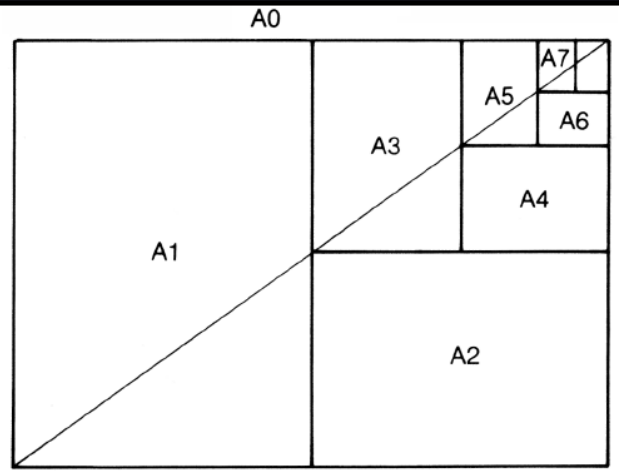
The numbers and capital letters surrounding a drawing provide a method whereby two people may discuss (perhaps over a telephone call) a particular feature on a drawing. This is most useful on large format sheets such as A0 and A1 sizes.

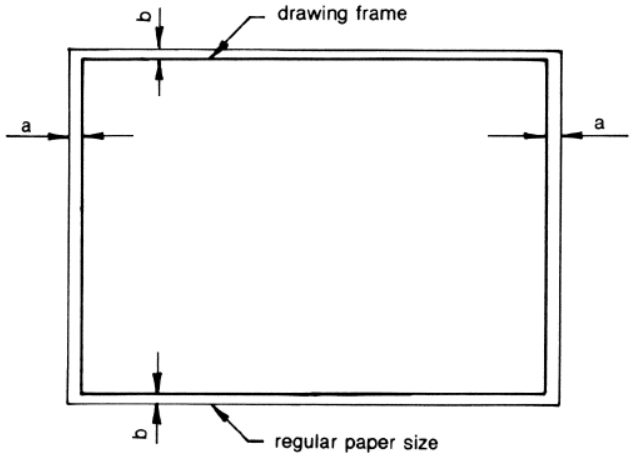
Revisions or Modifications



Revisions to designs may occur due to design development, manufacturing process refinement or the removal of errors. These changes require revisions to all of the drawings affected. In the drawing above, a revision is noted regarding the change of thread from 5/8" Whitworth to M16 Metric. There is usually more documentation associated with these changes than is noted in this example.

Drawing Sheet Sizes



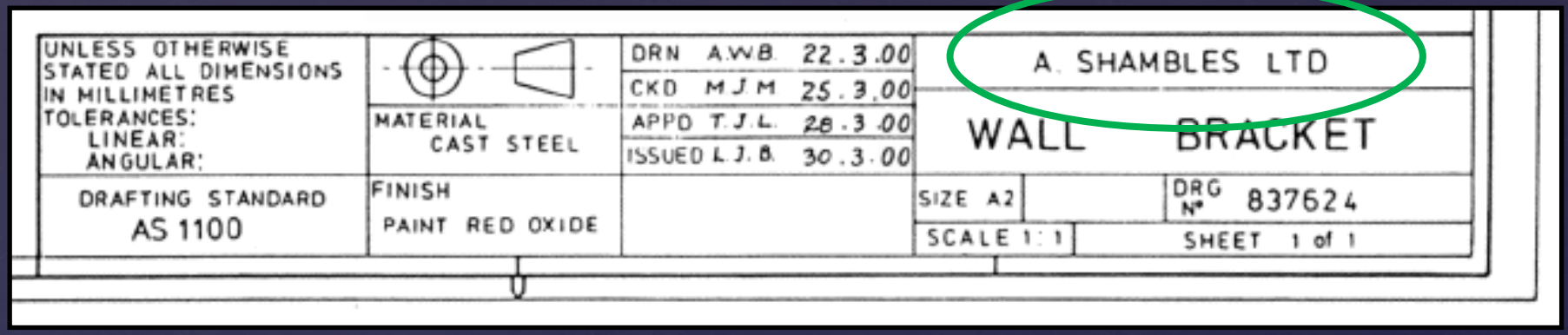


PAPER SIZE	BORDER WIDTH (mm)		DIMENSIONS OF DRAWING SHEETS (mm)
	BOTH SIDES	TOP AND BOTTOM	
	A	B	
A0	20	20	1189 × 841
A1	20	20	841 × 594
A2	10	10	594 × 420
A3	10	10	420 × 297
A4	10	10	297 × 210

Note: 1. The sides of the metric drawing paper sheets are in the ratio of 1: 2. Area of the A0 size sheet = 1 m^2.
2. If a filing margin is required, usually on the left hand side of the sheet, the dimension 'a' on the left is increased by 10 mm.

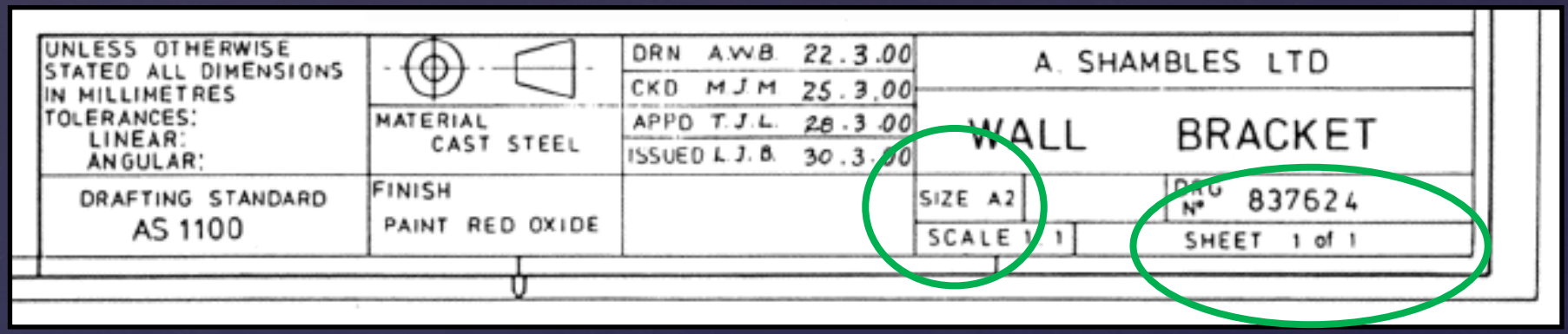
From AS1100 Part 101, the preferred paper sizes are A0, A1, A2, A3 and A4. An A0 sheet has 1m^2 of drawing area available. Subsequent sheet sizes are simply half values of their predecessor. In this subject, A4 and A3 are the two sizes that we will be dealing with as these are two sizes that we have printing facilities for.

Name of Company or Organisation



In the example above, the Company that owns the rights to the drawing is "A. Shambles Ltd." In your work within this subject, the organisation should be noted as "The School of AMME, University of Sydney – ENGG1960"

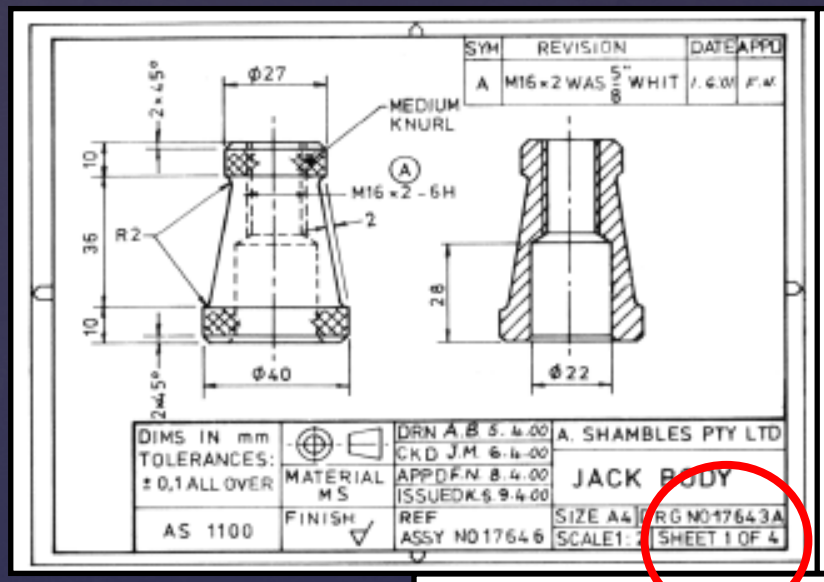
Drawing Sheet Reference

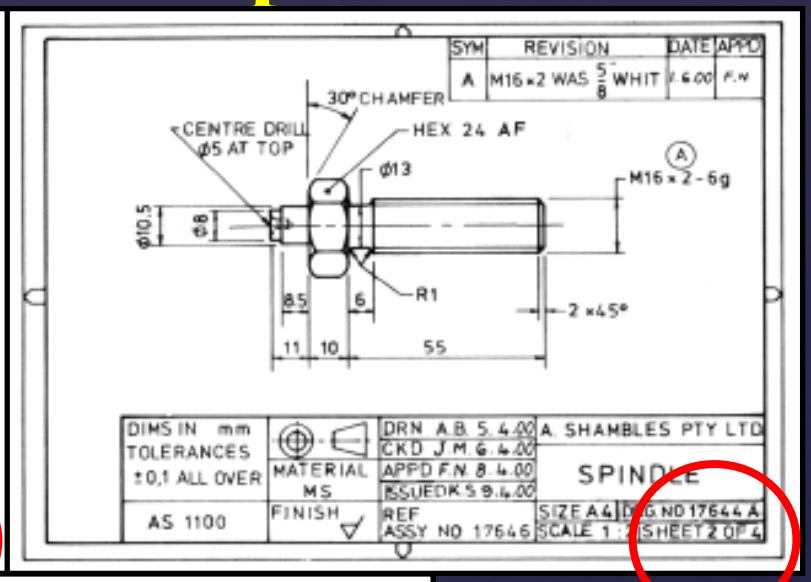


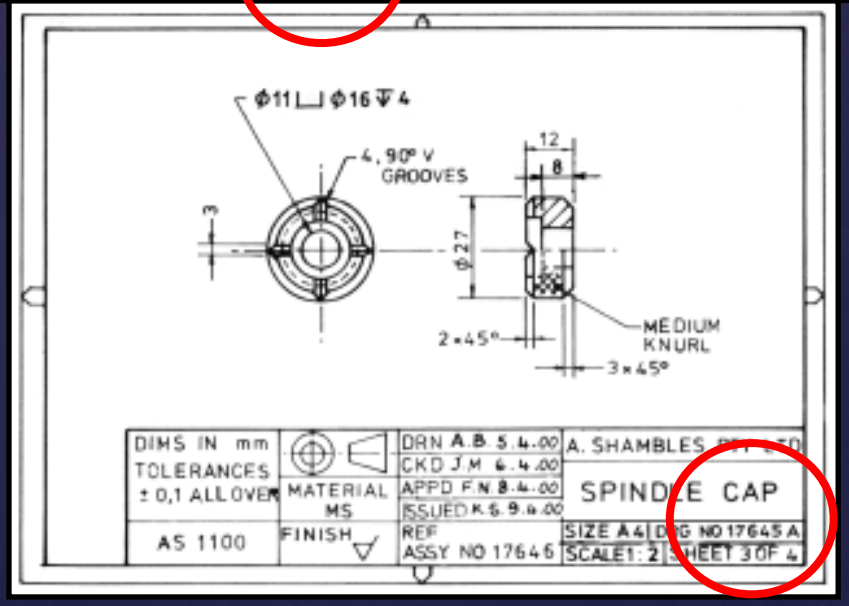
Many detail designs require multiple sheets to adequately define their content. Multiple views, auxiliary views, sections, extensive title blocks and notes may require more space than is available on a single sheet. If this is the case, then multiple sheets may be used. In the example above please note that this is, “SHEET 1 of 1” i.e. only one sheet is required to adequately define the detail design on a single sheet of A2 .

A multiple sheet drawing (or assembly) must have all drawing sheets quoting the same drawing number and name.
A multiple sheet drawing (or assembly) must be referenced sequentially i.e. SHEET 1 of 3, SHEET 2 of 3, SHEET 3 of 3 etc.

Drawing Sheet Reference (a bad example)

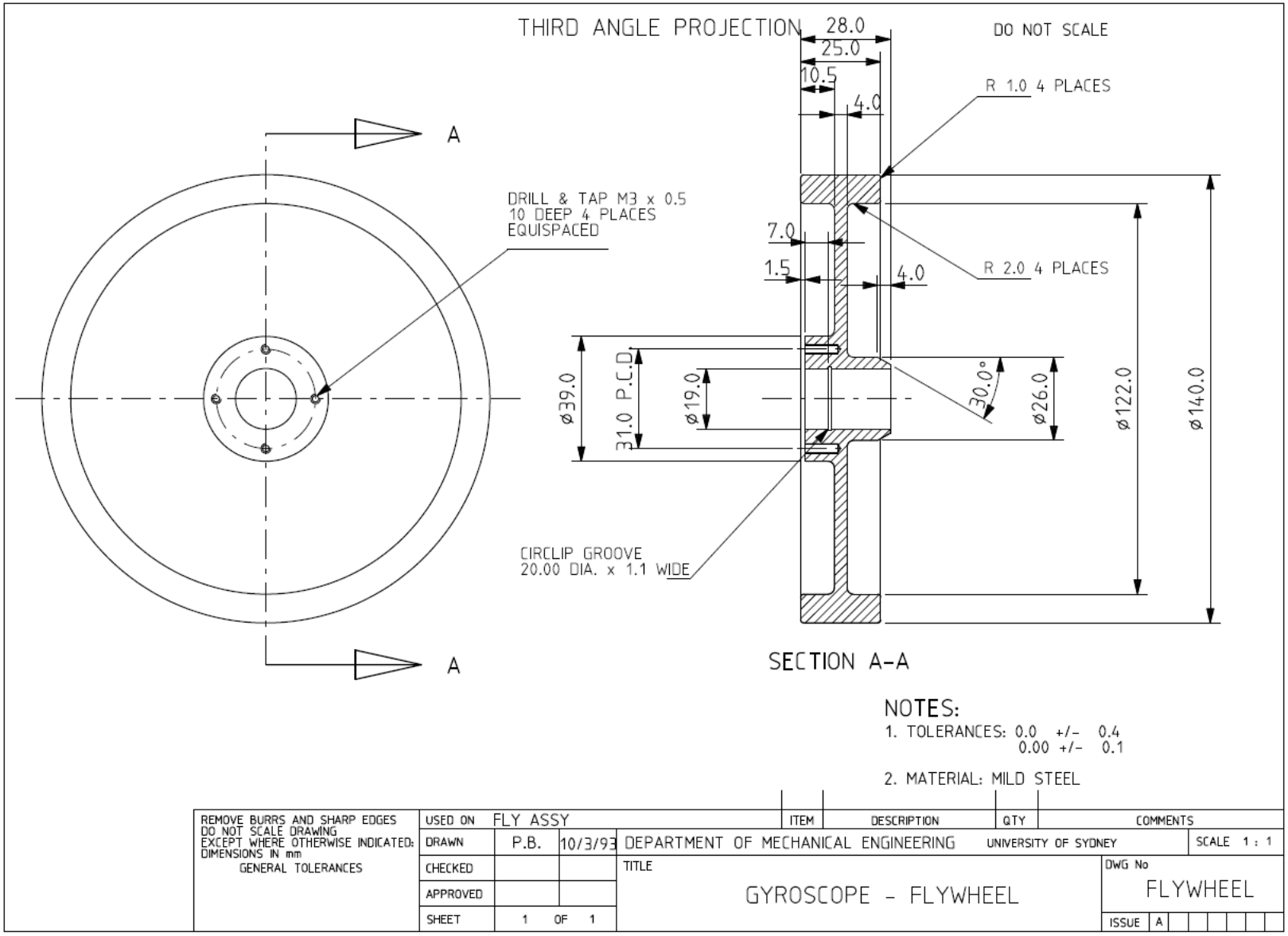




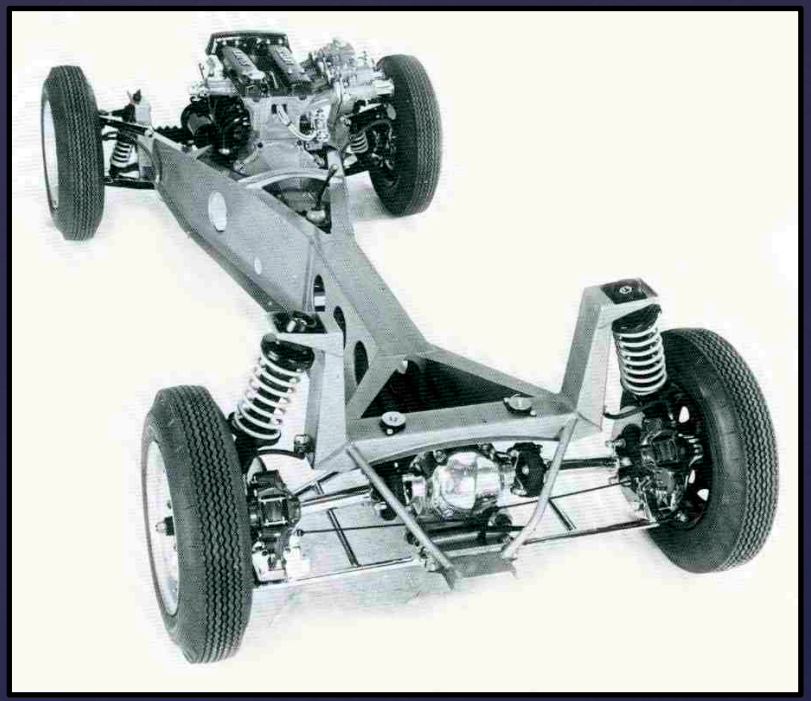


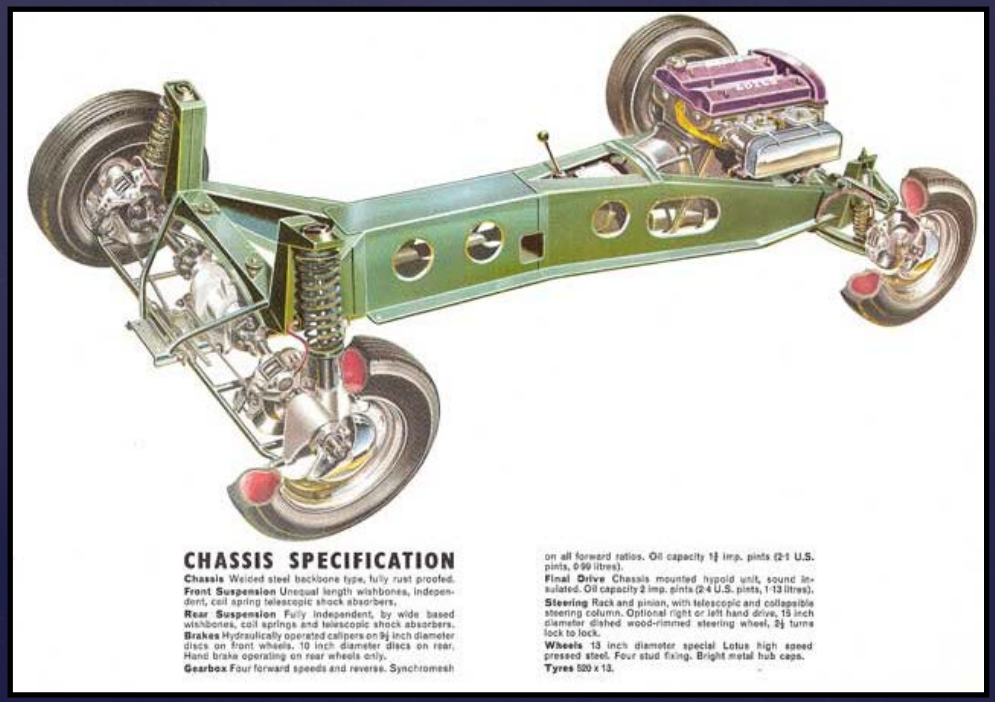
Why ?

Detail Drawing Example



Detail Drawing Example: Lotus Elan Recreation





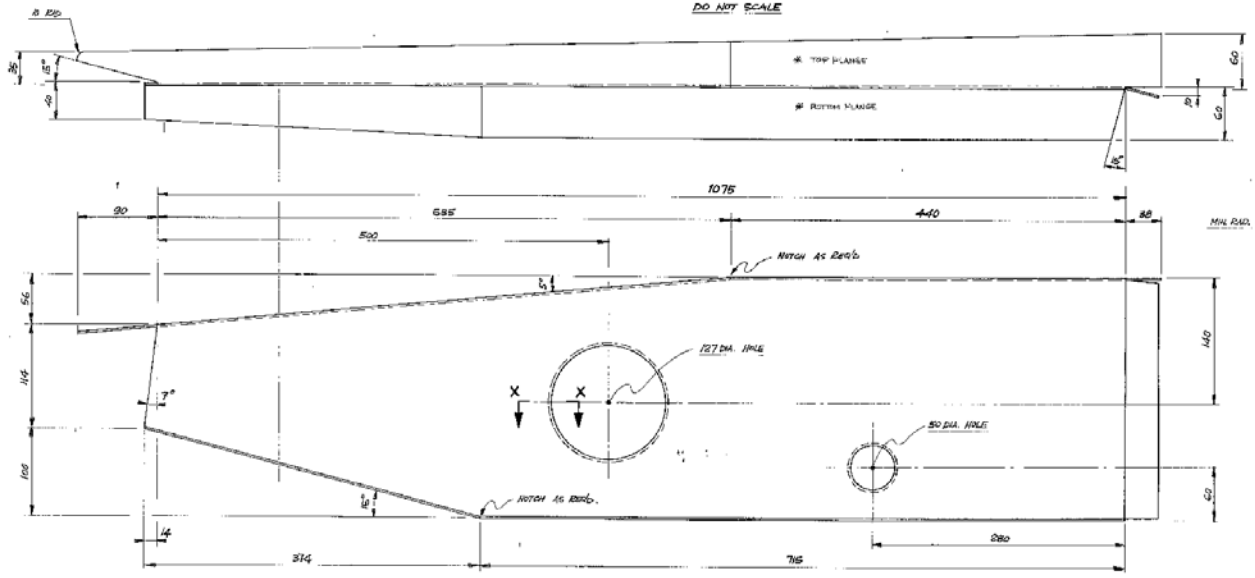
CHASSIS SPECIFICATION

Chassis Welded steel backbone type, fully rust proofed.
Front Suspension Unequal length wishbones, independent, coil spring telescopic shock absorbers.
Rear Suspension Fully independent, by wide based wishbones, coil springs and telescopic shock absorbers.
Brakes Hydraulically operated calipers on 9½ inch diameter discs on front wheels. 10 inch diameter discs on rear. Hand brake operating on rear wheels only.
Gearbox Four forward speeds and reverse. Synchromesh on all forward ratios. Oil capacity 1¾ imp. pints (2·1 U.S. pints, 0·99 litres).
Final Drive Chassis mounted hypoid unit, sound insulated. Oil capacity 2 imp. pints (2·4 U.S. pints, 1·13 litres).
Steering Rack and pinion, with telescopic and collapsible steering column. Optional right or left hand drive, 15 inch diameter dished wood-rimmed steering wheel, 2½ turns lock to lock.
Wheels 13 inch diameter special Lotus high speed pressed steel. Four stud fixing. Bright metal hub caps.
Tyres 520 x 13.

3RD. ANGLE PROJECTION

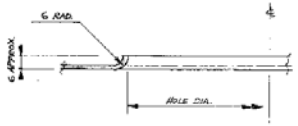
DO NOT SCALE

ALL DIMENSIONS ARE IN MILLIMETRES



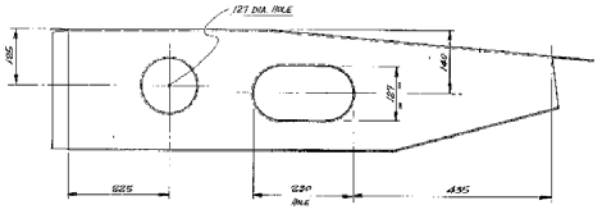
PART Nº : 26.01 - L.H. FRONT CHASSIS FORK

SCALE - 1:2.5



SECTION X-X

TYPICAL FOR ALL HOLES



PART Nº : 26.02 - R.H. FRONT CHASSIS FORK

[NOTE : ALL OTHER DIMENSIONS AS PER L.H. FORK, AS SHOWN ABOVE]

SCALE - 1:5

MAT'L : 1/8 THK. MILD STEEL

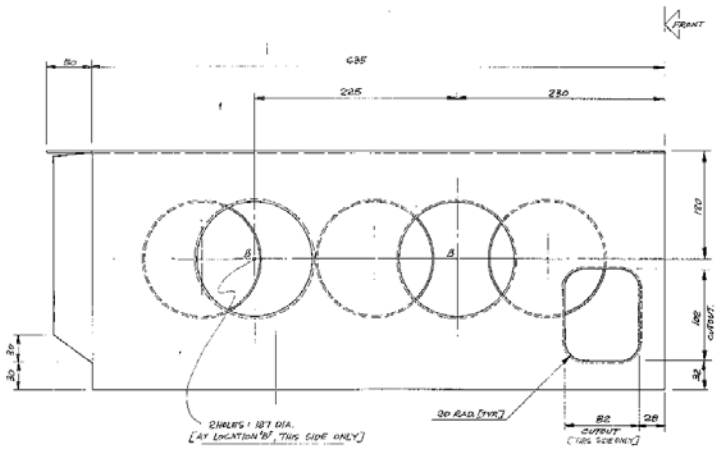
GENERAL TOLERANCE : ± 1.0

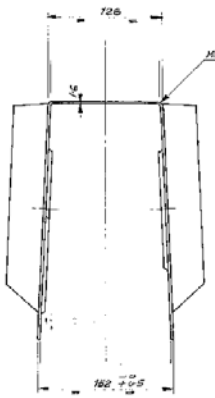
LOTUS ELAN CHASSIS	DWG. NO. 26.01 — 26.02
FRONT CHASSIS FORK - L.H. & R.H.	SCALE: 1:5, 1:25, 1:1
	DATE - ISSUE A

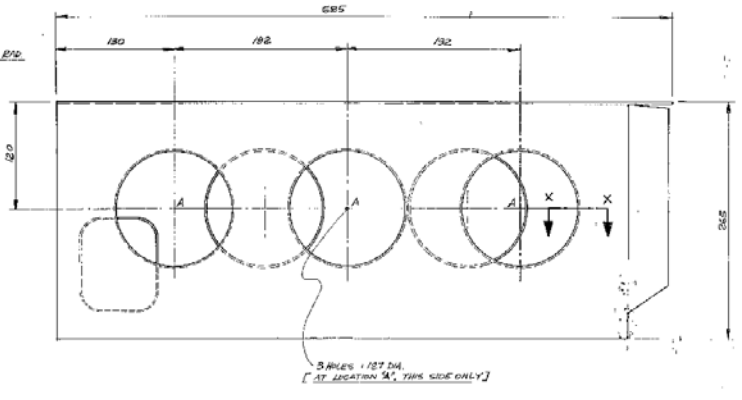
3RD. ANGLE PROJECTION

ALL DIMENSIONS ARE IN MILLIMETRES

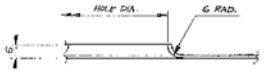
DO NOT SCALE





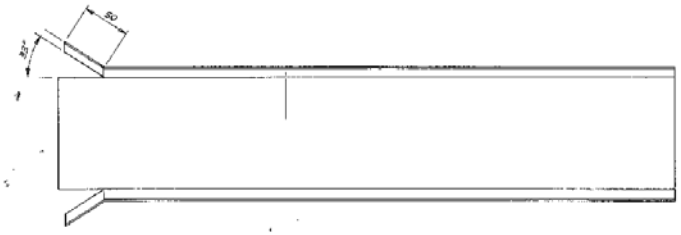


VIEW FROM FRONT



SECTION X-X

[TYPICAL - ALL HOLES & RECT. CUTOUT]



PLAN VIEW ON UNDERSIDE

[NOTE : HOLES OMITED FOR CLARITY]

MATERIAL : 1.6 THK. MILD STEEL

GEN. TOLERANCE UNLESS OTHERWISE STATED : ± 1.0

LOTUS ELAN CHASSIS CENTRAL BACKBONE SECTION	DRG. NO. 26.08
SCALE 1:2.5 + 1:1	DATE - ISSUE (A)