

Please be aware that this PDF has been created from the original hardcopy document, which might not be in good condition and so the PDF might reflect this.

W/D £ 1972 S/S by Pts 1-2-3
+ 3 hnds
+ 1 Supplement

BRITISH STANDARD 308 : 1964

UDC 744 : 621.71

ENGINEERING DRAWING PRACTICE

BRITISH STANDARDS INSTITUTION
LIBRARY
BRITISH STANDARDS HOUSE
2, PARK STREET, LONDON, W.1

BRITISH STANDARDS INSTITUTION

**SUPPLEMENT No. 1 (1967) to
BRITISH STANDARD 308 : 1964**



**ENGINEERING
DRAWING PRACTICE**

**Supplement No. 1
THE PREPARATION OF DRAWINGS
SUITABLE FOR MICROFILMING**

Price 3/- net

BRITISH STANDARDS INSTITUTION

INCORPORATED BY ROYAL CHARTER

BRITISH STANDARDS HOUSE, 2 PARK ST., LONDON, W.1

TELEGRAMS: STANDARDS LONDON W1 TELEPHONE: 01-629 9000

THIS SUPPLEMENT, having been approved by the Mechanical Engineering Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 31 July, 1967.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 4000, fully indexed and with a note of the contents of each, will be found in the British Standards Yearbook, price 15s. The B.S. Yearbook may be consulted in many public libraries and similar institutions.

This Supplement makes reference to the following British Standard:
B.S. 3429. Specification for the sizes of drawing sheets.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following B.S.I. references relate to the work on this standard:
Committee references MEE/10, MEE/10/1. Draft for comment D 64/14284.

CO-OPERATING ORGANIZATIONS

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Associated Offices' Technical Committee
Association of Consulting Engineers
Association of Mining Electrical and
Mechanical Engineers
Board of Trade
British Chemical Plant Manufacturers'
Association
British Compressed Air Society
*British Electrical and Allied Manufacturers'
Association
British Gear Manufacturers' Association
British Internal Combustion Engine
Manufacturers' Association
British Iron and Steel Federation
British Mechanical Engineering Federation
British Pump Manufacturers Association
*British Railways Board
Crown Agents for Oversea Governments
and Administrations
*Electricity Council, the Central Electricity
Generating Board and the Area Boards in
England and Wales
*Engineering Equipment Users' Association
Gas Council
Institute of Marine Engineers

*Institution of Civil Engineers
*Institution of Gas Engineers
Institution of Heating and Ventilating
Engineers
*Institution of Mechanical Engineers
Institution of Mechanical Engineers
(Automobile Division)
*Institution of Production Engineers
*Locomotive and Allied Manufacturers'
Association of Great Britain
London Transport Board
Machine Tool Trades Association
Ministry of Defence
Ministry of Labour (H.M. Factory
Inspectorate)
Ministry of Power
*Ministry of Public Building and Works
Ministry of Technology, National Engineering
Laboratory
Ministry of Transport
National Coal Board
National Physical Laboratory (Ministry of
Technology)
Radio Industry Council
Royal Institute of British Architects

The Government departments and scientific and industrial organisations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this supplement:

Association of Hydraulic Equipment
Manufacturers
British Constructional Steelwork Association
Department of Education and Science
Draughtsmen's and Allied Technicians'
Association
Drawing Office Material Manufacturers and
Dealers' Association
Electronic Engineering Association
Imperial College of Science and Technology

Institution of Engineering Designers
Ministry of Technology
Ministry of Defence, Army Department
Ministry of Defence, Navy Department
Post Office
Society of British Aerospace Companies Ltd.
Society of Motor Manufacturers and Traders
Ltd.
Steel Works Plant Association
United Kingdom Atomic Energy Authority

Supplement No. 1 to B.S. 308, 'Engineering Drawing Practice'

BRITISH STANDARD RECOMMENDATIONS FOR THE PREPARATION OF DRAWINGS SUITABLE FOR MICROFILMING

FOREWORD

The use of microfilm as a means of reproducing, storing and transmitting drawings requires that the finest detail on the drawing shall be capable of being recorded on the small negative without significant loss of quality; prints made from microfilm are commonly smaller than the original drawing. This supplement recommends the drawing practice to be adopted to ensure legible prints in these circumstances.

The use of the drawing practice recommended in this supplement is axiomatic when it is known that the drawing is to be subjected to microfilming. It is recommended, however, that it should be used for all drawings, for even if an originator has no immediate intention of microfilming a drawing there is a chance that some other authority may need to microfilm it, and perhaps in later years the originator himself.

The drawing practice recommended is essentially that of B.S. 308, with emphasis on open plan presentation and the avoidance of cramped detail. Its adoption should involve no increase in drawing office man-hours where B.S. 308 is already followed. Even where there may be some increase, there will be ample compensation in the greater number of man-hours saved over the years in which a drawing may be in use, due to the greater ease of comprehending it.

Prints the same size as the original may be made by projection from microfilm but prints smaller than the original are more economical and are commonly used.

The finest detail on a drawing must be capable of being recorded on the microfilm negative, taking account of the degree of reduction involved, and it must also be legible on the reduced size-print, taking into account that certain printback processes involve slight loss of definition but are used in some circumstances because of their speed and economy. The drawing practice recommended is appropriate to any make or system of microfilm equipment and allows for any reasonable worst case, with a small factor of safety for less than perfect draughtsmanship.

It may be found advisable to prepare more detailed instructions applicable in any one drawing office, applicable to the drawing sheet sizes in use, the type and quality of the camera projection equipment and photographic materials used, the nature of the drawings and the uses to which the reproductions will be put. Full size examples of the sizes of letters and figures to be used should be included, together with sample prints made at reduced sizes by the system or systems of reproduction in use or foreseen.

As written, this supplement is directly applicable to engineering drawing practice, but it is also applicable in many ways to architectural drawing practice and to engineering diagrams using graphical symbols. Symbols which are of the same degree of complexity as letters and numerals should be drawn in accordance with the recommendations for lettering in this supplement; symbols which include parts of greater complexity should be drawn in a larger size.

DRAWING PRACTICE

SCOPE

1. This supplement indicates particular points, additional to those in sections 1 to 22 of the standard, to be observed in the preparation of drawings to be subjected to microfilming in order that reproductions made from the film shall be satisfactory.

2. It refers particularly to unperforated 35 mm film. If other sizes of film are used the same general principles should be followed, together with the dimensions relating to the sizes of letters, etc., on finished prints, but the dimensions relating to drawing sizes and the negatives will not necessarily apply.

DRAWING SIZES

3. Microfilm is most economical and gives the best results when used with drawing sheets having an aspect ratio, i.e., the ratio of the lengths of the long and short sides, which is constant and equal to that of the effective area of

the microfilm negative. The ISO 'A' series* of drawing sheet sizes meets this requirement and is therefore particularly suitable for drawings to be microfilmed.

4. Drawings larger than A1 or 30 × 40 in will have to be filmed on a number of frames and reproduced in sections, except that certain camera equipments capable of a greater ratio of reduction may permit drawings of sizes A0 or 30 × 53 in to be filmed on a single frame.

5. A drawing should be made on the smallest sheet size consistent with clarity and unambiguity.

MATERIALS

6. Drawings may be prepared on translucent or white opaque drafting material, preferably one having a matt drawing surface. Most drafting materials are suitable provided adequate contrast between drawing matter and background is achieved.

* See B.S. 3429, 'Specification for sizes of drawing sheets'.

7. Pre-printed sheets may be printed on the front or on the back but the latter may involve some slight loss of quality in reproduction.

8. Pencils and inks giving a line with a matt surface are more satisfactory than those giving a reflecting surface.

CARE OF DRAWINGS

9. The surface immediately below the drafting material, i.e. the drawing board facing or an intermediate backing sheet, should be of such a nature as to minimize indentation under pencil pressure, since this indentation detracts from clarity of reproduction through the effects of reflected and refracted light.

10. Drawings which include pencil work must be handled as little as possible, both during drawing and subsequently, in order to avoid smudging.

11. Drawings should not be folded and drawings on paper should not be rolled if it can be avoided. When it is necessary to roll drawings, the drawn image should be on the outside circumference and the roll diameter should be not less than 75 mm.

12. Only those edge-binding tapes which do not shrink should be used, so as to maintain the flatness of the drawing.

DENSITY, THICKNESS AND SPACING OF LINES

13. All lines should be dense, black and bold. It is important that all lines on a drawing should be of a consistent density, including those added in any revision. The lines on any one drawing may be entirely in ink or entirely in pencil, or ink and pencil may be used on one drawing provided a uniform density is maintained.

14. Each line should be of consistent thickness throughout its length. The thinnest line should be drawn with such a width that in the smallest print* to be made from the microfilm it will have a width of not less than 0.25 mm.

15. Lines should be spaced so that in the smallest print* to be made from the microfilm the clear space between the lines will be not less than 0.5 mm.

FORM, SIZE AND SPACING OF LETTERS AND FIGURES

16. The density of the lines of which letters and figures are formed should be the same as that of the lines of the drawing.

17. All handwritten letters and figures should be well-formed as illustrated in Clause 7 (of B.S. 308). Line thicknesses should be as specified in 14 above. The clear space between characters should not be less than twice their line thickness.

18. Letters and figures should be drawn so that in the smallest print* to be made from the microfilm they will have a height of not less than 1.75 mm.

* If the size of the smallest print to be made from the microfilm is not known, a print size one quarter of the original (1 : 2 linear) should normally be assumed.

19. Since each numeral is a significant unit (compared to lettering which may be read a word at a time), particular care should be taken to make figures clear. The numerator and denominator of a fraction should each be of the size recommended for letters and figures.

20. In order that the drawing number may be legible even when the microfilm negative is viewed at a low magnification, the height of the figures of the drawing number should be not less than 7.5 mm.

21. When typewriting is used, the character face, size and density should be selected or controlled so as to conform as nearly as possible to the line work and handmade characters of the drawing. Capital letters only should be used, to take advantage of their size compared with lower case letters. The size of character should be as specified for lettering in 17 above. Clarity of image may be preserved by using ribbons which are used only once, provided adequate contrast is obtained. A typeface without serifs is preferred.

OPEN PLAN PRESENTATION

22. All views, dimension lines and characters should be well spaced out.

23. Section lining (hatching) should be omitted except where the meaning of the drawing cannot be made clear without it. Close section lining should be avoided.

24. Areas of fine detail should be shown in one or more separate views, suitably enlarged, to ensure satisfactory reproduction.

25. Only one thick line should be drawn in lieu of two lines representing the edges of sheet metal or thin material (see Clause 8 of B.S. 308), if on the smallest print* to be made from the microfilm the two lines would have a clear space between them of less than 0.5 mm.

CAMERA ALIGNMENT MARKS AND SCALE ON DRAWINGS

26. Camera alignment marks in the form of an outline arrow head should be shown at the centre of each of the four sides of a drawing, within the frame line.

27. Since the size of the copy printed back from microfilm will almost certainly be different from the size of the original, indications of scale, such as 'Full size', 'Scale 1/4' or '1 1/2 in = 1 ft', should not be used. Instead, a figured scale at least 150 mm long may be drawn, with the annotation 'DO NOT SCALE' if appropriate.

28. To facilitate recognition of any reduction or enlargement (compared to the original) of a copy printed from microfilm and the making of a print the exact size of the original (e.g., for additions and corrections to be made using the same scale as the original), the dimensions of the frameline of the original may be indicated upon it in a box at one corner of the drawing, e.g., 'ORIGINAL FRAME SIZE 570 x 815 mm. It may be convenient to have this detail included in preprinted sheets.

EXAMPLE

29. Plate 1 is an example of a drawing suitable for micro-filming.

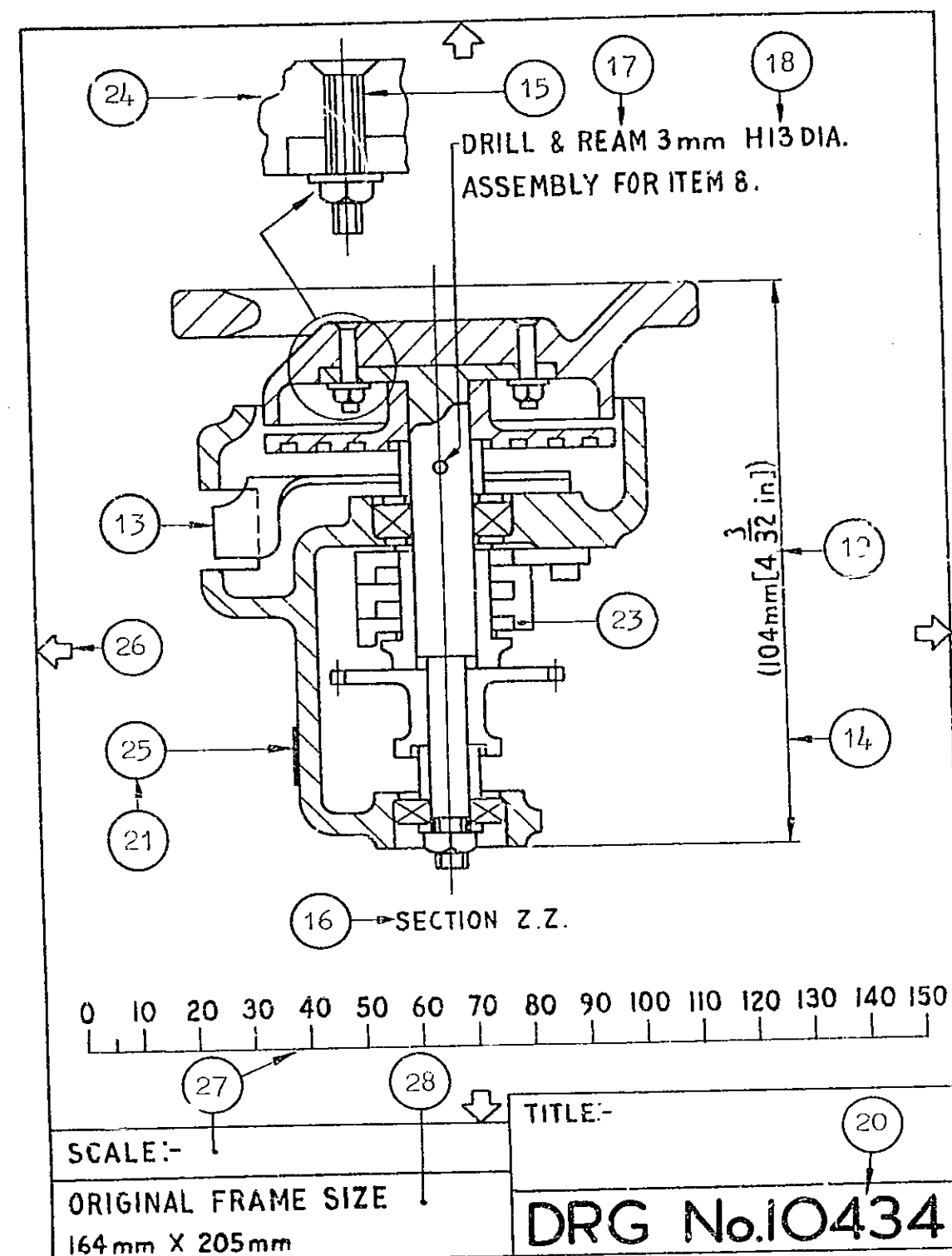


Plate 1. An example of a drawing suitable for microfilming. (The circled numbers refer to the paragraphs of the text.)



BRITISH STANDARD
ENGINEERING
DRAWING PRACTICE

B.S. 308 : 1964

Price 12/6 net

BRITISH STANDARDS INSTITUTION

INCORPORATED BY ROYAL CHARTER

BRITISH STANDARDS HOUSE, 2 PARK ST., LONDON, W.1

TELEGRAMS: STANDARDS LONDON W1 TELEPHONE: MAYFAIR 9000



Documents
Document Sharing

CONTENTS

	Page		Page
Co-operating organizations	4	15. Methods of dimensioning common features	42
Foreword	5	16. Keyways	49
1. Introduction	6	17. Tapered features	50
2. Layout of drawings	7	18. Geometrical tolerances	54
3. Numbering and referencing	15	19. Tolerances for roundness and cylindricity	73
4. Scales	16	20. Profiles and curved surfaces	74
5. Types of lines	17	21. Machining and surface texture symbols	77
6. Projection	19	22. Typical examples of engineering drawings	79
7. Lettering	20		
8. Section lining and sectional views	21		
9. Conventional representation of common features and materials	25		
10. Abbreviations for use on drawings	30		
11. General principles of dimensioning and tolerancing	31		
12. Projection and dimension lines and leaders	33		
13. Dimensions	35		
14. Toleranced dimensions	37		

APPENDICES

A. Differences between items in U.S.A. standard ASA Y14-5, British Standard B.S. 308 and Canadian standard CSA B78.1	91
B. Geometrical tolerance symbols	94
C. Other symbols	97
D. Drawing sizes	98
Index	99

THIS BRITISH STANDARD, having been approved by the Mechanical Engineering Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 27th November, 1964.

First published, September, 1927.

First revision, December, 1943.

Second revision, December, 1953.

Third revision, November, 1964.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

A complete list of British Standards, numbering over 4000, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook, price 15s.

This standard makes reference to the following British Standards:

B.S. 499 : Section 7. Scheme of symbols for welding.

B.S. 1134. The assessment of surface texture.

B.S. 1916. Limits and fits for engineering.

B.S. 1936. Undercuts and run outs for screw threads.

B.S. 3429. Sizes of drawing sheets.

B.S. 3730. Methods for the assessment of departures from roundness.

British Standards are revised, when necessary, by the issue either of amendments, slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following B.S.I. references relate to the work on this standard:
Committee references MEE/10, MEE/10/1 Draft for comment AB(MEE) 2417.

CO-OPERATING ORGANIZATIONS

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Associated Offices' Technical Committee
Association of Consulting Engineers
Association of Mining Electrical and Mechanical Engineers
British Chemical Plant Manufacturers' Association
British Compressed Air Society
*British Electrical and Allied Manufacturers' Association
*British Gear Manufacturers' Association
British Internal Combustion Engine Manufacturers' Association
British Iron and Steel Federation
British Mechanical Engineering Federation
*British Railways Board
Crown Agents for Oversea Governments and Administrations
D.S.I.R.-National Engineering Laboratory
*Electricity Council, the Generating Board and the Area Boards in England and Wales
*Engineering Equipment Users' Association
Gas Council
High Commission of India
Institute of Marine Engineers

Institute of Petroleum
*Institution of Civil Engineers
*Institution of Gas Engineers
Institution of Heating and Ventilating Engineers
*Institution of Mechanical Engineers
Institution of Mechanical Engineers (Automobile Division)
*Institution of Production Engineers
*Locomotive and Allied Manufacturers' Association of Great Britain
London Transport Board
Machine Tool Trades Association
*Ministry of Defence, Army Department.
*Ministry of Defence, Navy Department.
Ministry of Labour (I.L.M. Factory Inspectorate)
Ministry of Power
*Ministry of Public Building and Works
Ministry of Transport
National Coal Board
National Physical Laboratory (D.S.I.R.)
Radio Industry Council
Royal Institute of British Architects.

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following were directly represented on the Committee entrusted with the preparation of this standard:

Association of Hydraulic Equipment Manufacturers
British Constructional Steelwork Association
Draughtsmen's and Allied Technicians' Association
Drawing Office Material Manufacturers and Dealers Association
Electronic Engineering Association

Imperial College of Science and Technology
Institution of Engineering Designers
Ministry of Aviation
Ministry of Education
Society of British Aerospace Companies Ltd.
Society of Motor Manufacturers and Traders Ltd.
Steel Works Plant Association
United Kingdom Atomic Energy Authority

BRITISH STANDARD

ENGINEERING DRAWING PRACTICE

FOREWORD

This revision of B.S. 308 : 1953 has been prepared under the authority of the Mechanical Engineering Industry Standards Committee and takes account of the recommendations of the 1957 and 1962 ABC (America-Britain-Canada) conferences on drawing practice and the practices recommended by the International Organization for Standardization (ISO) in Recommendations R128 and R129. No fundamental changes to the basic principles given in the 1953 edition have been made but a number of paragraphs have been re-written to eliminate some misunderstandings.

There are still some minor differences (chiefly of expression) between the ASA and Canadian Standards on drawing practice and this revision, and these differences are shown in Appendix A.

Extensive enquiry has been made on the system of projection which is now preferred as the 1953 edition did not state a preference for either system. This enquiry revealed that a number of companies had changed to the third angle system since 1953 but there was a general desire to maintain the use of both systems without any preference. As far as other countries are concerned, the U.S.A. and Canada use only the third angle system whilst the first angle system is almost exclusively used in Europe.

The method of indicating the limits of size of parts on drawings has been under consideration by the ISO Technical Drawing Committee and it has now been agreed that the larger be given first where both maximum and minimum dimensions are given. An ISO recommendation is now in course of publication and Method A in Clause 14 of this standard has been made to agree with the recommendation. At the same time, the method of dimensioning incorporating reference to the ISO limits and fits system (given in B.S. 1916, Part 1) has been included as there is an increasing use of this method in the U.K., it is widely used in Europe and is contained in

the ISO recommendation now being published.

Drawing sizes are now given in B.S. 3429, 'Sizes of drawing sheets' and a summary of the sizes specified in that standard is given in Appendix D for reference.

Throughout the world there is an increasing interest in the use of symbols to denote geometrical tolerances and the matter is under study by the ISO and the ABC Committees on drawing practice. Recommendations have not yet been finalized although some of the symbols are already being used in some countries. The B.S.I. Committee did not consider it appropriate to recommend particular symbols at this time but those tentatively established in the U.S.A., and in ISO draft documents are given in Appendix B.

It has been agreed at ABC Conferences and at ISO Technical Drawing Committee meetings that there is a need to indicate machining requirements and surface texture on drawings to indicate, *a*, when machining is required either to a definite surface texture or not, *b*, when a particular surface texture is required and it is immaterial whether the surface is machined or not and *c*, when a particular surface texture is required and machining is *not* to be carried out. The method now given to indicate these conditions are those adopted at the 1962 ABC Conference and tentatively agreed by the ISO Committee.

Symbols to indicate the method of projection used in a drawing have been established in ISO Recommendation R128, and these have been included in Appendix C. A symbol to indicate the taper of a conical part has also been tentatively agreed by the ISO Technical Drawing Committee and this is also included in Appendix C.

The designation of screw threads has become more complex since 1953 and it is now recommended that reference be made to the appropriate screw thread B.S. when a full designation must be given on a drawing.

ENGINEERING DRAWING PRACTICE

1. INTRODUCTION

a. The figures used in the text of this standard are complete only in so far as is necessary to illustrate the point under consideration and they are not intended to be fully dimensioned working drawings. Except where otherwise stated the dimensions shown in the figures are inches.

b. Similarly, the numerical values of dimensions and tolerances given in the standard are typical only and are not quoted as recommended practices.

c. The tolerance diagrams given in some of the figures to illustrate the interpretation of the various tolerances are provided for explanatory purposes only and are not intended to appear on the component drawing.

d. In the illustrations to this standard, capital letters are used for notes which are intended to appear on the finished drawing; lower case letters are used for explanatory notes which are not intended to appear on the drawing.

e. Clauses 1 to 10 of the standard deal with general drawing practice and in these clauses the illustrations have been executed using first angle projection.

Clauses 11 to 21 cover the subjects of dimensioning and tolerancing and, in these, third angle projection has been employed. The plates representing typical working drawings, given at the end of the standard, illustrate the use of both methods of projection.

f. The clauses on dimensioning and tolerancing commencing at Clause 11 relate mainly to drawings which define products in their completely finished state as required by the designer. Such drawings do not necessarily define the manufacturing methods by which the design requirements are met. Many of the principles and practices, however, can be applied to process drawings which may define products in a partly finished state.

g. It is strongly recommended that when a drawing has been prepared in accordance with this standard and particularly when geometrical tolerances are specified (see Clause 18) the drawing should carry a prominent note to this effect such as 'For explanation of dimensions, notes, etc. see B.S. 308'.

2. LAYOUT OF DRAWINGS

The following notes on acceptable practices are given for guidance

a. **Title blocks.** It is recognized that latitude may be necessary in the arrangement and position of title blocks, etc. to meet differing requirements, but it is considered that the adoption by any particular organization of a standard layout of sheet will facilitate the reading of drawings and make it possible for essential references to be located easily. Many drawing offices use sheets of standard size and layout which are bought already cut to size and printed.

In general, the title block is located at the bottom right hand corner of the sheet but for convenience of drawing layout the top right hand corner may sometimes be preferred. In the latter case, however, the drawing number and title should also appear in the bottom right hand corner, and the title may be abbreviated as practicable. The drawing number may also be repeated in other positions as desired.

It is recommended that spaces should be provided in all title blocks for the following information:

Name of firm.
Drawing number.
Description or title of drawing.
Scale.
Date and signature.

b. **Additional information.** Where appropriate, the layout of the standard sheet may include or provide for the following additional information and notes:

(i) **Material or parts list.** When several parts are detailed on the same sheet, it is usual to tabulate them in a material or parts list, which should preferably be placed adjacent to the title block (see Figs. 2, 3 and 4). Alternatively, this list may appear on a separate sheet (see Subclause 2d). In either case it should include such information as:

Item or part number.
Description of part.
Quantity required.
Cross-references to other detail drawings (if the parts are not actually detailed on the new drawing).
Material (where appropriate, this should be clearly specified to be in accordance with a British Standard or other accepted specification, and the exact grade of the particular material defined as may be necessary).

(ii) Job or order number.
(iii) Treatment, finish, etc.
(iv) Key to machining and other symbols.
(v) Tolerances on dimensions not individually tolerated.
(vi) Tool and gauge references.
(vii) Standard notes (e.g. system of projection, unit of measurement, etc.).

In addition to the foregoing, individual drawing offices will naturally add to their drawings other information suited to their special requirements.

c. **Typical title blocks.** Typical examples incorporating the above recommendations are illustrated in Figs. 1, 2, 3, 4 and 5.

Figure 1. This is suitable for detail drawings, and particularly where one part only is shown on a given sheet, the size of which will vary to suit the actual detail. For convenience of manufacture it is preferable to include all necessary information on the drawing, and the title block should therefore cover such information as:

Name of firm.	Material form and treatment.
Drawing or part number.	Finish.
Name of part.	Key to symbols.
Scale.	General tolerances for dimensions not individually tolerated.
Material specification.	Date and signature.

Figures 2 and 3. These are suitable for assembly drawings and for detail drawings which show a number of parts on the same sheet. In either case, much of the necessary information will be given in a material or parts list (see Subclause 2b(i)) and the title block need only provide for the general information specified in Subclause 2a.

Figure 4. This is suitable for drawings of shop equipment, such as jigs, tools and gauges, where quantities are not usually involved, and it is often useful to include details and assembly on one sheet. The title block may cover such information as:

Name of firm.	Scale.
Drawing number.	Key to symbols.
Job number.	General tolerances.
Description.	Date and signature.

Figure 5. This layout is a typical case where the frame size of the drawing has been reduced to suit folding to particular dimensions and to provide a margin for binding.

d. **Separate material or parts lists.** It is sometimes found convenient to group a number of associated parts on a separate sheet distinct from the detail drawing or drawings. Such a list may be applied to a number of parts which are all detailed on one large drawing; alternatively it may be used to group a number of single-part drawings, or even several multi-part drawings, into an assembly or sub-assembly. A typical form of separate material or parts list is shown in Fig. 6.

NOTE. Some organizations use an independent series of item numbers (e.g. 1, 2, 3, 4, etc.) to identify the parts comprising the assembly; others find it convenient to identify the parts by their detail drawing numbers. It is also sometimes necessary to allocate other part reference numbers for special purposes, such as spare parts catalogues. These independent reference numbers can conveniently be indicated on the separate parts list.

e. **Drawing lists.** It is frequently necessary to compile a list of all drawings, assembly lists or sub-assembly lists comprising a complete project. A typical example of a separate sheet for this purpose is shown in Fig. 7.

f. **Grid system or zoning.** In order that a particular dimension or feature on a large drawing can be readily located, it is sometimes desirable to use a grid reference system based on numbered and lettered divisions in the margins (see Figs. 2 and 3).

(DRAWING NO.)																	
										MATERIAL		TOLERANCES		SCALE		DRAWING NO.	
										FORM						(TITLE)	
										FINISH						(NAME OF FIRM)	
MOD. NO.	REVISION	SIZE DATE	MOD. NO.	REVISION	SIG. & DATE	SCREW THREADS TO CONFORM TO BRITISH STANDARD		DATE									

Fig. 1. Typical layout of a drawing sheet

(DRAWING NO.)																	
										MATERIAL		TOLERANCES		SCALE		DRAWING NO.	
										FORM						(TITLE)	
										FINISH						(NAME OF FIRM)	
MOD. NO.	REVISION	SIZE DATE	MOD. NO.	REVISION	SIG. & DATE	SCREW THREADS TO CONFORM TO BRITISH STANDARD		DATE									

Fig. 2. Typical layout of a drawing sheet

Fig. 5. Typical layout of a drawing sheet

Fig. 6. Typical layout of a parts list

[illegible]

Fig. 7. Typical layout of a drawing list

CLÁUSE 2 (contd.)

g. Revisions. It is most important that all revisions should be indicated on the drawing, and that each new issue be identified by a change in the date, issue number, or letter. One convenient method of recording a revision is a table, on the face of the drawing, in which details of the revisions are given. Suitable tables for recording such revisions are shown in Figs. 1, 2, 3 and 4.

The marginal grid reference may be used to identify the position of the revision and the appropriate zone reference quoted in the revision table, e.g. C4, etc. A further method of identification is the use of a revision letter or number enclosed within a circle or square which is placed in proximity to the revised dimension or detail. Reference is made in the revision table or elsewhere to this number or letter. In either case complete details of the change made should be recorded either on the drawing itself or in some other appropriate form.

Where interchangeability of a part is not affected, either in the dimensional or any other sense, the drawing number or part number should not be changed. If interchangeability is affected, a new drawing number or a new part number should be given to the detail concerned.

In conjunction with revisions to drawings it is usual to issue a form or note to record the change, to ensure the replacement or correction of existing prints, and to give instructions concerning any existing parts or work in progress.

h. Assembly drawings. Where a number of drawings is required to detail a complete design, an assembly drawing is necessary. Such drawings will show the project to a convenient scale, and the drawing or part numbers, which deal with each part or section in detail, may be recorded in suitable tabular form on the drawing or on a separate sheet.

j. Key plan. An alternative method, particularly applicable to structural work, is to include on each individual sheet of a series of drawings a small key plan or elevation, or both, conveniently placed preferably near to the title block, indicating in bold lines to which part of the whole work the particular sheet refers. An example is given in Fig. 8.

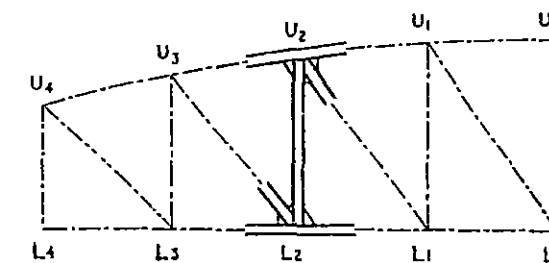


Fig. 8. Key plan

k. Grouping of parts. When several parts are shown on one drawing they should preferably be grouped according to the process involved (e.g. parts machined from bar material, castings, welded structures, sheet metal work, etc.).

1. Orientation of views. A drawing should show an article in the clearest possible manner. In general, the main view of a part should have the same orientation as that shown on the assembly drawing.

NOTE. In most cases assemblies are drawn forward to the left. As a rule, however, ship and marine engineering drawings are made forward to the right, aft to the left.

3. NUMBERING AND REFERENCING

a. *Numbering.* The system of numbering drawings will be a matter for individual firms or departments but, in general, the following rules should be observed:

- (i) A register, book or master file should be used for the systematic allocation of drawing numbers.
- (ii) When a given part is changed so as to be no longer interchangeable with the previous design, either in the dimensional sense or for any other reason, a new drawing or part number should be given, as indicated in Subclause 2g (above).
- (iii) Any given part, although it may be used in various models, types or sizes of mechanism, should always retain the original drawing number or part number and should be detailed on one drawing only.

- (iv) Wherever possible, right and left hand parts or assemblies should have consecutive drawing numbers or part numbers.

b. Referencing. Where assembly drawings comprise a large number of parts it is recommended that part reference numbers should be arranged as far as possible in vertical columns or horizontal rows in the most convenient groupings outside the drawn views, with leader lines indicating the respective parts by means of arrow heads or dots.

These part reference numbers should be ringed with a circle or other geometrical figure, to facilitate the location of the numbers when reading the drawing.

4. SCALES

a. Scale. All drawings should be drawn to scale and the scale used stated on the drawing. Drawings of details drawn larger than full size should, where practicable, include an undimensioned view to the actual size. This view may be three dimensional.

Where it is necessary or desirable to indicate that a particular dimension is not to scale, the abbreviation NTS should be added, or the dimension underlined—preferably with a wavy line (see Fig. 10).

When a drawing is to be reproduced in reduced or enlarged form, it is desirable to add a drawn scale.

b. Recommended scales.

Full size (1/1)	$\frac{3}{4}$ in = 1 ft (1/16)
Half size (1/2)	$\frac{1}{2}$ in = 1 ft (1/24)
	$\frac{3}{8}$ in = 1 ft (1/32)
3 in = 1 ft (1/4)	$\frac{1}{4}$ in = 1 ft (1/48)
1 $\frac{1}{2}$ in = 1 ft (1/8)	$\frac{1}{8}$ in = 1 ft (1/96)
1 in = 1 ft (1/12)	$\frac{1}{16}$ in = 1 ft (1/192)

Where scales greater than full size are required, scale multipliers of 2, 4, 8 and 10 are recommended.

For indicating the scale in the appropriate division of the title block a simple abbreviation is:

Scale 1/1 (for full size).

Scale 1/4 (for quarter size).

Scale 2/1 (for twice full size) and so on.

c. Decimal scales. Where decimal scales are required, scale multipliers and divisors of 2, 5 and 10 are recommended.

d. Dual scales. In the case of framed structures, convenient and much used practice consists in drawing the layout of the centre lines of members to one scale and superimposing drawings of the details to a larger scale on the intersection points of these centre lines. Other views of the parts detailed are drawn in convenient positions alongside. A case of this kind is illustrated in Fig. 9. The two scales used should be clearly indicated.

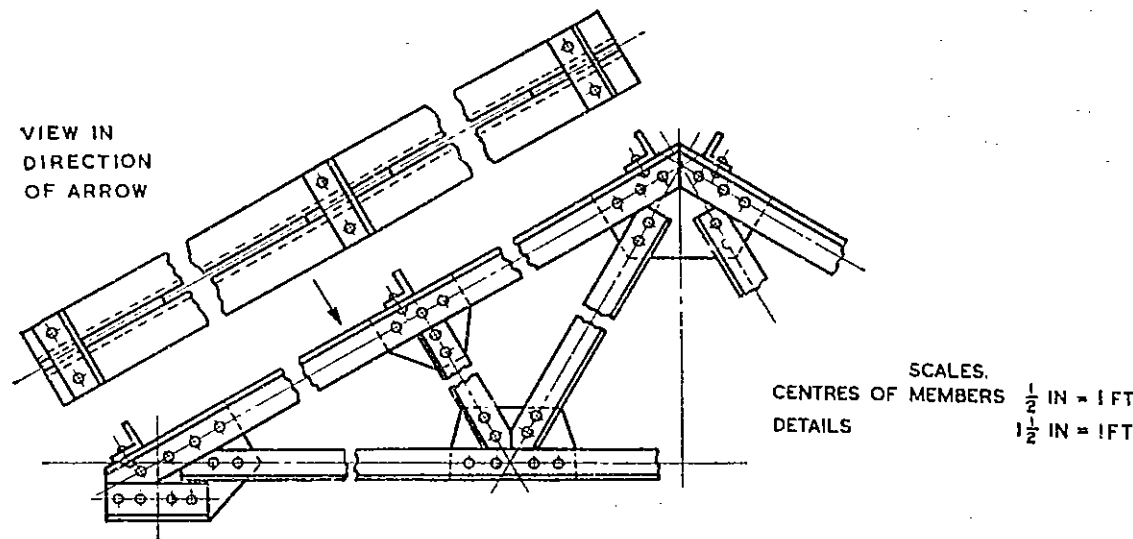


Fig. 9. Use of dual scales

5. TYPES OF LINES

For general engineering drawings, the following types of lines should be used:

Type of line	Example	Application
Continuous (thick) A		Visible outlines.
Continuous (thin) B		Dimension lines. Projection or extension lines. Hatching or sectioning. Leader lines for notes. Outlines of revolved sections.
Short dashes (thin) C		Hidden details. Portions to be removed.
Long chain (thin) D		Centre lines. Path lines for indicating movement. Pitch circles.
Long chain (thick) E		Cutting or viewing planes.
Short chain (thin) F		Developed or false views. Adjacent parts. Feature located in front of a cutting plane. Alternative position of moveable part.
Continuous wavy (thick) G		Irregular boundary lines. Short break lines.
Ruled line and short zig-zags H		Long break lines.

Lines should be sharp and dense to obtain good reproduction.

Lines specified as thick should be from two to three times the thickness of lines specified as thin.

Centre lines should project for a short distance beyond the outline to which they refer, but where necessary to permit dimensioning, they may be extended as dimension lines (Type B). Centre lines should not intersect in the spaces between dashes.

Typical applications of recommended types of lines

are shown in Fig. 10.

Lines depicting hidden details should always begin and end with a dash in contact with the visible or hidden detail line at which they start or end, except when such a dash would form a continuation of a visible detail line. Dashes should join at corners and arcs should start with dashes at the tangent points.

Blend lines and indefinite intersections may be thick or thin as advisable for clarity.

CLAUSE 5 (contd.)

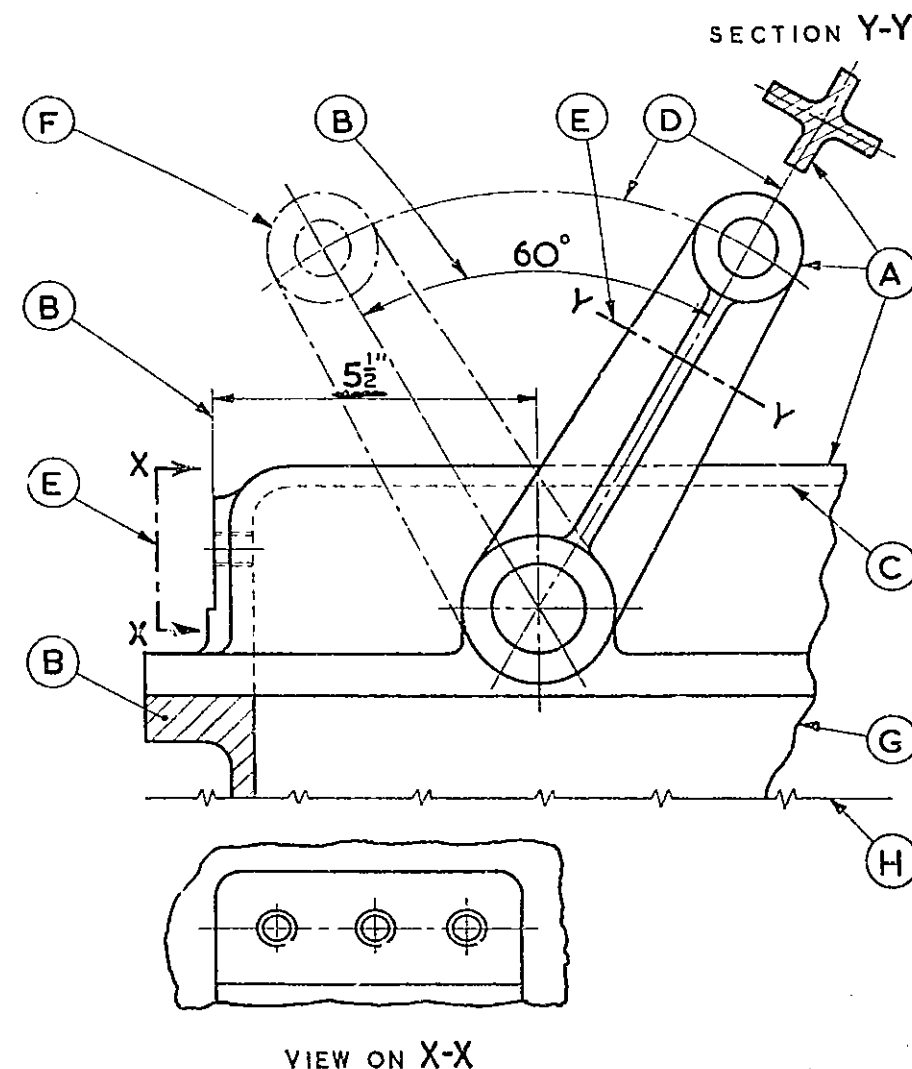


Fig. 10. Typical applications of recommended types of lines

6. PROJECTION

a. *Systems of projection.* Two systems of projection, known respectively as FIRST ANGLE and THIRD ANGLE are acceptable as British Standards.

In FIRST ANGLE PROJECTION each view shows what would be seen by looking on the far side of an adjacent view (see Fig. 11).

In THIRD ANGLE PROJECTION each view shows what would be seen by looking on the near side of an adjacent view (see Fig. 12).

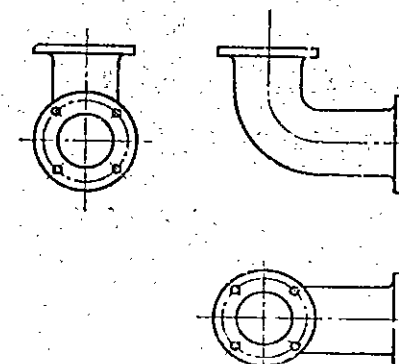


Fig. 11. Pipe bend, first angle projection

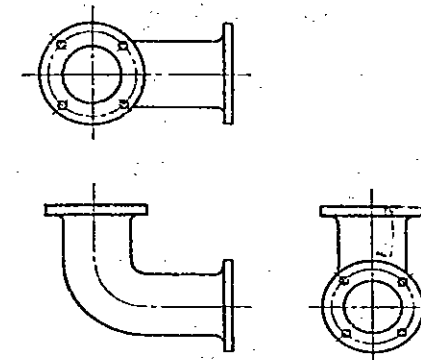


Fig. 12. Pipe bend, third angle projection

b. *Indication on drawings.* The drawings should be marked FIRST ANGLE PROJECTION or THIRD ANGLE PROJECTION, to indicate the method of projection used; otherwise the direction in which the views are taken should be clearly indicated (see Appendix C for symbol for projection as given in ISO/R128).

c. *Long objects.* With first angle projection for long objects, it is not uncommon to place an end view adjacent to the face which it represents. The practice should be indicated by a note when it is adopted; a suitable note would be 'view in direction of arrow A'.

d. *Number of views.* The number of views should be the minimum necessary to ensure that there will be no misunderstanding. Views should be selected to give as few hidden lines as possible. Scrap or local views may be used to define particular features where a complete view of the object is not necessary (see Fig. 10).

e. *Auxiliary views.* Objects having inclined faces may have such faces projected to show the true shape of the inclined surface (see Fig. 13).

f. *Space between views.* Ample space should be provided between views to avoid crowding of dimensions or notes.

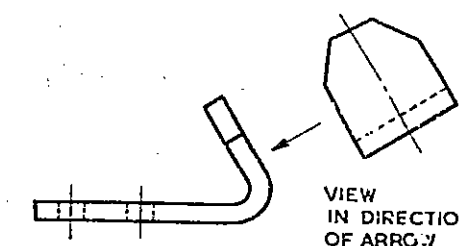


Fig. 13. Projection of inclined faces

7. LETTERING

The objective should be to employ uniform letters and figures which can be produced by hand, stencil or other means with reasonable rapidity and which will ensure good and legible reproductions from either pencil or ink originals.

On large drawings which are to be reduced for illustrative or other purposes, the lettering should be large enough to be legible when reduced.

Sloping or vertical letters and figures are suitable for general use. However, vertical characters are recommended for drawing numbers, titles and reference numbers. The specimens reproduced in Fig. 14 are given as a guide only (they have been produced by stencils).

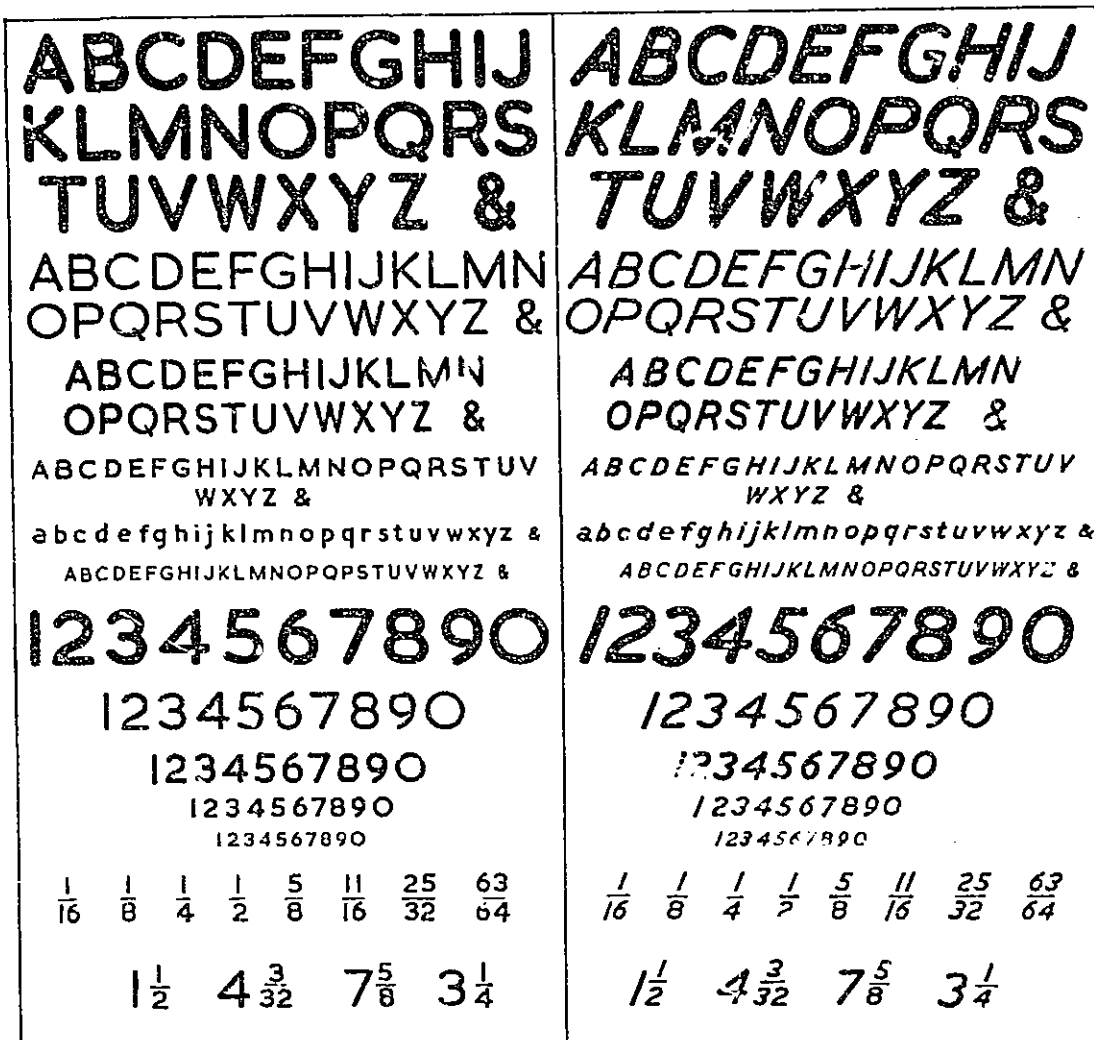


Fig. 14. Types of lettering

8. SECTION LINING AND SECTIONAL VIEWS

a. Sectional views. A sectional view represents that part of an object which remains after a portion is assumed to have been cut or broken away and removed. The exposed cut or broken surfaces should be indicated by section lining (hatching), except for relatively simple cases where the construction is obvious.

Section lining should be made with thin parallel lines (type B, Clause 5), usually drawn at an angle of 45° to the edges of the drawing sheet and suitably spaced in relation to the area to be covered. Where a large area of a section has to be shown, it is recommended that the edges only be section lined as shown in Fig. 15.



Fig. 15. Section lining of large areas

If the shape or position of the section would bring 45° section lining parallel or nearly parallel to one of the sides, another angle may be chosen (see Fig. 16).

In all views showing sections of the same part, the section lining should be similar in direction and spacing.

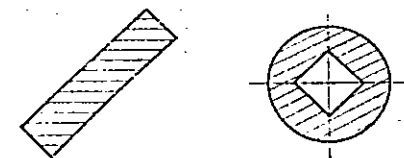


Fig. 16. Special section lining

The section lining of adjacent parts should be in different directions or to a different pitch (see Fig. 17).

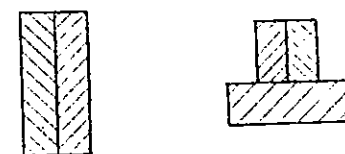


Fig. 17. Section lining for adjacent parts

Where the insertion of dimensions or lettering on a sectioned area is unavoidable, section lines should be interrupted (see Fig. 18).

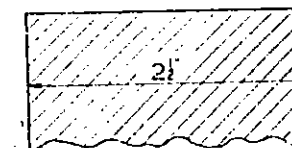


Fig. 18. Section lining interrupted for dimensions

b. Location of cutting planes. The position of a cutting plane should, where necessary, be indicated on one or more views of an object by thick long chain lines (Clause 5, type E) with letters in bold type, and, where required,

arrows at the ends pointing in the direction in which the object is viewed in section (see Figs. 19, 20 and 21).

The following examples illustrate the methods which should be adopted:

Fig. 19. A section in one plane not on a centre line.

Fig. 20. A section in one plane along a centre line.

Fig. 21. The path of a section in more than one plane. The path should be indicated by thick long chain lines (see type E, Clause 5).

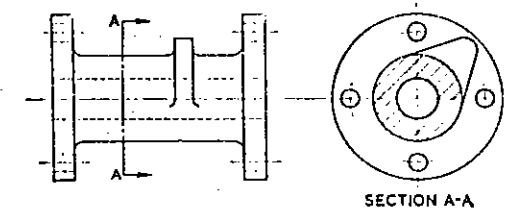


Fig. 19. Section in one plane not on centre line

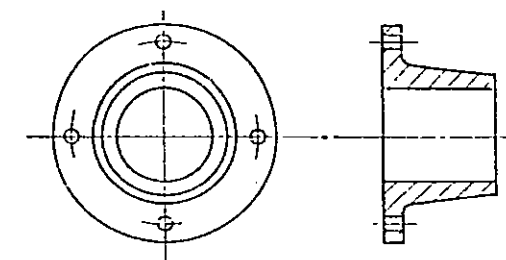


Fig. 20. Section in one plane along centre line

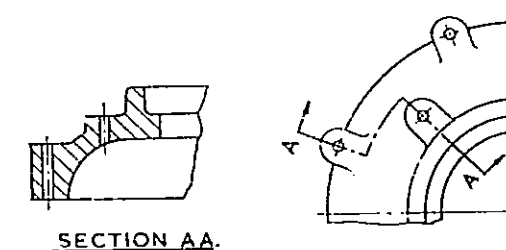


Fig. 21. Section in two planes

c. Half sections. Objects which are symmetrical about a centre line may be drawn having one half in outside view and the other half in section (see Fig. 22).

Hidden lines behind the cutting plane (see right hand half section, Fig. 22) should be omitted unless required for the definition of the object.

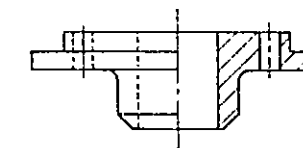


Fig. 22. Detail in half section

CLAUSE 8 (contd.)

Hidden lines on the unsectioned side (see left hand side, Fig. 22) may be shown if needed for dimensioning or clarity. In assemblies it is customary not to show hidden lines on the unsectioned side (see Fig. 23).

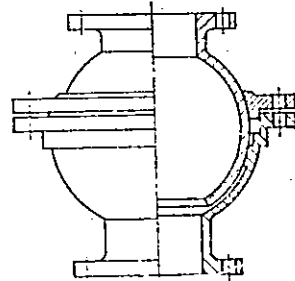


Fig. 23. Assembly in half section

d. Part sections. Part sections may be taken at convenient places to show detail which would otherwise be hidden, the boundary of such sections being shown by an irregular boundary line (type G, Clause 5) as shown in Fig. 24.

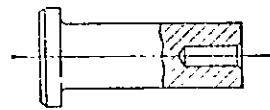


Fig. 24. Part section

e. Revolved and removed sections. Revolved sections show the shape of the cross section on the actual view of the part, the cutting plane being revolved in position (see Fig. 25).

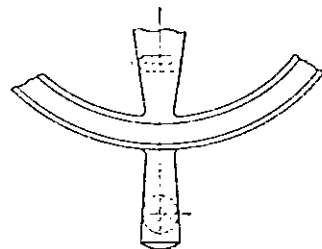


Fig. 25. Revolved sections

Removed sections are similar to revolved sections except that the cross section is removed from the actual view of the part (see Fig. 26) and a thick outline is used.

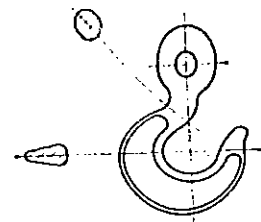


Fig. 26. Removed sections

f. Thin sections. Sections which are too thin for sectioning may be shown solid, e.g. structural shapes, sheet metal, packing, gaskets, etc. Where two or more adjacent parts are shown solid, a space should be left between them (see Fig. 27).

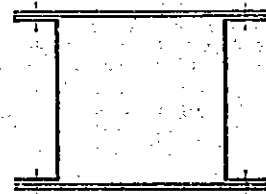


Fig. 27. Thin sections

g. Parts located in front of a cutting plane. When it is necessary to represent parts located in front of the cutting planes these parts are represented in short thin chain lines (type F, Clause 5) (see Fig. 28).

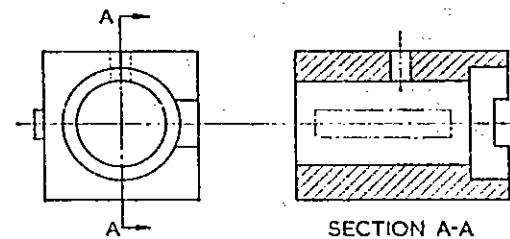


Fig. 28. Parts located in front of a cutting plane

h. Exceptions. Exceptions to the general rule for indicating sections should be made where the cutting plane passes longitudinally through ribs, shafts, bolts, nuts, rods, rivets, keys, pins and similar parts. These should be shown by outside views and not in section (see Fig. 29).

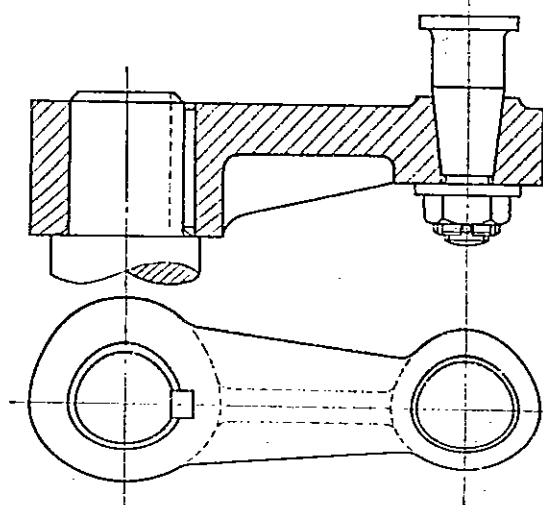


Fig. 29. Rib, shaft, key, crank pin, nut and washer not shown in section

9. CONVENTIONAL REPRESENTATION OF COMMON FEATURES AND MATERIALS

a. Common features. Conventional representation is adopted in cases where complete delineation of the part would involve unnecessary drawing-time or space. Typical

examples are shown in Figs. 30 to 35.

Where the conventional representation given is not considered adequate, a more detailed view may be shown.

TITLE	SUBJECT	CONVENTION
EXTERNAL SCREW THREADS (DETAIL)		 Preferred
INTERNAL SCREW THREADS (DETAIL)		 Preferred
SCREW THREADS (ASSEMBLY)		 Preferred
		 When this convention is used externally threaded parts are shown covering internally threaded parts.
COMPRESSION SPRINGS		 Schematic
TENSION SPRINGS		 Schematic
SPLINED SHAFTS		
SERRATED SHAFTS		

Fig. 30. Conventional representation of common features

CLAUSE 9 (contd.)

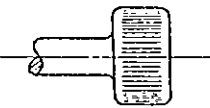
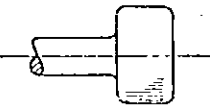
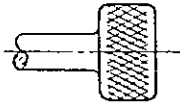
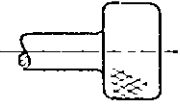
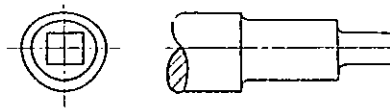
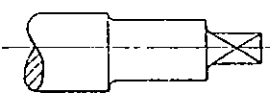
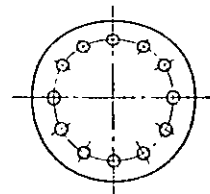
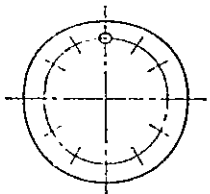
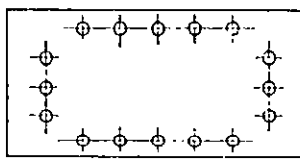
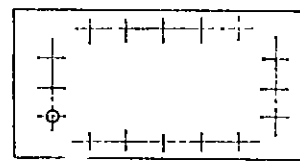
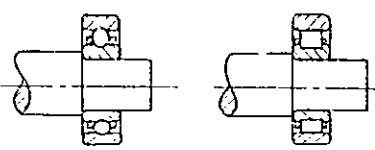
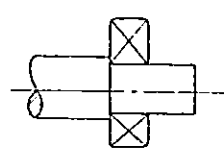
TITLE	SUBJECT	CONVENTION
STRAIGHT KNURLING.		
DIAMOND KNURLING.		
SQUARE ON SHAFT.		
HOLES ON CIRCULAR PITCH.		
HOLES ON LINEAR PITCH.		
BEARINGS.		

Fig. 31. Conventional representation of common features

CLAUSE 9 (contd.)

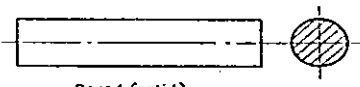
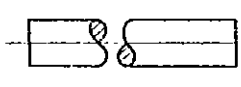
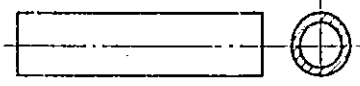
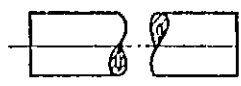
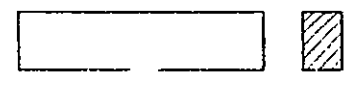
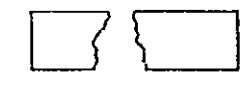
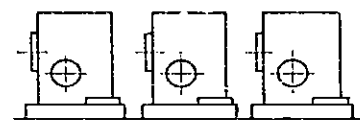
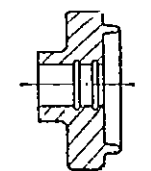
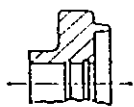
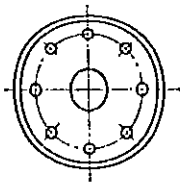
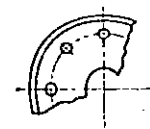
TITLE	SUBJECT	CONVENTION
BREAK LINES	 Round (solid)	
	 Round (tubular)	
	 Rectangular	
REPEATED PARTS		
TREATMENT OF SYMMETRICAL PARTS		
		

Fig. 32. Conventional representation of common features

CLAUSE 9 (contd.)

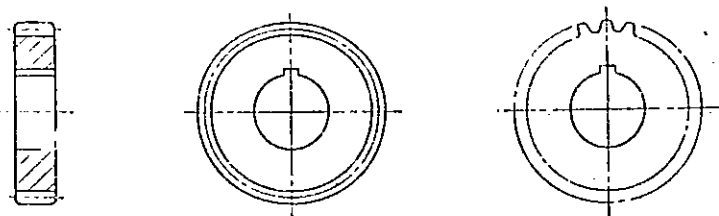
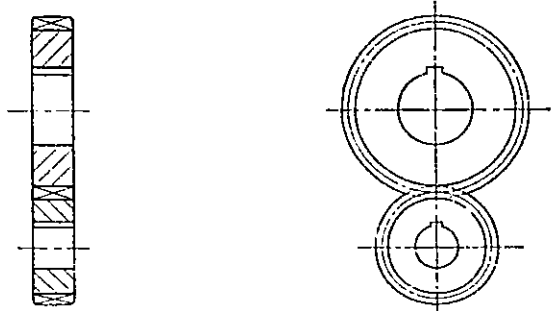
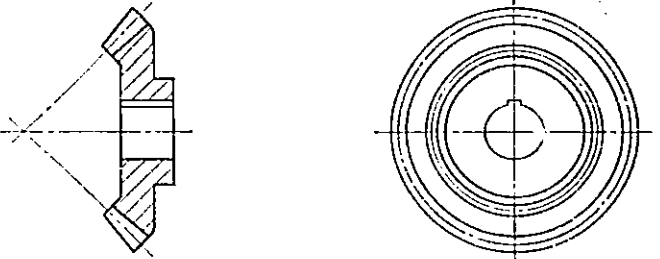
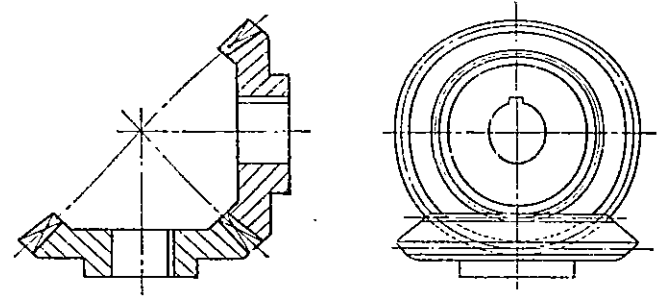
TITLE	CONVENTION
SPUR GEAR (DETAIL.)	 Alternative
SPUR GEARS (ASSEMBLY)	
BEVEL GEAR (DETAIL.)	
BEVEL GEARS (ASSEMBLY)	

Fig. 33. Conventional representation of common features

CLAUSE 9 (contd.)

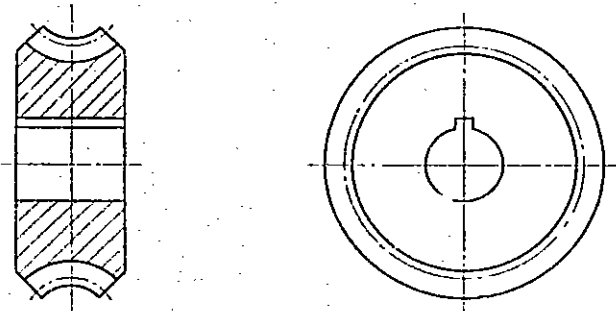
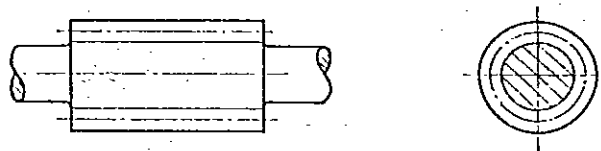
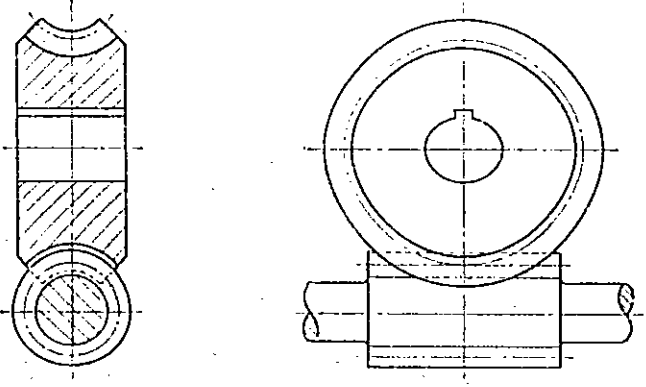
TITLE	CONVENTION
WORMWHEEL (DETAIL.)	
WORM (DETAIL.)	
WORM AND WORMWHEEL (ASSEMBLY)	

Fig. 34. Conventional representation of common features