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ENGINEERING DRAWING PRACTICE

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BRITISH STANDARD
ENGINEERING
DRAWING PRACTICE

B.S. 308 : 1953

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BRITISH STANDARDS INSTITUTION

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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.

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 2000, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook, price 12s. 6d.

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. 1265. Engineers' pattern drawing boards.

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

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.

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 :—

*Admiralty
Air Ministry
Associated Office Technical Committee
Association of Consulting Engineers' Incorporated
British Chemical Plant Manufacturers' Association
British Compressed Air Society
*British Electrical and Allied Manufacturers' Association
British Electricity Authority and Area Boards
British Engineers' Association
British Internal Combustion Engine Manufacturers' Association
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Engineering Equipment Users' Association
Gas Council

High Commission of India
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*Institution of Mechanical Engineers
Institution of Mechanical Engineers (Automobile Division)
*Institution of Production Engineers
Locomotive Manufacturers' Association
Machine Tool Trades' Association
Ministry of Fuel and Power
Ministry of Labour and National Service, Factory Department
*Ministry of Supply
Ministry of Transport
*Ministry of Works
*National Physical Laboratory
*Radio Industry Council
War Office

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 Engineering and Shipbuilding Draughtsmen
Drawing Office Material Manufacturers' and Dealers' Association
H.M. Stationery Office
Imperial College of Science and Technology
MEE/10

Institution of Engineering Draughtsmen and Designers
Ministry of Education
Society of British Aircraft Constructors
Society of Motor Manufacturers and Traders

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BRITISH STANDARD

ENGINEERING DRAWING PRACTICE

FOREWORD

This British Standard, which has been prepared under the authority of the Mechanical Engineering Industry Standards Committee, supersedes B.S. 308 : 1943, 'Engineering drawing office practice'. The most important changes concern the section on Dimensioning and Tolerancing, which has been greatly amplified in the light of valuable experience gathered during the intervening years. In other respects, the section on General Practice has been confined to recommended principles and methods to be followed in the preparation of engineering drawings. Subjects such as architectural drawings, survey plans, graphs, drawing reproduction, and the nature and handling of drawing materials have been excluded, as it is considered that such matters are more fully and appropriately dealt with in other British Standards. The appendix on British Standards for materials specifications and general engineering, which included a list of British Standards for rolled steel sections and pipes, has also been omitted, on the ground that such references may become out of date in course of time, and can always be obtained quite readily and in more detail from other B.S.I. publications.

In view of the above changes in the character of the standard, it has been considered appropriate to alter the title from 'Engineering drawing office practice' to 'Engineering drawing practice'.

In its approach to the section on Dimensioning and Tolerancing, the technical committee responsible for drafting this standard came to the conclusion that there was indisputable evidence that in some circumstances customary dimensioning and tolerancing, however well applied, did not necessarily ensure that components would assemble or function correctly. This section has therefore been drafted, firstly to ensure a reasonably uniform practice in the expression of drawing dimensions and tolerances, and secondly to provide means of tolerancing such geometrical characteristics as straightness, flatness, parallelism, squareness, angularity, concentricity, symmetry, and position.

It should be clearly understood, however, that it is not suggested that the whole comprehensive system of tolerancing need be applied unless the circumstances indicate that material advantages will accrue from the increased drawing work entailed. It rests with the design organization to decide how far it is necessary to specify geometrical tolerances in each particular instance, having regard to functional requirements, interchangeability and probable manufacturing circumstances. Drawings prepared for widespread mass production at home or abroad, or for sub-contracting in workshops of widely varying equipment and experience, may be quoted as particular

cases in which the most complete and explicit tolerancing is desirable, and in fact necessary. In such circumstances, reference back to the designer by those responsible for production and inspection is often quite impracticable, and the information given on the drawing must be so complete in dimensional and geometric requirements as to enable the work to be made, and inspected, to suit the full requirements of the design. On the other hand, a large proportion of work can be produced quite satisfactorily without resorting to tolerances on geometrical form, or even without the necessity for tolerancing the bulk of dimensions which need not be machined to very fine limits. This is particularly true where products are specially made in small quantities in a self-contained works, in which manufacturing technique, machine tool equipment and inspection organization have been built up through years of specialized experience. It is considered, however, that when the principles of geometrical tolerancing become more widely known, an increasing number of cases will be found where the full or partial application of the more complete tolerancing system set out in this standard will enable the design requirements to be expressed more exactly than hitherto, with advantage to the design, manufacturing and inspection departments.

This foreword would not be complete without an acknowledgement of the pioneer work of the Inter-Services Committee on Dimensioning and Tolerancing, which led to the publication, in 1948, by H.M. Stationery Office of 'Dimensional Analysis of Engineering Designs'. The fundamental principles established in that publication form the basis on which the Dimensioning and Tolerancing section of this revised British Standard have been considered, and those who wish to make a deeper study of the subject will find 'Dimensional Analysis of Engineering Designs' a useful volume of reference.

NOTE. It is worthy of mention that a Conference on Drawing Practice was held in Ottawa in November, 1950, between Service representatives of U.S.A., Canada and the United Kingdom, with the collaboration of industrial delegates from Canada and Britain. The British Delegation, which consisted mainly of members of the committee responsible for drafting this revision of B.S. 308, tabled a preliminary draft of the proposed section on Dimensioning and Tolerancing, which was discussed in full detail. It is significant to record that it was unanimously agreed by the Conference that drawings produced in this country in accordance with the principles of this standard would be more clearly understood in Canada and U.S.A. than hitherto. Standards of a similar nature submitted by the U.S.A. Munitions Board Standards Agency were also discussed in detail at the Conference, and a very real measure of uniformity was attained by mutual adjustment of the proposals tabled by the three countries.

A further American-British-Canadian (A.B.C.) Conference

* Now out of print

was held in New York in June, 1952, at which both Services and Industrial interests of all three countries were well represented; and discussions are continuing. It is expected that these will result in a common understanding of the principles involved and in the unification of the methods by which those principles should be expressed on drawings. It is evident, therefore, that if the drawing offices in the three countries follow the practices recommended in their respective standards, the mutual interpretation of drawings

will be materially facilitated.

Contacts have also been made during 1951, 1952 and 1953 with various European countries, through the International Organization for Standardization (I.S.O.) and further I.S.O. Conferences will be held in the future. It is hoped that the I.S.O. Standards to be issued in due course will embody many of the principles and practices on which this standard is based.

NOTES ON READING THE STANDARD

A. The figures used in the text of this standard are complete only in so far as is necessary to illustrate the point in question and they are not intended to be fully dimensioned working drawings. Except where otherwise stated the dimensions shown in the figures are in 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 should not 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 23 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. In general, the terms used in this standard are in conformity with the definitions given in B.S. 3311, 'Definitions for use in mechanical engineering'.

* In course of preparation.

SECTION ONE : GENERAL PRACTICE

1. SIZES OF DRAWINGS AND TRACINGS

a. Selection of sizes. A list of standard sizes of drawing sheets in common use is given in Column 1, Table 1. From this list a number of sizes—marked with an asterisk—have been selected as preferred sizes on the basis of the following consideration :

The economical use of standard rolls of drawing and tracing paper, tracing cloth and sensitized paper and cloth, all of which are manufactured in nominal 30 in. and 40 in. widths. When cut or printed sheets are used, these in the first place have to be cut from 30 in. and 40 in. rolls.

It is recognised that many sizes other than those marked as preferred have been in general use for a long time, and that drawing boards, plan cabinets, and filing receptacles have been designed to accommodate them. In such cases, for reasons of economy, it may be necessary to continue the use of non-preferred sizes.

It is however recommended that the preferred sizes be adopted wherever it is economically possible to do so.

TABLE 1. STANDARD SIZES

Nominal sizes of drawings and tracings. Overall dimensions in inches across edges of sheet. (See Fig. 1)		Maximum frame size. Dimensions in inches between border lines (See Fig. 1)	
A	B	C	D
*40 × 72		*38 × 70	
*40 × 60		*38 × 58	
*30 × 55		*29 × 52	
*30 × 40		*29 × 39	
27 × 40		26 × 39	
15 × 40		14 × 39	
22 × 30		21 × 29	
*20 × 30		*19 × 29	
20 × 27		19 × 26	
*15 × 20		*14 × 19	
*10 × 15		*9¼ × 14¼	
†13 × 8		12¾ × 7¾	
†10 × 8		9¾ × 7¾	

* Preferred sizes.

† Additional sizes to be in conformity with commercial stationery. Drawings which are to be filed in binders and which have heights of 13 in. or 10 in. may have widths greater than 8 in.

It is to be noted that provision has been made for a blank border which will enable prints to be trimmed if necessary without incurring the use of uneconomical sizes of sensitized material to allow for trimming. Finished prints which have been trimmed will then be slightly less in size than the original drawings but not less than the frame or border line size of the drawings.

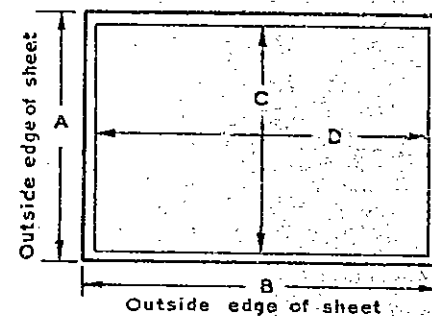


Fig. 1. Drawing sheet sizes

b. General. (i) Dimensions C and D (Fig. 1) are the recommended maximum border line sizes; these border lines may be drawn further in from the edge of the sheet if desired, for example, to provide a binding margin, or an additional allowance for trimming.

(ii) Drawing, tracing and sensitized sheets should be cut to sizes A × B. After printing, the sensitized sheets may be trimmed if necessary but it is recommended that the prints be left as large as possible. The border lines which appear on the drawings and tracings should not be trimmed off the prints.

(iii) No notes or figures which are required to be reproduced on the print should appear outside the border lines.

(iv) On the commercial stationery size sheets, border lines may be omitted if desired, but it is recommended that the drawing space utilized should not exceed that determined by the C and D dimensions.

(v) It is recommended that all drawings and tracings should be marked with the standard sheet size (A × B) in inches, or an identification letter, in a convenient place.

NOTE. For information on British Standard drawing boards reference should be made to B.S. 1265, 'Engineers' pattern drawing boards'.

2. LAYOUT OF DRAWINGS

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.

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. Repetition of drawing number. The drawing number may be repeated in other corners of the drawing to ensure that it is visible when the drawing is filed.

c. 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. 3, 4 and 5). Alternatively, this list may appear on a separate sheet (see Clause 2 e). 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 toleranced.

(vi) Tool and gauge references.

(vii) General notes. (For examples see Clause 15, page 43, in Section Two.)

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

d. Typical title blocks. Typical examples incorporating the above recommendations are illustrated in Figs. 2, 3, 4, 5 and 6.

Figure 2. 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.
Drawing or part number.
Name of part.
Scale.
Material specification.
Material form and treatment.
Finish.
Key to symbols.
General tolerances for dimensions not individually toleranced.
Date and signature.

Figures 3 and 4. 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 Clause 2 c (i)) and the title block need only provide for the general information specified in Clause 2 a.

Figure 5. 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.
Drawing number.
Job number.
Description.
Scale.
Key to symbols.
General tolerances.
Date and signature.

Figure 6. 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.

e. 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. 7.

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.

f. 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. 8.

(DRAWING No.)									
20 X 15									
DRAWING No.									
(TITLE)									
(NAME OF FIRM)									
MATERIAL		TOLERANCES		SCALE		DIN		SAD	
FORM									
FINISH									
REVISION		REVISION		REVISION		REVISION		REVISION	
MOD		MOD		MOD		MOD		MOD	
DATE		DATE		DATE		DATE		DATE	

Fig. 2. Typical layout of a drawing sheet

(DRAWING No.)									
20 X 15									
DRAWING No.									
(TITLE)									
(NAME OF FIRM)									
MATERIAL		TOLERANCES		SCALE		DIN		SAD	
FORM									
FINISH									
REVISION		REVISION		REVISION		REVISION		REVISION	
MOD		MOD		MOD		MOD		MOD	
DATE		DATE		DATE		DATE		DATE	

Fig. 3. Typical layout of a drawing sheet

Fig. 4. Typical layout of a drawing sheet

Fig. 5. Typical layout of a drawing sheet

Fig. 6. Typical layout of a drawing sheet

Fig. 6. Typical layout of a drawing sheet

Fig. 7. Typical layout of a parts list

[illegible]

Fig. 8. Typical layout of a drawing list

CLAUSE 2 (cont.)

g. 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. 3 and 4).

H. 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. 2, 3, 4 and 5.

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 instruction concerning any existing parts or work in progress.

j. Assembly drawings. Where a number of drawings are 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

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 Clause 2 h (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.

recorded in suitable tabular form on the drawing or on a separate sheet.

k. 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. 9.

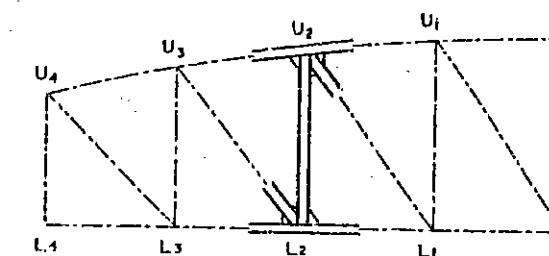


Fig. 9. Key plan

m. 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.).

n. 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.

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. 11).

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, a 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. 10. The two scales used should be clearly indicated.

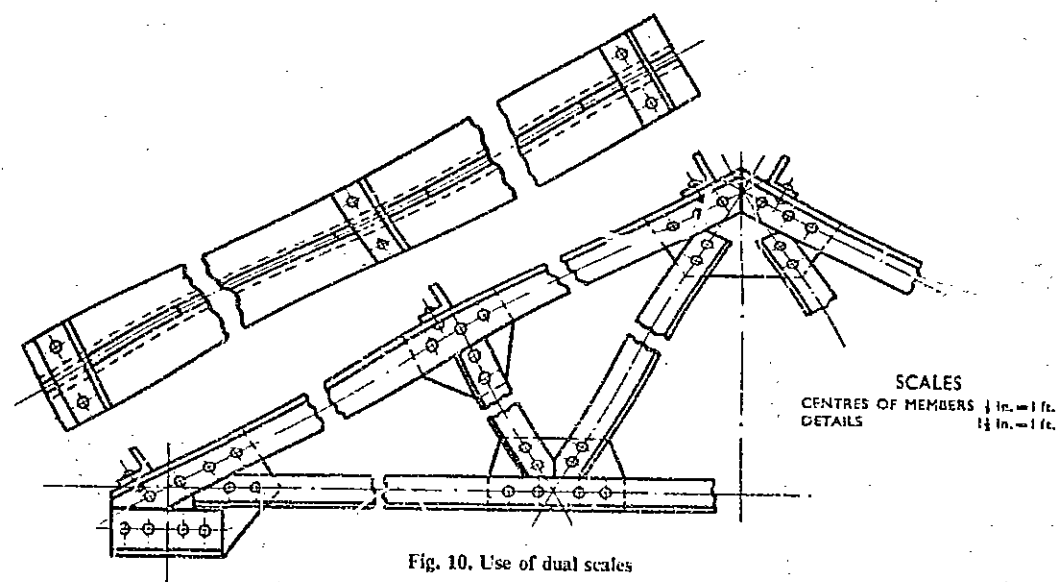


Fig. 10. Use of dual scales

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.
Short dashes (thin) C		Hidden details. Portions to be removed.
Long chain (thin) D		Centre lines. Path lines for indicating movement.
Long chain (thick) E		Cutting or viewing planes.
Short chain (thin) F		Developed or false views. Adjacent parts.
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 aid dimensioning or to correlate views, they may be extended.

Typical applications of recommended types of lines are shown in Fig. 11.

CLAUSE 5 (cont.)

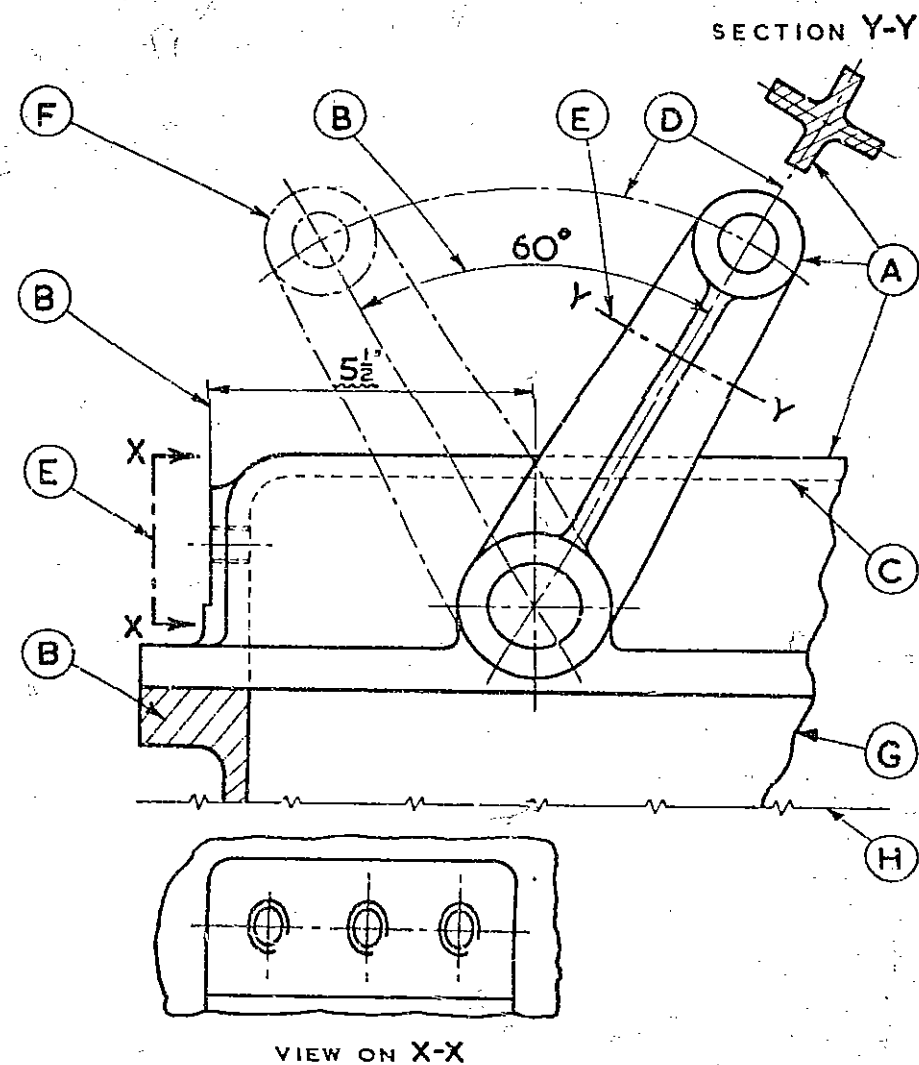


Fig. 11. Typical applications of recommended types of lines

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. 12).

In **THIRD ANGLE PROJECTION** each view shows what would be seen by looking on the near side of an adjacent view (see Fig. 13).

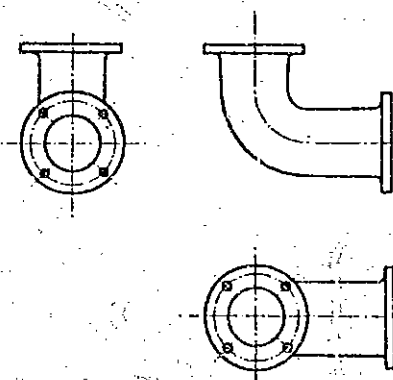


Fig. 12. Pipe bend, first angle projection

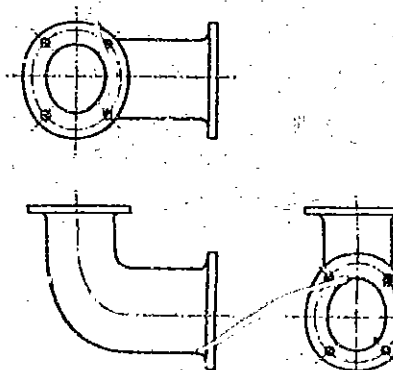


Fig. 13. Pipe bend, third angle projection

b. Marking of drawings. The drawings should be marked to indicate the method of projection used; otherwise, the directions in which the views are taken should be clearly indicated.

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. 11).

e. Auxiliary views. Objects having inclined faces may have such faces projected to show the true shape of the inclined surface (see Fig. 14).

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

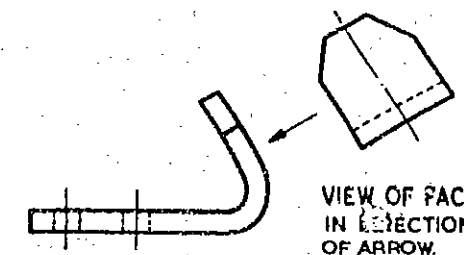


Fig. 14. Projection of inclined faces

by hand, stencil or other means

7. LETTERING

The object should be to employ uniform letters and figures which can be produced 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. 15 are given as a guide only (they have been produced by stencils).



Fig. 15. Types of lettering

8. SECTIONING 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, page 17), 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 large areas of sectioning have to be shown, it is recommended that the edges only be sectioned as shown in Fig. 16.

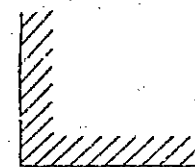


Fig. 16. Section lining of large areas

If the shape or position of the section would bring 45° sectioning parallel or nearly parallel to one of the sides, another angle may be chosen (see Fig. 17).

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

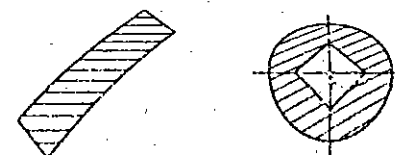


Fig. 17. Special section lining

Adjacent parts should be sectioned in different directions or to a different pitch (see Fig. 18).

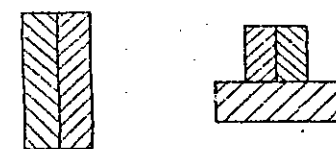


Fig. 18. Section lining for adjacent parts

Where it is necessary to insert dimensions or lettering on a sectioned area, section lines should be interrupted (see Fig. 19).

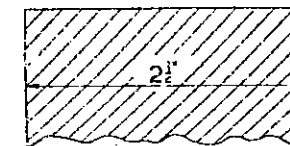


Fig. 19. Section lining interrupted for dimensions

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. 20, 21 and 22).

The following examples illustrate the methods which should be adopted:

Fig. 20. A section in one plane not on a centre line.

Fig. 21. A section in one plane along a centre line.

Fig. 22. 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, page 17).

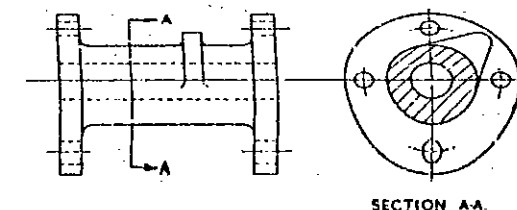


Fig. 20. Section in one plane not on centre line

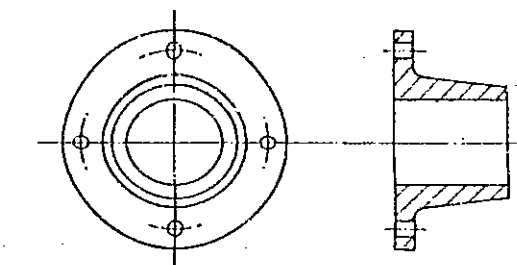


Fig. 21. Section in one plane along centre line

CLAUSE 8 (cont.)

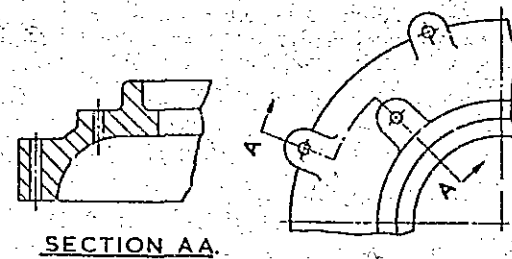


Fig. 22. Section in two planes

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. 23).

Hidden lines behind the cutting plane (see right hand half section, Fig. 23) should be omitted unless required for the definition of the object.

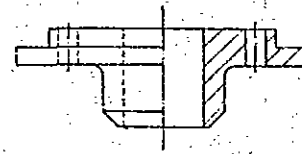


Fig. 23. Detail in half section

Hidden lines on the unsectioned side (see left hand side, Fig. 23) 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. 24).

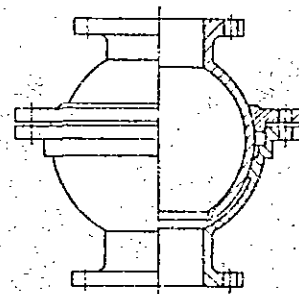


Fig. 24. Assembly in half section

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, page 17) as shown in Fig. 25.

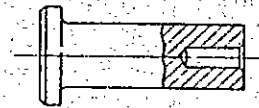


Fig. 25. Part section

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. 26).

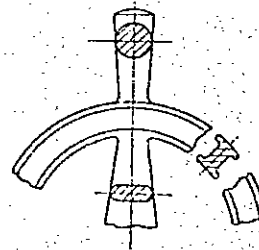


Fig. 26. Revolved sections

Removed sections are similar to revolved sections except that the cross section is removed from the actual view of the part (see Fig. 27).

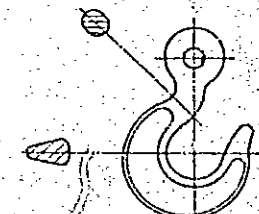


Fig. 27. Removed sections

CLAUSE 8 (cont.)

f. Thin sections. Sections which are too thin for line 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. 28).

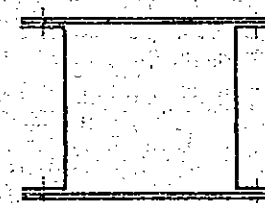


Fig. 28. Thin sections

g. 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).

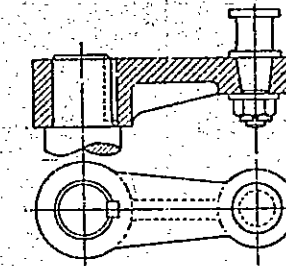


Fig. 29. Rib, shaft, and crank pin not shown in section

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.

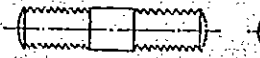
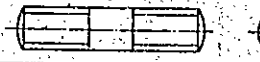
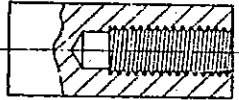
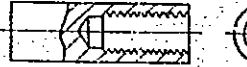
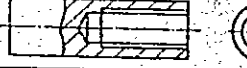
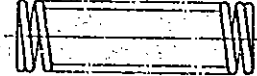
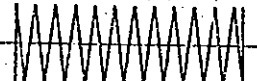
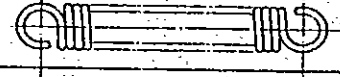
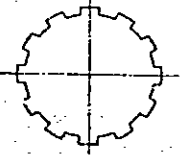
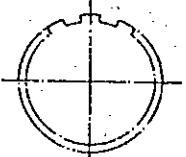
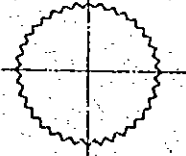
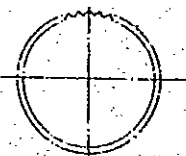
TITLE	SUBJECT	CONVENTION
EXTERNAL SCREW THREADS		
		
		 ALTERNATIVE
INTERNAL SCREW THREADS		
		
		 ALTERNATIVE
COMPRESSION SPRINGS		
		 SCHEMATIC
TENSION SPRINGS		
		 SCHEMATIC
SPLINED SHAFTS		
SERRATED SHAFTS		

Fig. 30. Conventional representation of common features

CLAUSE 9 (cont.)

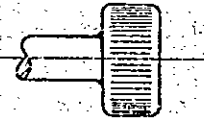
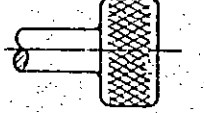
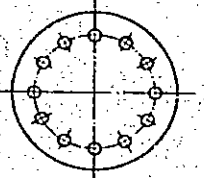
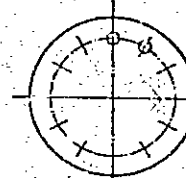
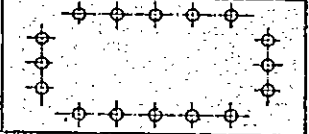
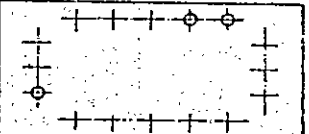
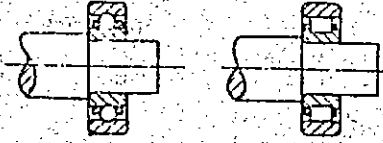
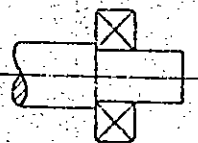
TITLE	SUBJECT	CONVENTION
STRAIGHT KNURLING.		
DIAMOND KNURLING.		
SQUARE ON SHAFT.		
HOLES ON CIRCULAR PITCH.		
HOLES ON LINEAR PITCH.		
BEARINGS.		

Fig. 31. Conventional representation of common features

CLAUSE 9 (cont.)

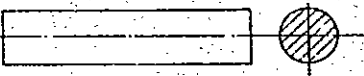
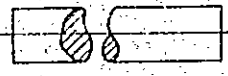
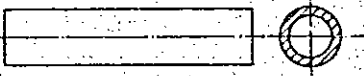
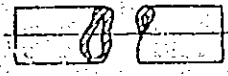
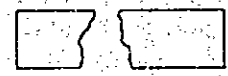
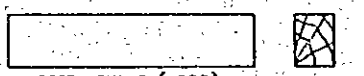
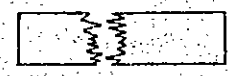
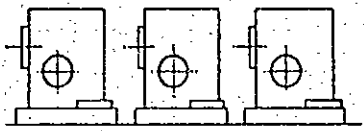
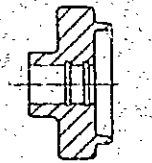
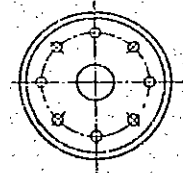
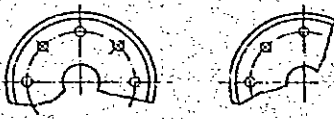
TITLE	SUBJECT	CONVENTION
BREAK LINES	 ROUND (SOLID)	
	 ROUND (TUBULAR)	
	 RECTANGULAR	
	 RECTANGULAR (WOOD)	
REPEATED PARTS		
TREATMENT OF SYMMETRICAL PARTS	 	 

Fig. 32. Conventional representation of common features

CLAUSE 9 (cont.)

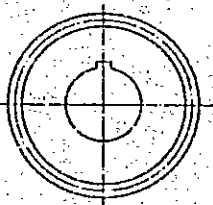
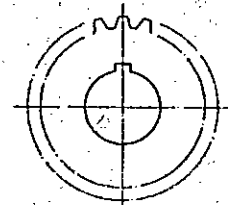
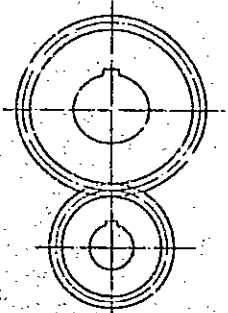
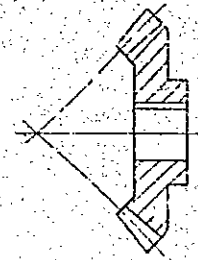
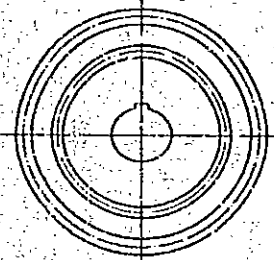
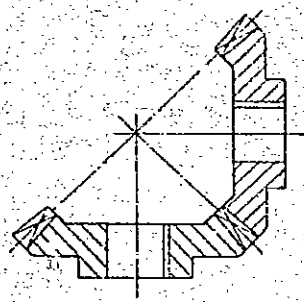
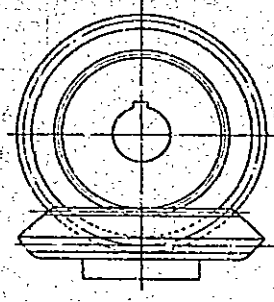
TITLE	CONVENTION
SPUR GEAR (DETAIL)	   ALTERNATIVE
SPUR GEARS (ASSEMBLY)	 
BEVEL GEAR (DETAIL)	 
BEVEL GEARS (ASSEMBLY)	 

Fig. 33. Conventional representation of common features

CLAUSE 9 (cont.)

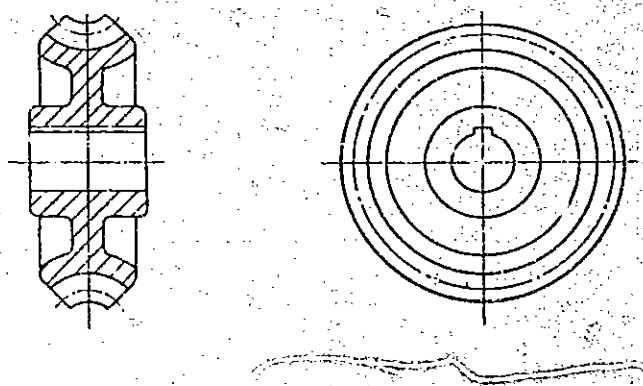
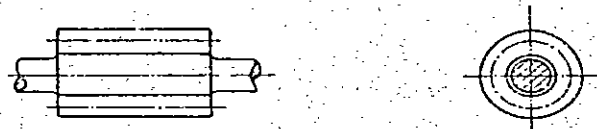
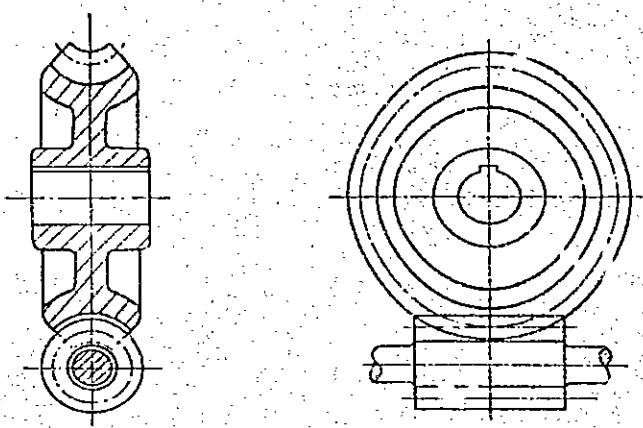
TITLE	CONVENTION
WORMWHEEL (DETAIL)	
WORM (DETAIL)	
WORM AND WORMWHEEL (ASSEMBLY)	

Fig. 34. Conventional representation of common features

CLAUSE 9 (cont.)

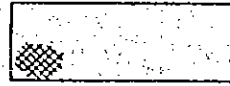
TITLE	CONVENTION
ELECTRIC WINDING	
FINE WIRE MESH	
COARSE WIRE MESH	
PERFORATED SHEET	

Fig. 35. Conventional representation of common features

b. Materials. (i) *Sectioning.* In view of the variety of materials used it is undesirable to rely on the various conventions of section lining to differentiate between different materials.

It is therefore recommended that, with the exception of insulation, glass, wood, concrete and water, ordinary section lining be used in all cases where materials are shown in section.

Fig. 37 illustrates recommended methods of showing insulation, glass, wood, concrete and water.

(ii) *Colouring.* Where it is desired to indicate materials in section by colours or coloured lines, the following are recommended:

Material	Colour
Cast iron	Payne's grey
Wrought iron	Prussian blue
Steel	Purple
Brass, phosphor bronze and gunmetal	Light yellow
Copper	Crimson lake
Aluminium, tin, white metals and light alloys	Light green
Brickwork	Vermilion
Concrete	Light green
Earth, rock	Sepia
Timber	Burnt sienna
Glass	Pale blue wash
Insulation (electrical)	Black

c. Methods of indicating rivets. Normally, rivets may be indicated sufficiently by their centre lines in the direction of, and at right angles to, the seams.

In long seams such indication need only be shown at each end, the intermediate rivets being indicated only by the centre lines of the rivet rows in the direction of the seam (see Fig. 36).

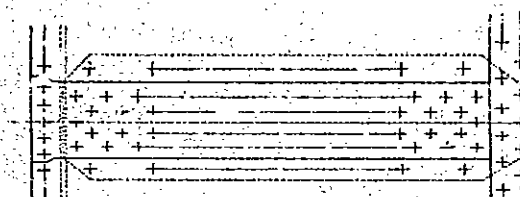


Fig. 36. Indication of rivets

d. Rivet symbols. Where symbols are used to indicate types of rivet, a key to the symbols should be shown.