Fundamentals
M7
MAINTENANCE PRACTICES

Rev.-ID: 1
Author: DiO
For Training Purposes Only
©LTT Release: Jul. 22, 2013

M7.5
Engineering Drawings, Diagrams and Standards

EASA Part-66
CAT B1

Training Manual

Lufthansa Technical Training

For training purposes and internal use only.

© Copyright by Lufthansa Technical Training (LTT).

LTT is the owner of all rights to training documents and training software.

Any use outside the training measures, especially reproduction and/or copying of training documents and software – also extracts there of – in any format at all (photocopying, using electronic systems or with the aid of other methods) is prohibited.

Passing on training material and training software to third parties for the purpose of reproduction and/or copying is prohibited without the express written consent of LTT.

Copyright endorsements, trademarks or brands may not be removed.

A tape or video recording of training courses or similar services is only permissible with the written consent of LTT.

In other respects, legal requirements, especially under copyright and criminal law, apply.

Lufthansa Technical Training

Dept HAM US
Lufthansa Base Hamburg
Weg beim Jäger 193
22335 Hamburg
Germany

Tel: +49 (0)40 5070 2520
Fax: +49 (0)40 5070 4746
E-Mail: Customer-Service@LTT.DLH.DE

www.Lufthansa-Technical-Training.com

Revision Identification:

- The date given in the column "Revision" on the face of this cover is binding for the complete Training Manual.
- Dates and author's ID, which may be given at the base of the individual pages, are for information about the latest revision of that page(s) only.
- The LTT production process ensures that the Training Manual contains a complete set of all necessary pages in the latest finalized revision.

© Lufthansa Technical Training

M7 MAINTENANCE PRACTICES

M7.5 ENGINEERING DRAWINGS, DIAGRAMS AND STANDARDS

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

DRAWING TYPES, DIAGRAMS, SYMBOLS, DIMENSIONS, TOLERANCES AND PROJECTIONS

Engineering drawings general

Introduction

Engineering drawings contain all the information which is required for production, assembly, work planning, checking and inspection of parts or assemblies.

Standards set the criteria which should be followed when creating an engineering drawing.

As well as showing the shape by drawing, the actual size of the shape must be given.

Furthermore information about e. g. material, heat treatment, surface treatment, connection to other components/assemblies, manufacturing method, working sequence, assembly/disassembly is required.

Reading Drawings

Reading a drawing means you are able to realize all the information, which is given in the drawing and the corresponding lists, correctly. Therefore the worker must be familiar with common drawing practices.

Drawing Sheet Sizes

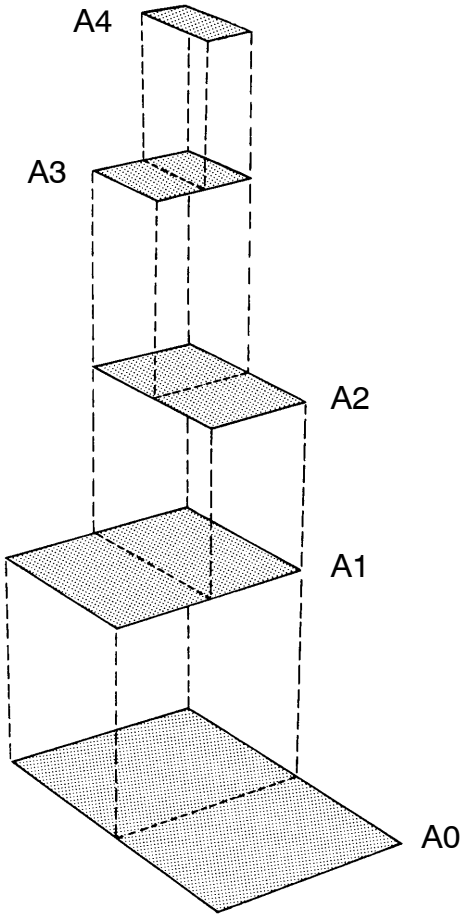
Engineering drawings from the European aircraft producer Airbus are given normally in the 'A'- DIN standard paper-size

The dimensions given (opposite) are the overall size of the sheets; the actual drawing frame is smaller.

The American company Boeing uses American standards for paper-size.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training



A4	210mm x 297mm
A3	297mm x 420mm
A2	420mm x 594mm
A1	594mm x 841mm
A0	841mm x 1189mm

Figure 1 DIN „A“ Standard Paper-Sizes

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

AIRCRAFT ENGINEERING DRAWINGS

Specifications

The layout, content and numbering system for aircraft engineering drawings is decreed by ATA Spec. 100 or the iSpec 2200 of the Air Transport Association of America.

Scale

Drawings are normally drawn to a uniform scale which is stated on the drawing and is usually shown in a scale box by a ratio e. g. 1:1 (full size), 1:2 (half size), etc.

Drawings to scale 1:1 would be too large to handle comfortably. Therefore they are printed smaller or are drawn in a smaller scale.

During this 'shrinking' process actual dimensions can become distorted, so taking a measurement directly from the print would invariably be inaccurate. In the working process it is not allowed to measure in the drawing to determine a dimension which is not given.

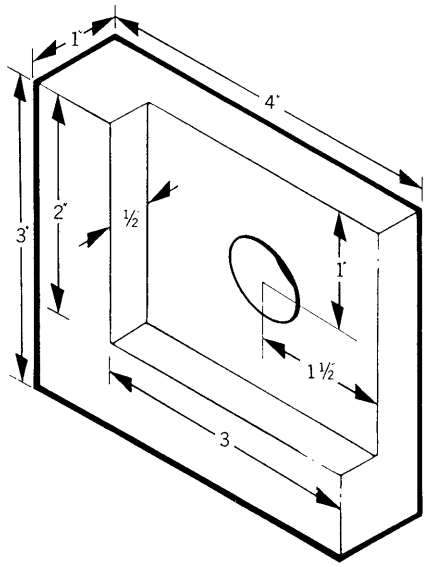
If a particular dimension has been omitted, enquiry must be made to the Design Office or appropriate authority for the information.

VIEWS

Pictorial (isometric) view

Isometric is a mathematical method of constructing a 3–dimensional object on a 2–dimensional area in such a way, that a spatial and therefore more realistic view is created.

An isometric drawing shows two sides of the object and the top or bottom of the object. All vertical lines are drawn vertically, but all horizontal lines are drawn at 30° to the horizontal.



Isometric
View

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

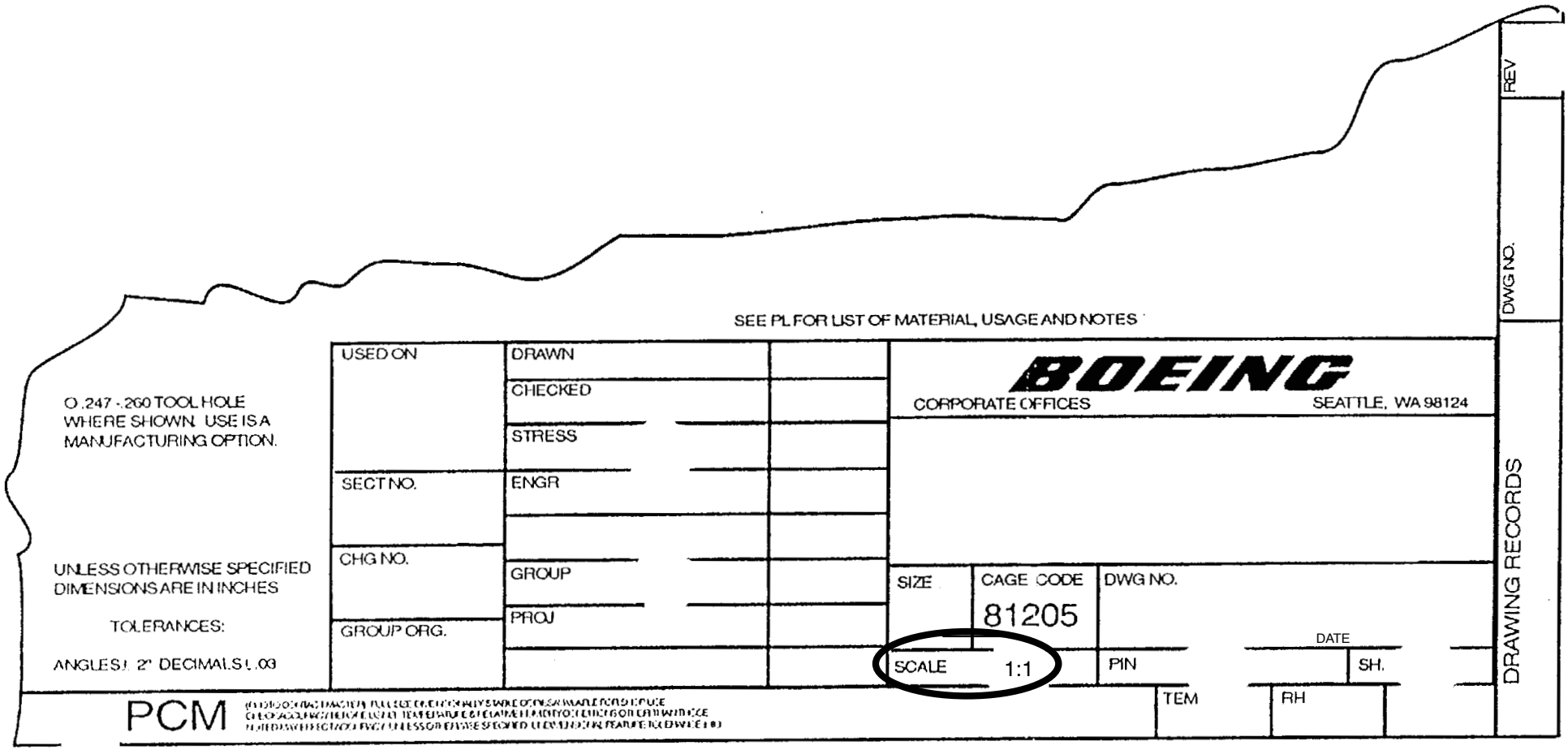


Figure 2 Scale

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Projection

Projection methods

In the title block the projection method is described according to which the parts are geometrically and in scale depicted in the drawing area. Thereby it is made a difference between the European and the American projection method.

The standard views in the European drawings are:

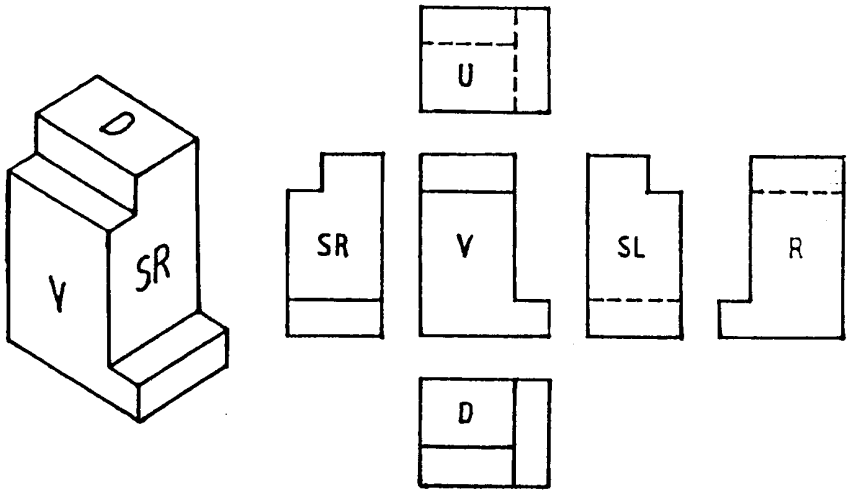
- Front View
- Side View
- Top View

The standard views in the American drawings are:

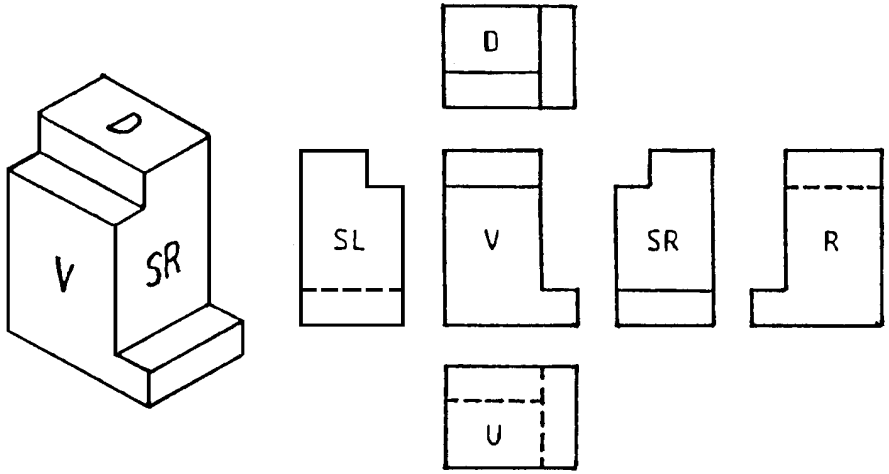
- Top View
- Left Side View
- Rear View

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training



European projection method



American projection method

Figure 3 Projections

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

SECTIONAL VIEWS

General

A sectional view shows the object drawn as if part of it is removed so that the interior shape is seen clearly. For this purpose the cutting plane selected must be clearly shown on one of the other views.

As the example opposite shows, section lines are drawn equally spaced across the material which has been cut. These section lines, sometimes called hatching lines, are drawn at 45° to the axis of the section.

If the drawing shows an assembly of parts, adjacent parts are hatched in different directions so as to distinguish the separate parts clearly.

Nuts, bolts, rivets, shafts and ribs are not normally shown in longitudinal section.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

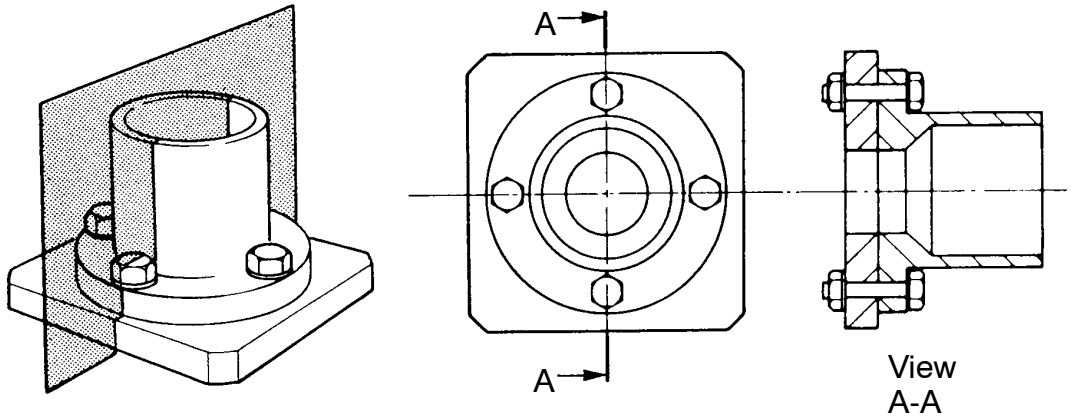


Figure 4 Sectional View

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Sectional views (contd.)

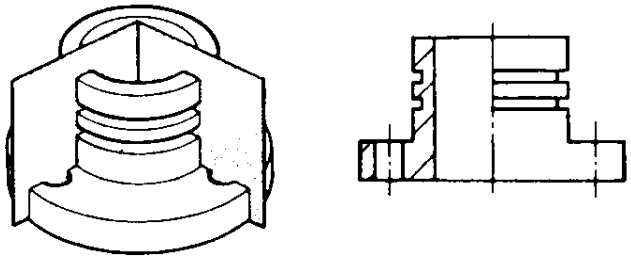
Part -, Half -, and Staggered Sections

If a full section is not necessary, a part or half section is used. Therefore a view is created from the side face, which shows the outer contours and the section area of the part.

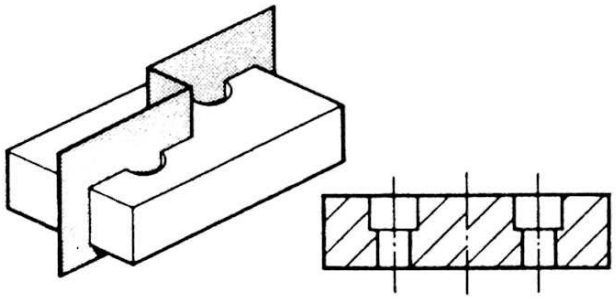
Staggered sections are often used to illustrate particular features. At this the section is located in different directions in the drawing; this means that the section axis is not straight but rotated with a corresponding degree.

FOR TRAINING PURPOSES ONLY!

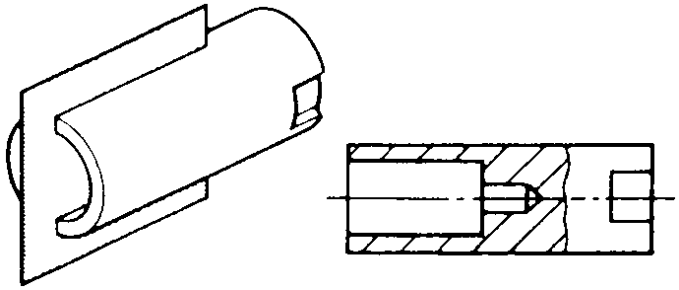
© Lufthansa Technical Training



Half section



Staggered section



Part section

Figure 5 Part-, Half- and Staggered Section

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Sketches and perspectives

Sketches

A sketch is a loosely-structured hand-drawing graphically depicting an object.

They are typically created without the benefit of drawing instruments. For this reason, an invaluable aid when creating a sketch is graph paper.

Perspectives

A perspective drawing shows an object in the way the human eye sees it.

Lines used to construct this type of drawing meet up at a distant point - the **vanishing point**.

Perspective drawings are seldom used in engineering, as they cannot accurately portray dimensions.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

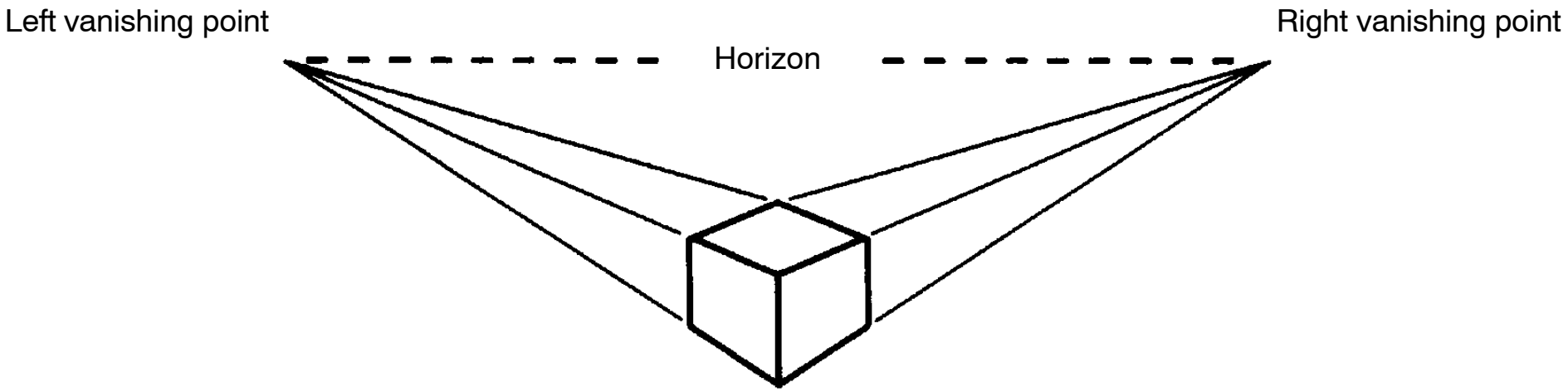


Figure 6 Perspective

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

AUXILIARY VIEWS

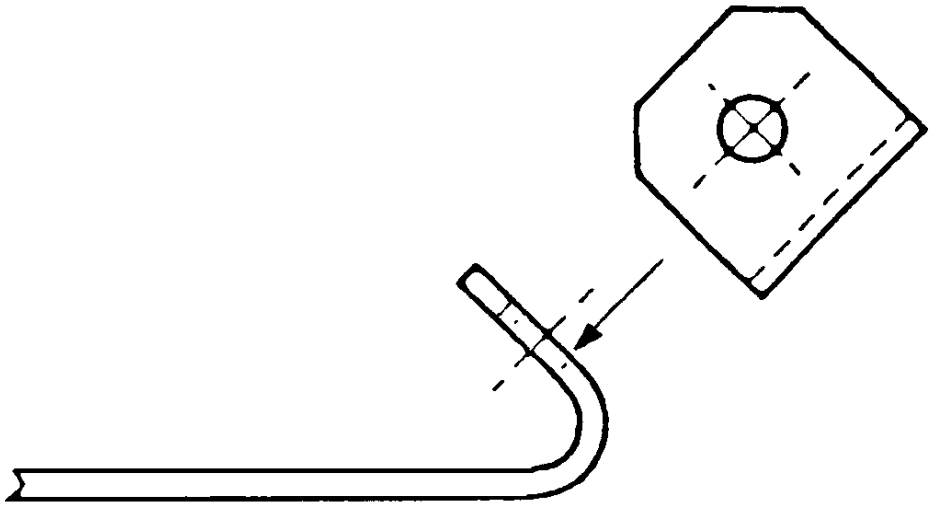
General

None of the types of view mentioned will show the true shape of a surface if it is inclined to the normal planes of projection.

The true shape of such a surface is shown by means of an auxiliary view drawn at right angles to the surface.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training



View In Direction of Arrow

Figure 7 Auxiliary View

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Dimensioning from a common datum

General

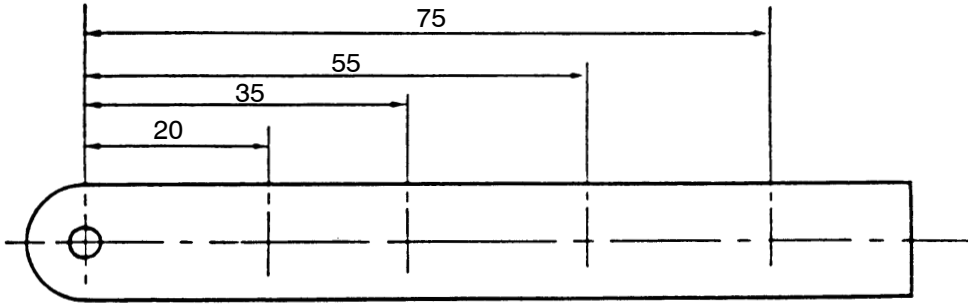
One of the methods shown below is usually used when dimensions are given from a common datum.

Chain dimensions (e. g. from hole to hole) are not often used since they allow a build up of tolerances.

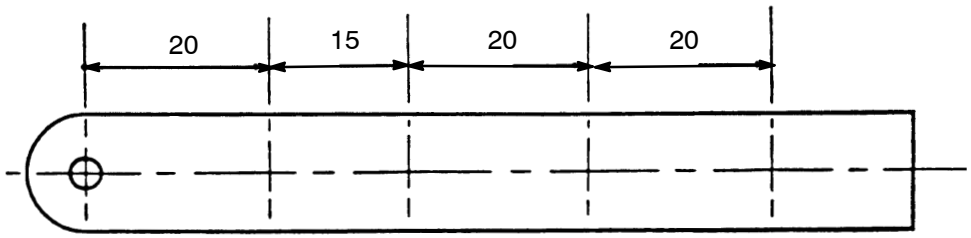
An alternative method, used with riveted joints, is to locate the end holes and add a note such as ’11 rivets equally spaced.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training



Dimensioning from a common datum



Chain dimensions

Figure 8 Dimensioning

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

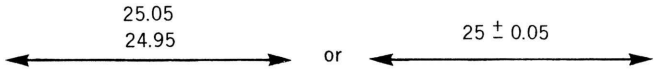
Dimensional Tolerances

It is the aim of modern engineering production to produce parts economically and to an acceptable degree of accuracy by using high-class machines.

If it has been assured that the parts are manufactured according to the dimensional tolerances, the parts are accurately fitting and fully interchangeable.

This is done by adopting a system of limits which, in practice, defines how much bigger or smaller than the basic size an item is allowed to be.

In practice, therefore, on an engineering drawing, a basic linear dimension of 25 millimeters is likely to appear so:



This indicates that, although ideally the required size of the item is 25 mm, in practice, provided that its actual size falls between the extremes shown, the item is acceptable.

The upper dimension is the maximum permitted size or the **High Limit** and the lower dimension is the minimum or **Low Limit**. The difference between these high and low limits of size is called the **tolerance**.

In the example above, the limits of size are in each case 25.05/24.95mm; the tolerance is the difference between them, which is 0.10mm.

A tolerance may be 'unilateral' or 'bilateral'. The examples used in the previous paragraph are bilateral tolerances because the dimensional variation is disposed both above and below the **basic size** (25mm).

A unilateral tolerance is one which permits a variation in one direction only, either above or below the basic size, which means plus or minus the tolerance.

When an overall general tolerance is applied to the majority of dimensions, a general note to this effect is used.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

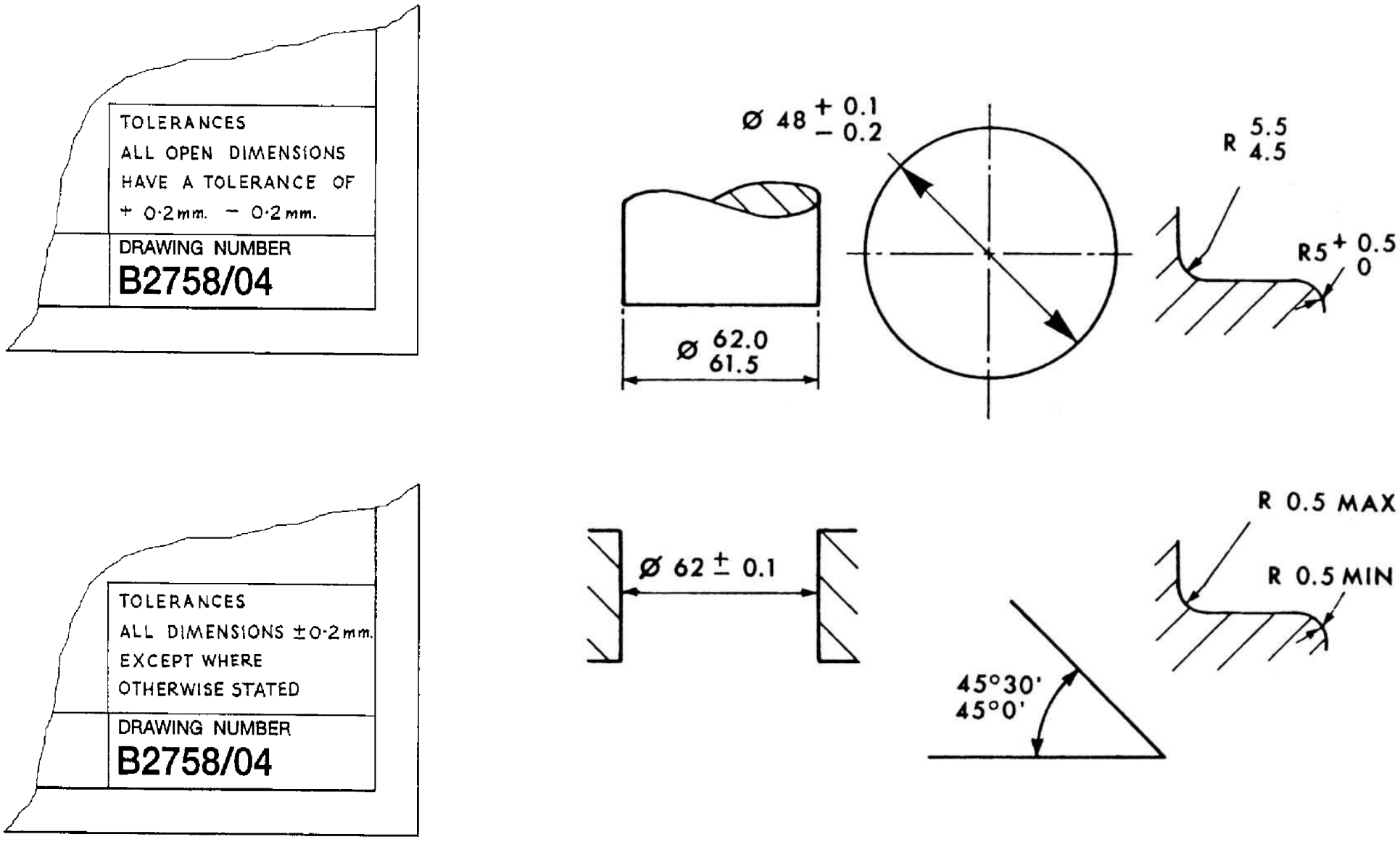


Figure 9 Dimensional Tolerance

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

TYPES AND USE OF LINES (CONTID.)

Break Lines

Because of limited space on a sheet of drawing paper, and so as to produce a compact drawing, the use of break lines is often practised. Through break lines it is possible to show a continous body or item not in its full elongation without losing any essential informations in the drawing.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

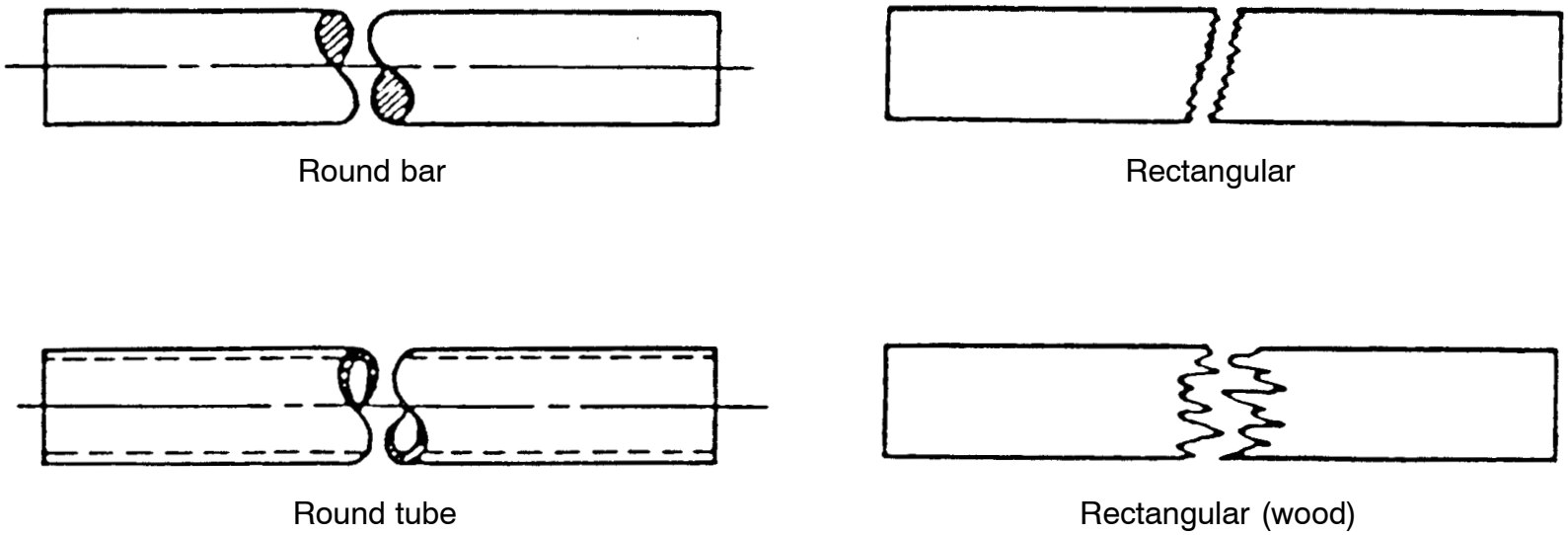


Figure 10 Break Lines

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

REPETITIVE INFORMATION

General

Where several features are repeated in a regular pattern, such as rivets, bolts or slots, only the number required to establish the pattern may be shown, by marking their centerlines. Any further information may be given in a note.

The graphic below shows a typical skin joint which could be drawn and simplified in this manner.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

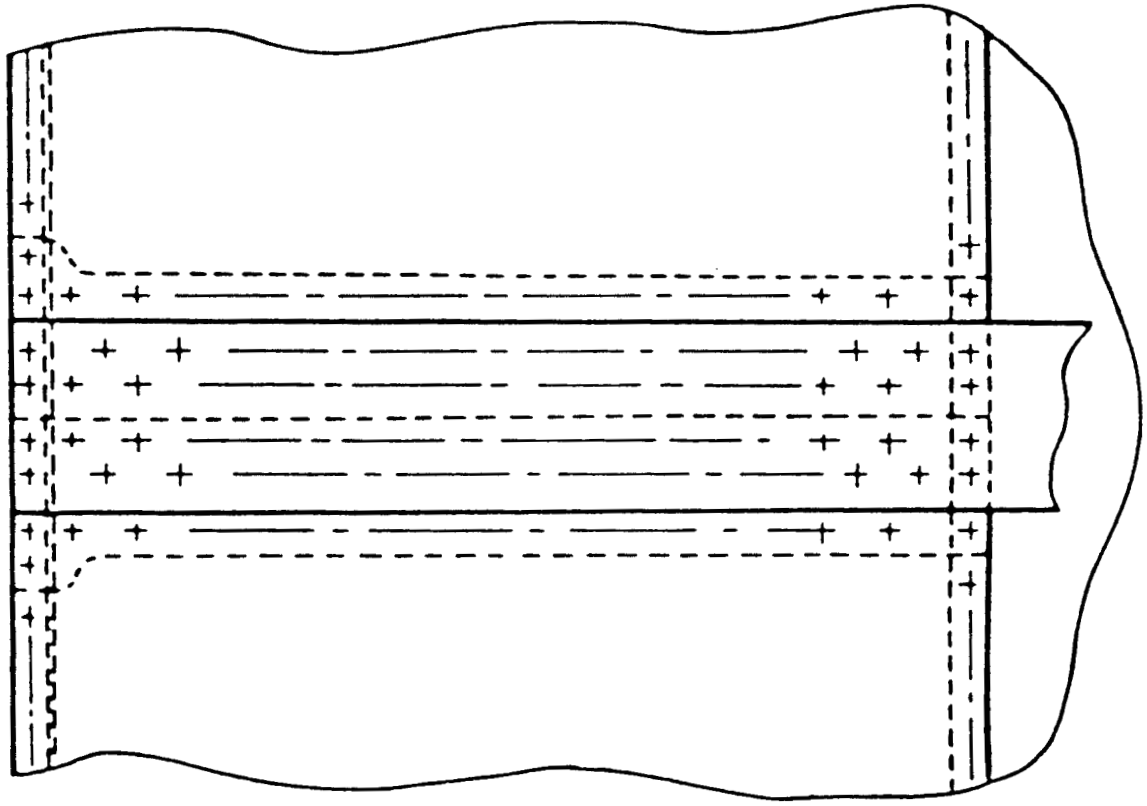


Figure 11 Repetitive Information

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Drawing reading fundamentals

General

The ability of drawing reading means that you are familiar with the engineering production drawing, procedures and specifications and are able to realize this information in the right way.

Furthermore the fabrication, assembly and installation of the components have to be described.

Production drawing

Drawings used in the design, construction and maintenance of engineering projects are called ”production drawings”.

Tool drawing

Drawings used in the design, construction and maintenance of the jigs, tools and checking fixtures are called ”tool drawings”.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

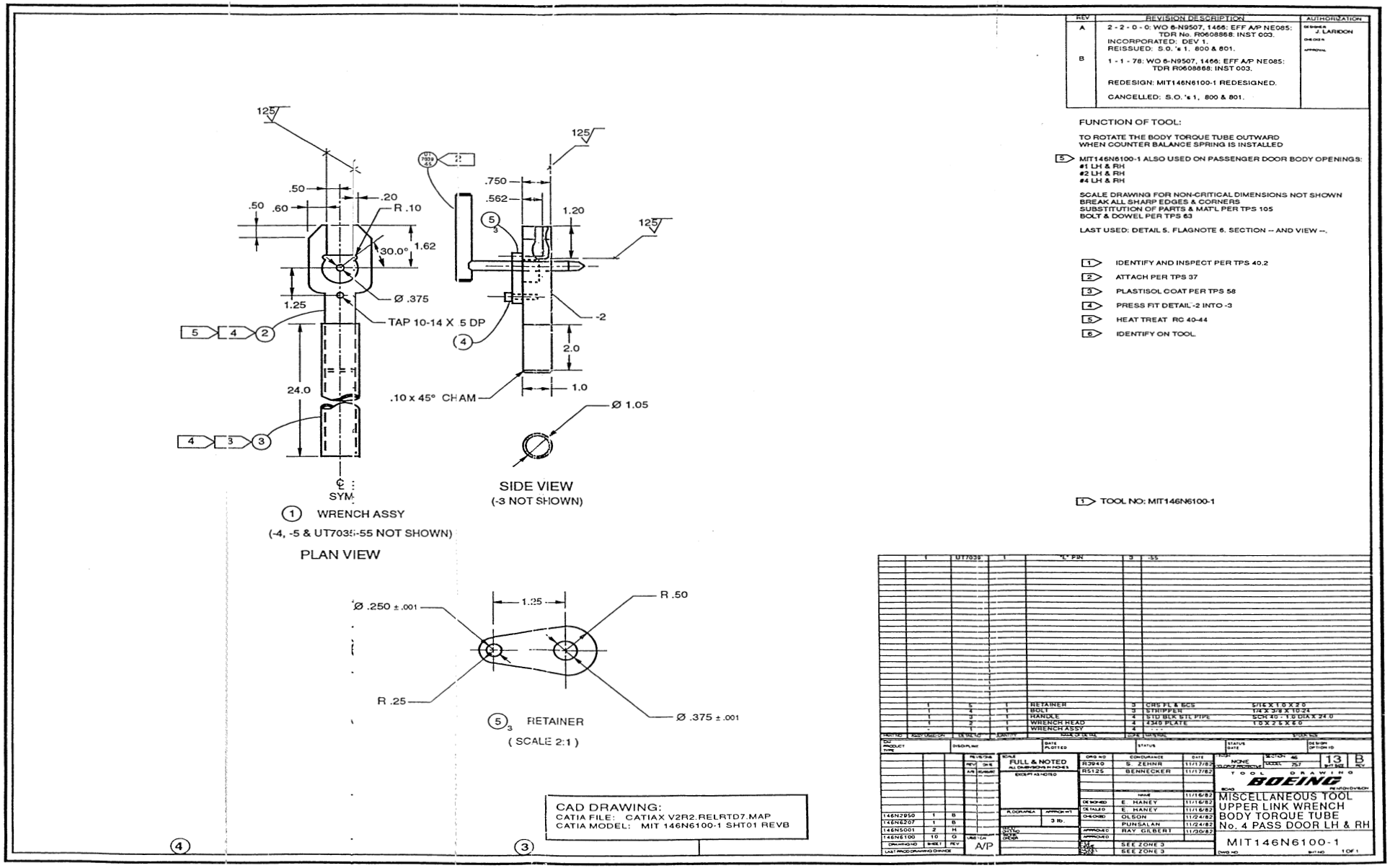


Figure 12 Tool Drawing

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Detail Drawings

General

Drawings used in the detailing or fabrication of single parts are called ”detail” drawings.

Most detail drawings are easily recognized by their titles. If the word ”assembly” or ”Installation” does not appear in the title, the drawing is a detail drawing.

An inseparable assembly delineates items or parts separately fabricated and permanently joined together, such as welded or riveted parts not subject to disassembly. The size of the drawing is governed only by the size of the part or parts being detailed.

Detail drawings do not ordinarily show location, position or fastening method. They will occasionally show where a fastener will eventually be installed, but they do not show the fastener itself.

Detail drawings are designed primarily to give instruction for fabrication personnel and provide only information used to make a part, since the assembly and installation information is of little value in fabrication work.

Detail drawing information includes:

- Size and shape description
- Material and heat treatment requirements
- Machine finish if required (surface smoothness for metal)
- Protective finish Instruction (painting, plating, etc.)
- Part numbering and marking instructions
- The next higher drawing number (by lists).

The engineer may not issue a separate detail drawing for each individual part. Frequently, several parts are detailed on one detail drawing, or some parts are detailed on assembly or installation drawings.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

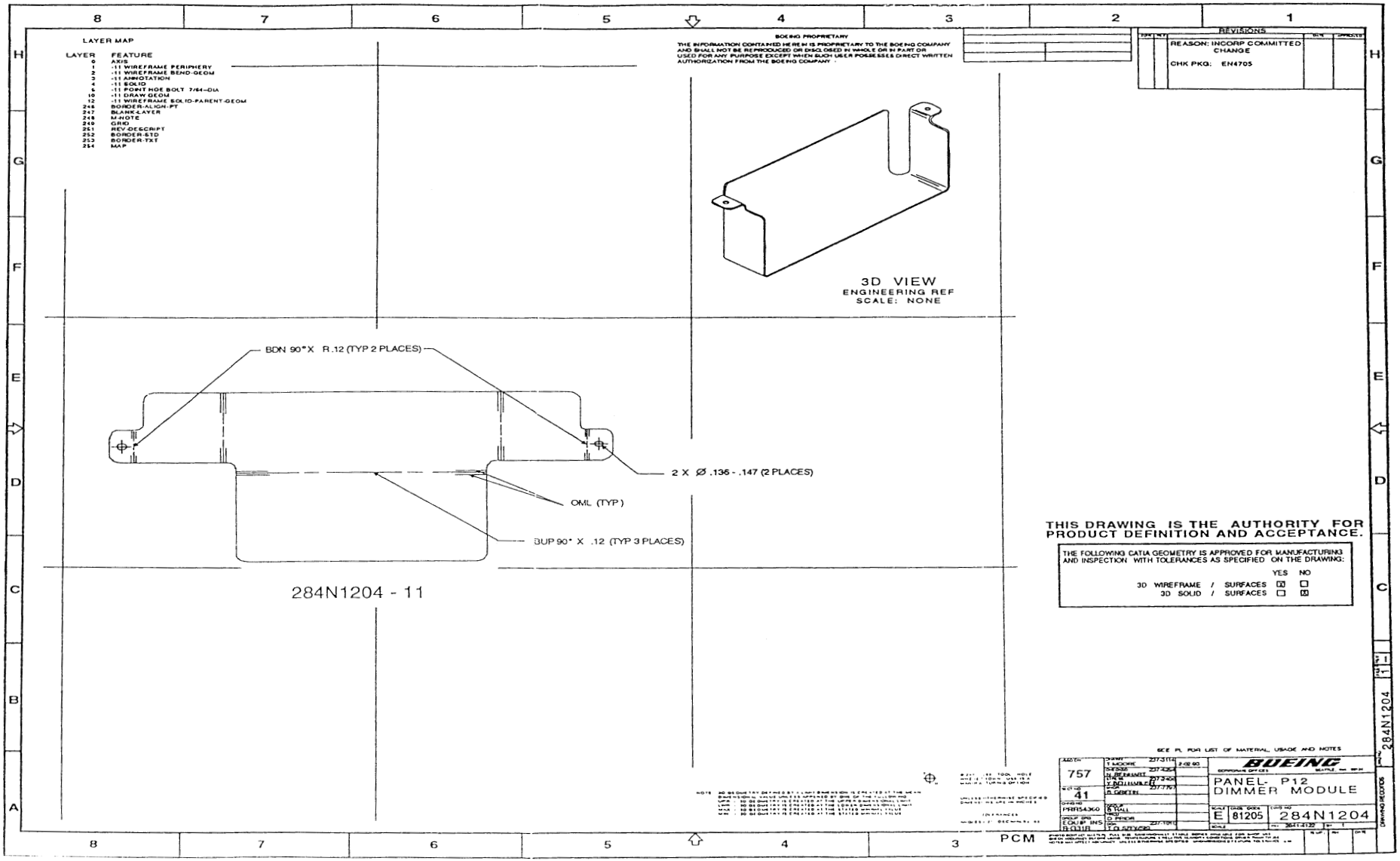


Figure 13 Detail Drawing

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Assembly Drawings

General

An assembly may be comprised of only two parts or many, depending on the whim of the designer. In some cases, a large assembly may comprise several small assemblies fastened together.

Information about how to locate the parts in reference to each other (not in reference to the entire airplane or vehicle) and about how to fasten them together is called ”assembly Information”.

The primary function of the assembly drawing is to show the relationship of two or more parts and subordinate assemblies, or a group of assemblies to form an assembly of a higher order.

An assembly drawing must provide five items of information:

- A list of required component parts and process specifications
- Location dimensions (showing exactly how parts fit together)
- Fastening methods
- A part number for the finished assembly
- The next higher drawing number (where the assembly will be used).

NOTE: Some of this information can be found in the Parts List.

In addition, an assembly drawing may provide detail fabrication information about some or all the parts from which it is made. Thus, many are actually combination detail/assembly drawings. These are called assembly drawings even though they are not strictly assembly. Many assembly drawings contain some detail fabrication information.

Most assembly drawings are recognized by their drawing titles, which must contain the word assembly” or ”ASSY”.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

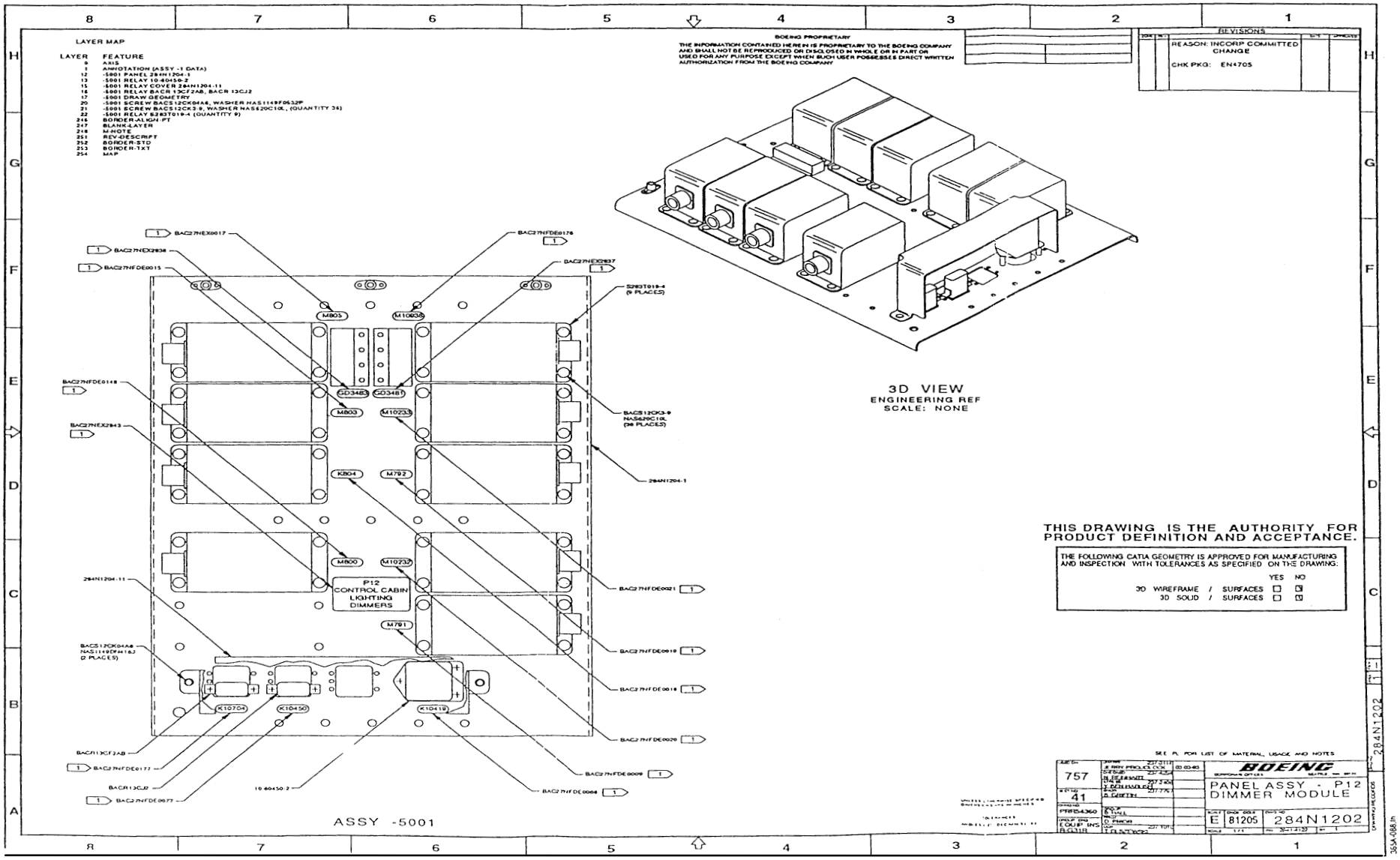


Figure 14 Assembly Drawing

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Installation drawings

General

Installation drawings are designed to describe exactly where on the airplane or vehicle, or in a portion of the airplane or vehicle, certain parts or assemblies are to be permanently affixed.

Installation drawings must provide the following information:

- A list of required component parts (parts list)
- A list of process specifications
- Location dimensions (in reference to the entire airplane or vehicle)
- Fastening methods
- A part number for the finished installation
- The next higher drawing number.

ATTENTION: Some of this Information is found in the Parts List.

Note that the Items listed above are almost identical to those listed for assembly drawings. The major difference between the two lies in the interpretation of the word ”location”. Assembly drawings give locations of parts only as they pertain to each other; Installation drawings give position within the aircraft or vehicle structure.

It is also possible that installation drawings contain information which is normally described on detail- or assembly drawings. In this case the installation drawing is a combination of detail -, assembly and installation drawing. Anyhow the word ”installation” appears in the title of the drawings

Installation drawings often describe so much parts that they can not all be shown on the drawing paper. That is the reason why you can find several drawing papers for one drawing number.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

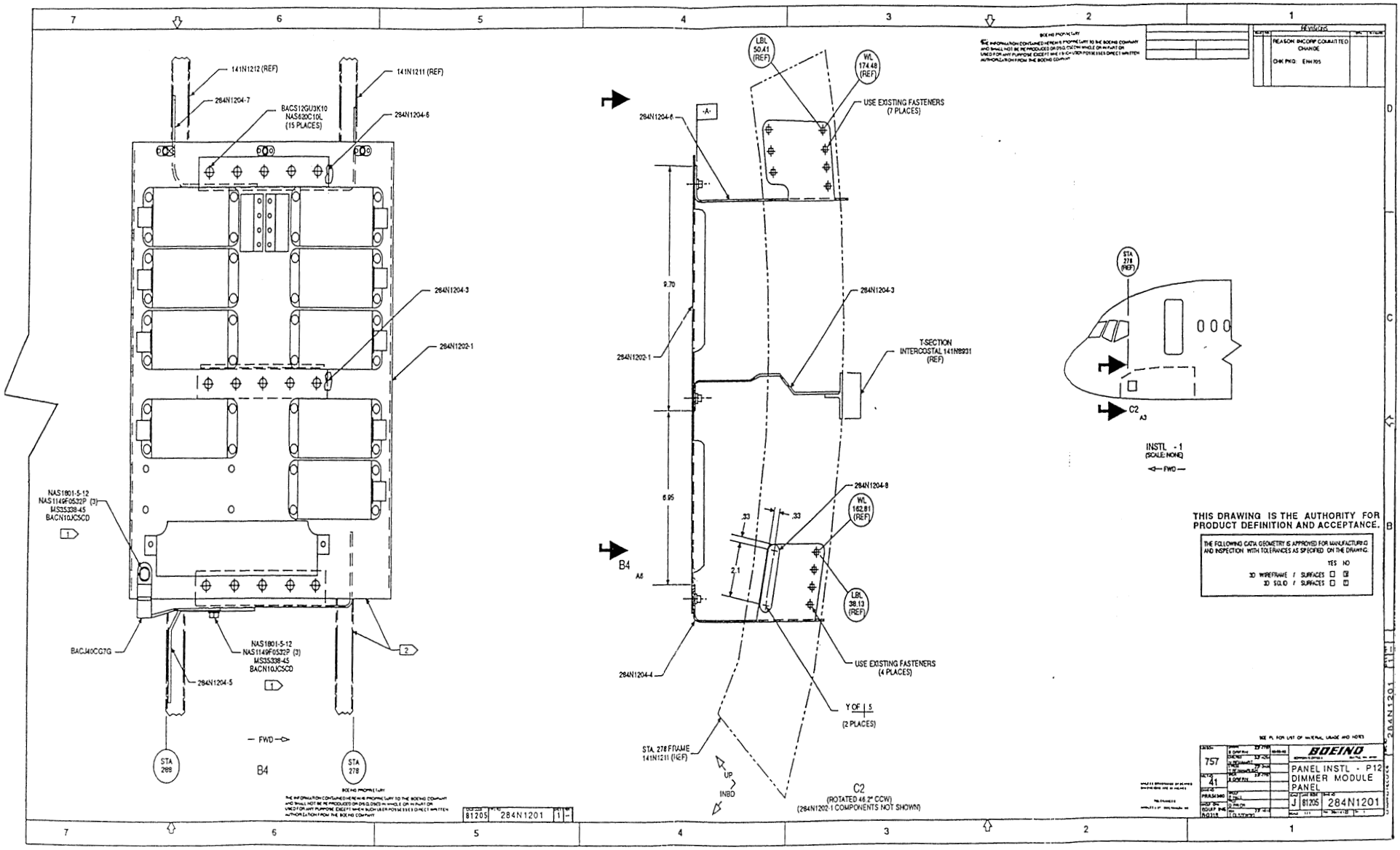


Figure 15 Installation Drawing

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Exploded–View Drawings

General

Illustrated parts lists often make use of exploded–view drawings to show every part that is in an assembly.

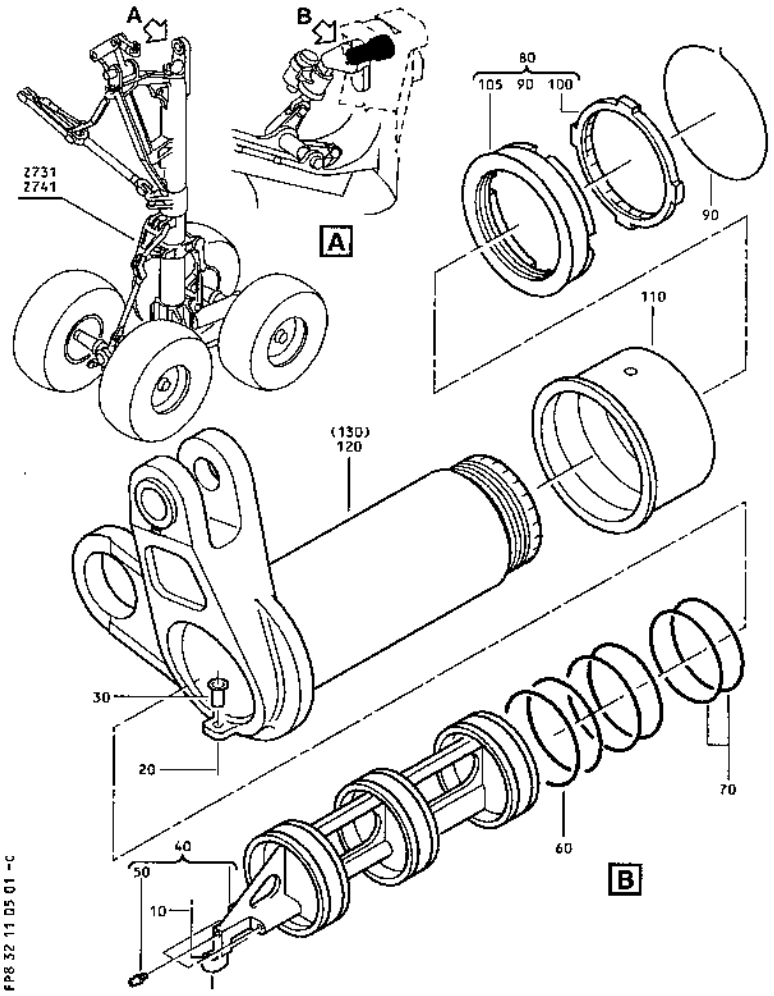
All of the parts are in their relative position, but are expanded outward, so that each part can be identified by its physical appearance or by its name. It can also be identified by a reference number that is coded to the parts list.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

FOR TRAINING PURPOSES ONLY!

A340
ILLUSTRATED PARTS CATALOG



PIN INSTL-REAR PINTLE,Z731

FIGURE 1

DLH

Printed in France

32-11-05
PAGE 1 -0
MAR.01/93

A340
ILLUSTRATED PARTS CATALOG

FIG-ITEM	PART NUMBER	NOMENCLATURE		USAGE FROM TO	UNITS PER ASSY
1 - 1	F3215006000860	PIN INSTL-REAR PINTLE, Z731 (LH)	(NP)	001001 003007 051058	RF
- 1B	F3215500900060	PIN INSTL-REAR PINTLE, Z731 (LH)	(NP)	101120	RF
- 2	F3215006000960	PIN INSTL-REAR PINTLE, Z741 (RH)	(NP)	001001 003007 051058	RF
- 2B	F3215500900160	PIN INSTL-REAR PINTLE, Z741 (RH)	(NP)	101120	RF
10	NSA5472-4K7	.NUT OPT TO BH00521-4 (V27238) OPT TO P9357-4S7 (VF0224) OPT TO HWS1130-4K7 (VK6405)	VACRT		1
20	NAS6604-14	.BOLT	VACRT		1
30	NSA5122C4-110	.BUSH-SHOULDERED	VACRT		1
40	F3215002300000	.PLUG ASSY-GREASER		001001 003007 051058	1
40A	F3215501200000	.PLUG ASSY-GREASER		101120	1
50	MS15001-1	..FITTING, NIPPLE LUBRICATION			3 R
60	NSA8203-241	.O-RING	VACRT	001001 003007 051058	4
60A	NSA8203-239	.O-RING	VACRT	101120	4
70	NSA8203-240	.O-RING OPT TO 100-240-8903 (VU1068)	VACRT	001001 003007 051058	2
70A	NSA8203-238	.O-RING OPT TO 100-238-8903 (VU1068) OPT TO 2-238L806-80 (VC0308)	VACRT	101120	2
80	F3215002700200	.NUT ASSY F3215002700200 RPLD BY F3215002700400		001001 003007 051058	1
80A	F3215002700400	.NUT-ASSY		001001 003007 051058	1
80B	F3215501400000	.NUT ASSY OPT TO SL40927 (V97393)		101120	1
90	SLL40789M130	..WIRE-LOCKING,STA LOK	V97393		1
100	SLW40789M130	..WASHER-LOCK,STALOK	V97393	RU080	1
100A	SL40933	..WASHER-LOCK	V97393	RU080 RU080A RU080B	1
105	SLN40874M130	..NUT	V97393	RU080 RU080A	1

-ITEM NOT ILLUSTRATED
MISSING ITEMS AND VARIANTS ARE NOT APPLICABLE

DLH

Printed in France

32-11-05
PAGE 1 - 1
JAN.01/03

Figure 16 Explosion Drawing

© Lufthansa Technical Training

Schematic drawings

General

A schematic drawing does not show an exact image of an object; it is used to illustrate a principle of operation.

It does, however, indicate where objects are located in relation to each other in a system and (for example) the directions of hydraulic fluid flow in a valve.

Schematic drawings are ideal for trouble-shooting.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

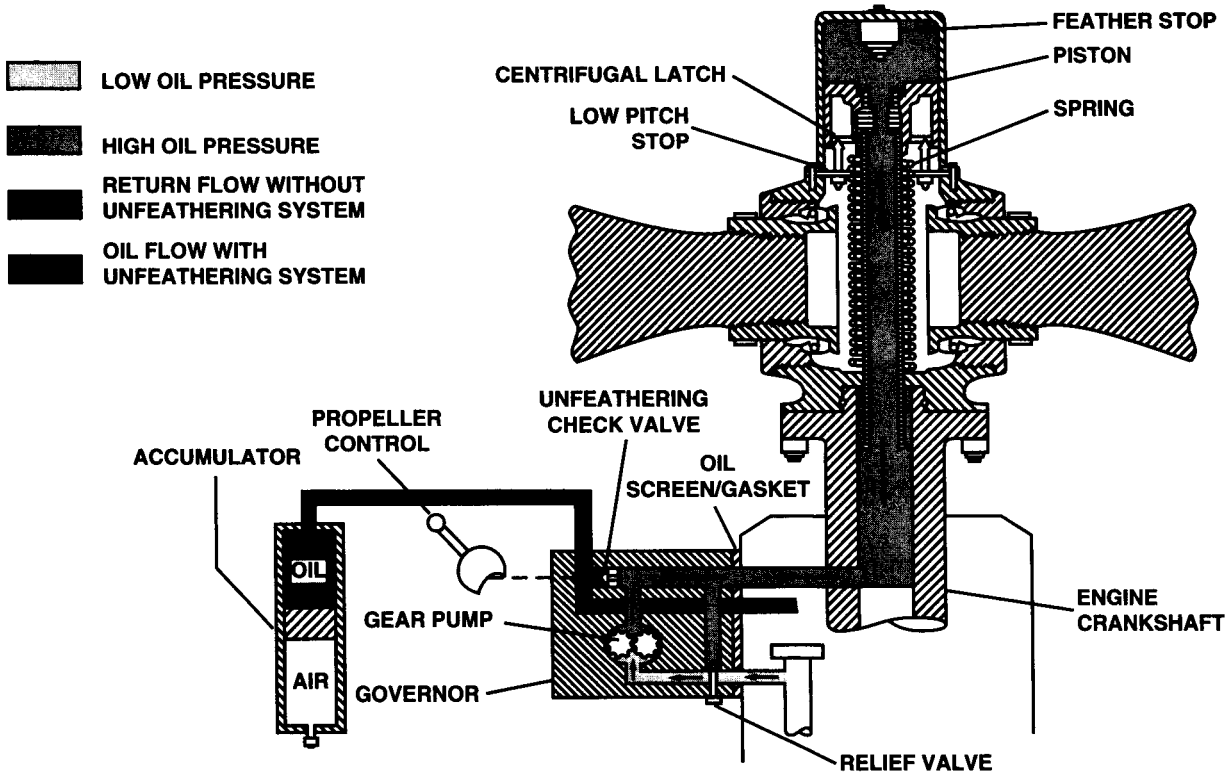


Figure 17 Schematic Drawing

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Electrical wiring diagrams

General

Wiring diagrams indicate such things as size of wire and parts like switches, lamps, connectors or fuses used in the system.

There are different types of wiring diagrams:

- Some show only the circuit,
- Others portray several circuits within a system

Normally all parts are marked by their part or serial number.

More detailed diagrams show wire connections at splices or the arrangement of parts.

Like schematic diagrams, wiring diagrams do not show an exact image of a circuit; it is used to illustrate a principle of operation. It does, however, indicate where objects are located in relation to each other in a circuit.

Wiring drawings are ideal for trouble-shooting.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

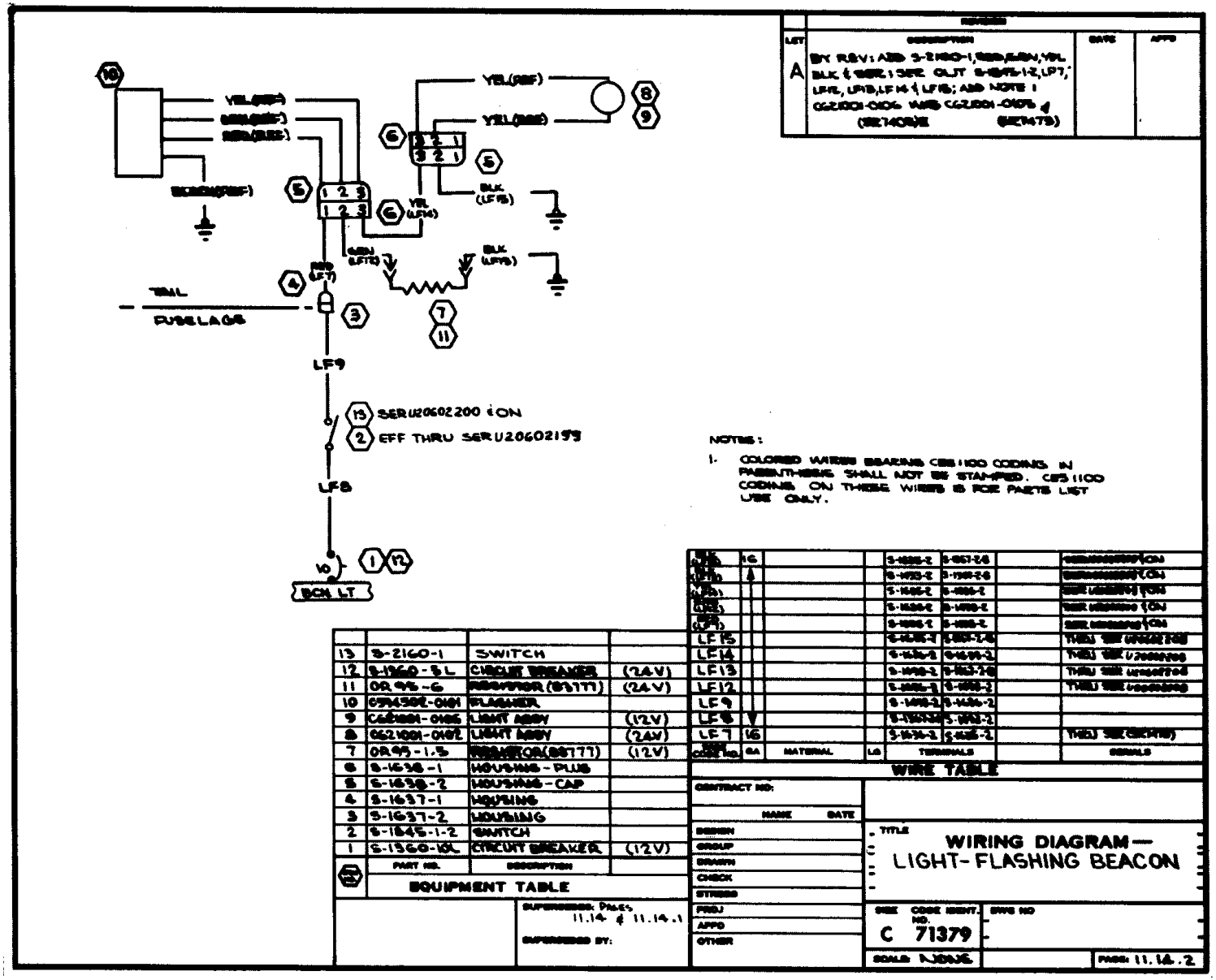


Figure 18 Wiring Diagram

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Types and use of lines

General

Different types and thickness of lines have different meanings in engineering drawings. For this as well a international standard (ISO 128) is valid, which defines the correct determination and application for different lines.

To imagine a body or item in three dimensions, which is generally only shown in several two-dimensional views, you have to get known to the common line types.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

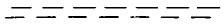
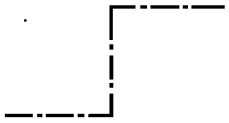
	Continuous (thick)	Visible outlines and edges
	Continuous (thin)	Dimension lines, leader lines, bending lines, projection lines, hatching, groove of a thread.
	Continuous (thin, irregular)	Limits of partial or interrupted views and sections
	Continuous (thin, straight with zigzags)	Limits of partial or interrupted views and sections
	Dashed (thin)	Hidden outlines and edges
	Chain (thin)	Center lines, lines of symmetry, trajectories, pitch lines and circles
	Chain (thick)	Lines or surfaces to which a special requirement applies
	Chain (thin, thick at ends and changes of direction)	Cutting planes
	Chain (thin double dashed)	Outlines and edges of adjacent parts, alternative and extreme positions of movable parts, centroidal lines, initial outlines prior to forming, bend lines on developed blanks or patterns

Figure 19 Types and Use Of Lines

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Drawing Symbols

Introduction

To minimize confusion, certain conventions have been adopted to standardize the way items appear on engineering drawings.

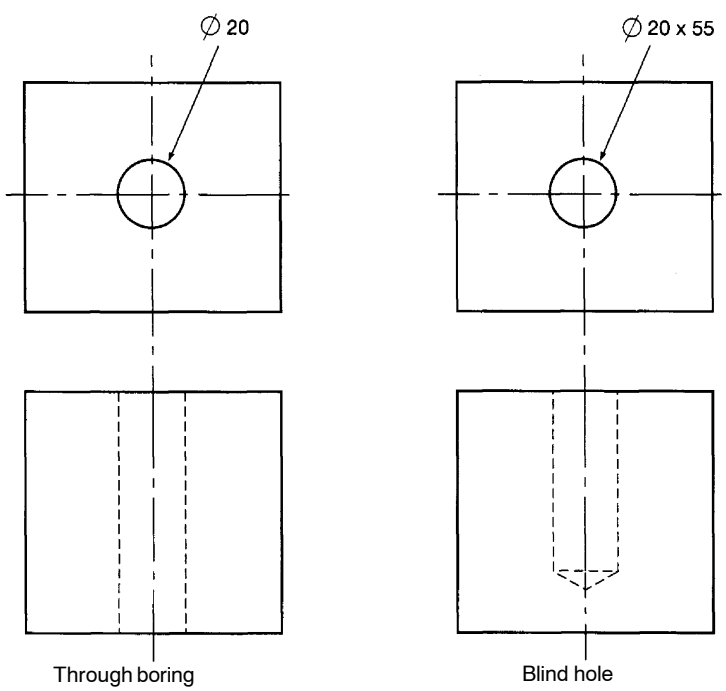
Symbols for Bores

As can be seen opposite, bores can be plain–drilled, reamed or threaded.

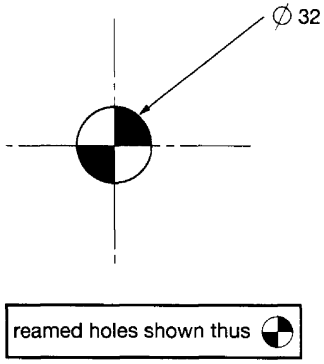
- **Drilled bores**
  - are portrayed by a thick–lined circle. Its diameter may be shown by a note. If the hole is 'blind' the note will include the depth. Fastener holes are often shown as symbols with an accompanying explanatory table.
- **Reamed bores**
  - symbols will include an explanatory note differentiating them from plain bores.
- **Threaded bores**
  - are defined with a thick circular line for the thread crest and a thin, broken one for the root.

FOR TRAINING PURPOSES ONLY!

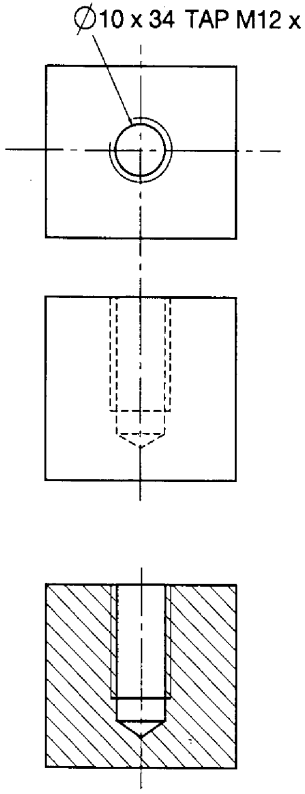
© Lufthansa Technical Training



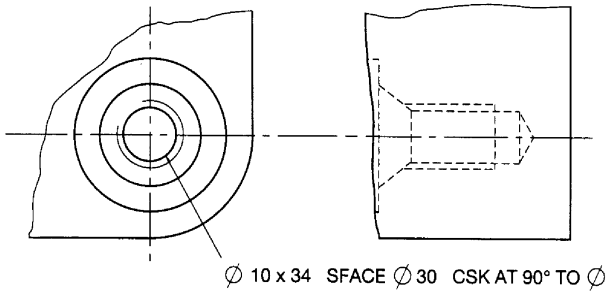
Plain drilled bores



Reamed bore



Threaded bore



A hole may incorporate one or more features, as in this case (spot-faced, threaded and countersunk).

Figure 20 Common Drawing Symbols – Bores

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

DRAWING SYMBOLS (CONTD.)

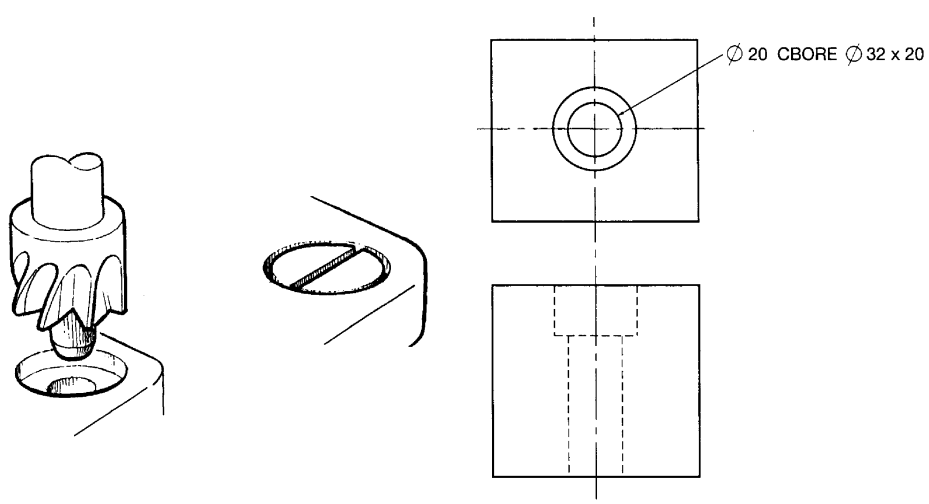
Symbols – Recessed Bores

Bores can be counterbored, spot–faced or countersunk to accommodate fastener heads for flush fitting.

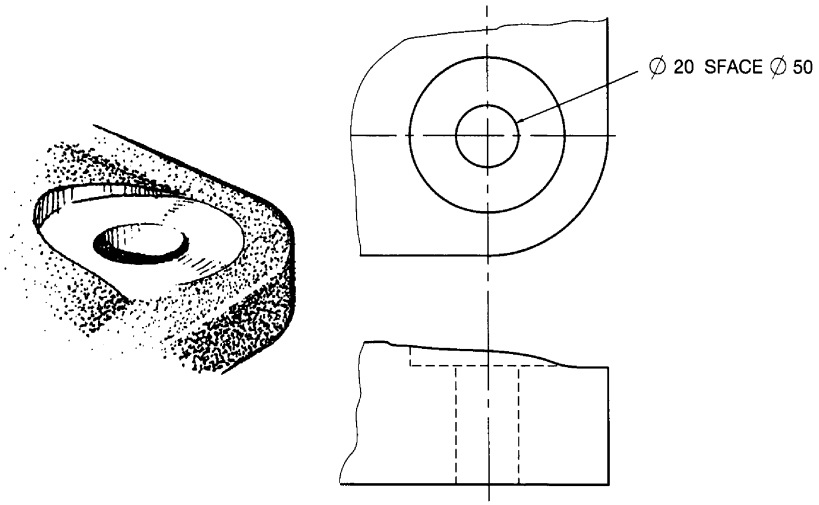
- **Counterbores**
  - are required i. e. to incorporate the head of a cylindrical head bolt. For this a concentric hole with a defined depth and diameter to the primary hole is drilled. It is portrayed in plan view as two concentric thick–line circles.
- **A spot-face**
  - is effectively a shallow counterbore to provide a flat, smooth seating for a mating part or for a fastener head or nut. It is necessary when the casting has a rough finish or is not square to the hole. It is portrayed in plan view just like a counterbore, but the diameter of the spot-face must be given. The depth is **not** given; it is the minimum necessary to achieve a flat seating.
- **Countersunk**
  - holes accept the tapered head of a fastener and are created by special countersinking bits with a defined angle. It is portrayed in plan view by two concentric thick lines, with details of the hole and the angle and diameter of the countersink.

FOR TRAINING PURPOSES ONLY!

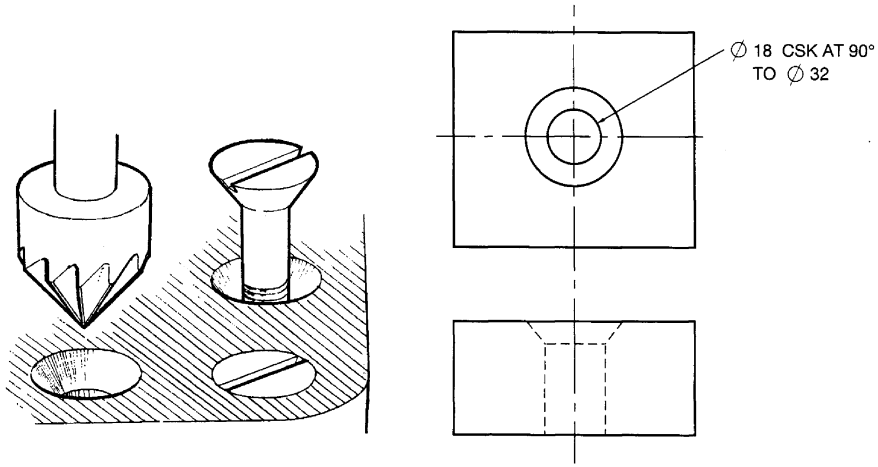
© Lufthansa Technical Training



Counterbore



Spot-face



Countersunk

Figure 21 Common Drawing Symbols – Recessed Bores

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Symbols – Conventions

General

In engineering drawings special views, dimensions, tolerances, abbreviations etc. are used which are not standardized but are commonly used.

This and other rules are explained in detail in the technical literature.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

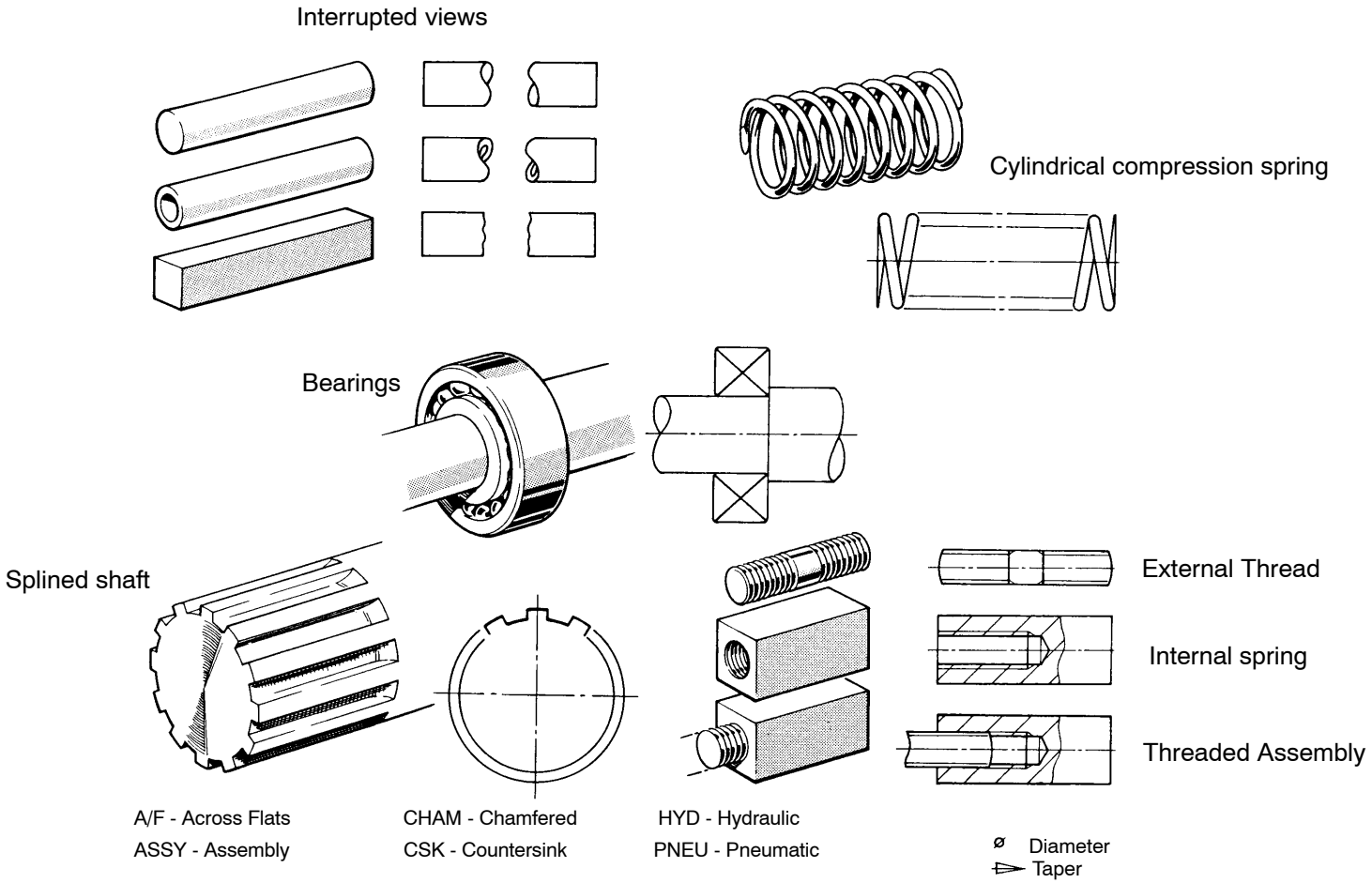


Figure 22 Typical Conventions and Abbreviations

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

SYMBOLS – SURFACE TEXTURE

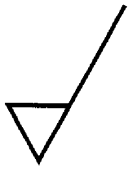
Surface Texture

In engineering drawings specified surface qualities can be found; this means the needed surface roughness is specified.

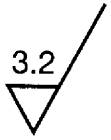
The required surface texture is explained with standardized symbols.

When a particular quality of surface finish is required, it will be stated by numbers above the triangle.

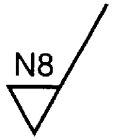
The drawing should specify which scale is being used – centerline average or roughness number. (Roughness classes N1 to N12).



Machining symbol



Surface texture in micro-meters

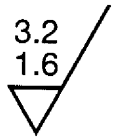


Surface texture in roughness numbers

When there is just a single number on the symbol, it shows the maximum degree of roughness that is acceptable.

Sometimes, however, the surface texture is required between limits – it must not be too rough or too smooth.

This is shown by giving the maximum and minimum values:

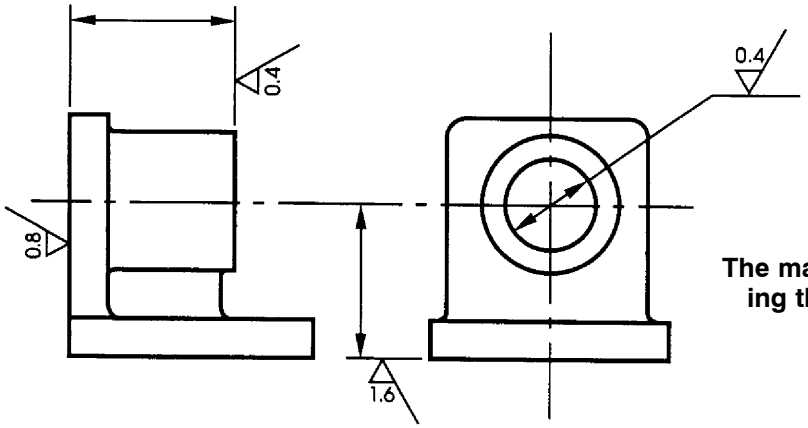


FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Centre line average (CLA)	micrometre	50	25	12.5	6.3	3.2	1.6	0.8	0.4	0.2	0.1	0.05	0.025
	microinch	2000	1000	500	250	125	63	32	16	8	4	2	1
Roughness number		N12	N11	N10	N9	N8	N7	N6	N5	N4	N3	N2	N1

**There are three scales commonly used for measuring surface texture.
The smaller the number, the smoother the texture.**



The machining symbol can be applied directly to the line representing the surface or it can be placed on a leader or extension line.

Figure 23 Symbols

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Fastener Symbols

Introduction

The presentation of fasteners within drawings can be made by using two different methods:

- by using of a fastener symbol,
- by using of drawing symbols.

By using these different methods, it has to be ensured, that the presentation and information of the fastener can clearly be identified.

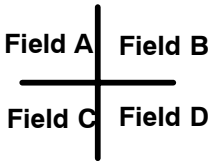
TYPES OF PRESENTATION

Fastener symbol

The presentation of fasteners by using the fastener symbol within construction drawings is always used, when the amount of fasteners is high.

- The basic symbol is a cross, which represents the fastener within the drawing. Two at an angle of 90° crossing lines patterns four quadrants / fields.

  Within these quadrants/fields information and details about the fasteners are given.



Drawing Symbols

The presentation of fasteners by using drawing symbols within construction drawings is always used, when the amount of fasteners is low.

- Simple symbols are used, e. g. circles, pitch circles, triangles, squares etc., whereat every symbol one fastener type represents.



FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

EUROPEAN FASTENER SYMBOLS (AIRBUS)

General

Due to the claim for a proper identification and the development of different Airbus aircraft-types, two fastener symbol-standards are arises, one acc. to DAN3 and another one acc. to prEN2544.

Symbol acc. to DAN3–Standard

The fastener symbol (fastener cross) acc. to DAN3–standard is used for Airbus aircraft-types A300 and A310.

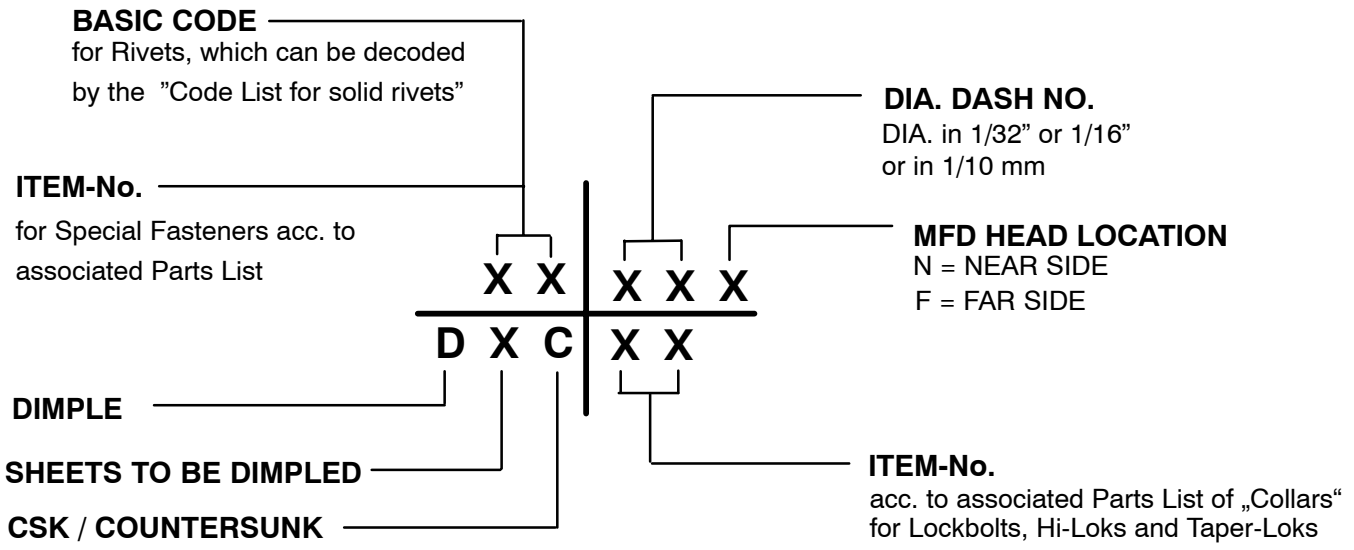
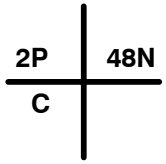


Figure 24 Fastener Symbol acc. to DAN3

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Examples of fastener symbol acc. to DAN3



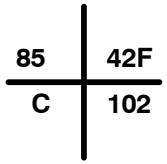
In field A the basic code 2P for a rivet is inserted.

The field B indicates the rivet diameter in mm (48 = 4,8 mm) and the manufacturer head location N for Near Side, which means, that the manuf. head must be installed from the near side.

In field C the letter C is inserted which means, that a countersunk of 100° has to be performed.

Nietart	Nietartsymbol	Werkstoff	Werkstoffsymbol	Nietbezeichnung	Nietsymbol
LN 9198	1	3.1124 T4	P	Universalniet	1 P
LN 9198	2	3.1324 T4	P	Universalniet	2 P
DIN 65399	1	3.1124 T4	C	Senkniet	1 C
DIN 65399	2	3.1324 T4	C	Senkniet	2 C
NSA 5414	3	Monel N-U30 gegl.	C	Senkniet	3 C
NSA 5415	3	Monel N-U30 gegl.	P	Universalniet	3 P
NSA 5410	4	Titan T40	C	Senkniet	4 C
NSA 5411	4	Titan T40	P	Universalniet	4 P
LN 9198	5	3.0255 H14	P	Universalniet	5 P
DIN 65399	5	3.0255 H14	C	Senkniet	5 C

Figure 25 Code List for Solid Rivets

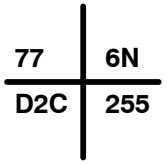


The Item-No. 85 within this example means, that a tension Lockbolt has to be installed.

The number 42 indicates the fastener diameter = 4,2 mm and the manuf. head location F = Far Side

C stands for Countersunk (100°), but on the far side!

Item-No. 102 indicates the Collar.



Item-No. 77 in this example represents a Hi-Lok.

The number 6 indicates the fastener diameter = 6/32” (3/16”), and that the fastener has to be installed from Near Side.

The symbol D2C means, that two sheets have to be dimpled and that the third sheet has to be countersank.

Item-No. 255 indicates the Collar.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

EUROPEAN FASTENERSYMBOLS (AIRBUS), CONTD.

Symbol acc. to prEN2544–Standard

The fastener symbol (fastener cross) acc. to prEN2544–standard is used for the Airbus aircraft-types A318, A319, A320, A321, A330 and A340.

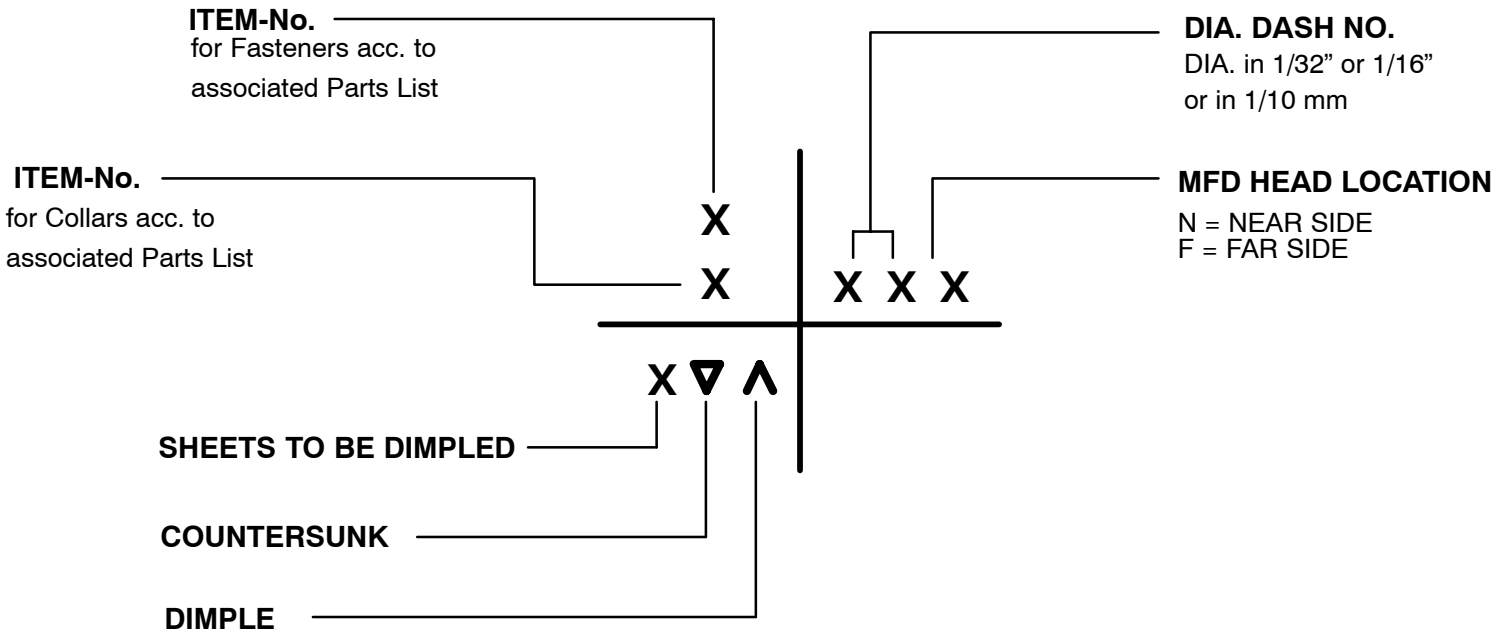
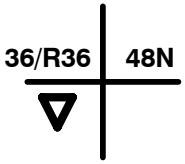


Figure 26 Fastener Symbol acc. to prEN2544

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Examples of fastener symbol acc. to prEN2544

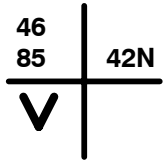


In field A, the symbol R36/36 is inserted. The letter R indicates, that a rivet has to be installed.

If only the number 36 is inserted, this is the Item number, which can be identified by the part list as a rivet.

In field B, the information of the fastener diameter (48= 4,8mm) and the manufacturer head location N for Near Side is given.

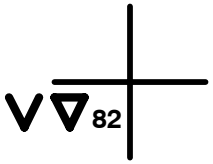
The symbol in field C indicates a 100° countersunk.



The item-no. 46 in this example means, that a special fastener (Hi-Lok) has to be installed with item no. 85, which indicates the Hi-Lok collar.

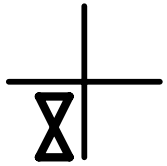
42= 4,2mm diameter, N= Near Side.

The symbol in field C means: 100° dimpled.

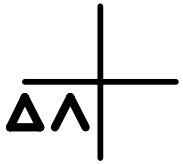


Two sheets, one of them is dimpled with an angle of 82°, the other one is countersank with an angle of 82°.

Dimpling and countersinking have to be performed from near side..

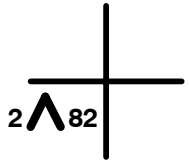


The sheet/part has to be countersank from both sides, the countersunk angle is 100°.



Two sheets, one of them is 100° dimpled, the other sheet is 100° countersank.

Dimpling and countersinking are located on the far side.



Two sheets are dimpled, the angle is 82°

Dimpling has to be performed from the far side.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

AMERICAN FASTENER SYMBOL (BOEING)

Fastener Symbol acc. to NAS524

Compared with the European aircraft manufacturer Airbus, the American manufacturer Boeing uses only one fastener symbol, which is subject to the NAS 524–standard.

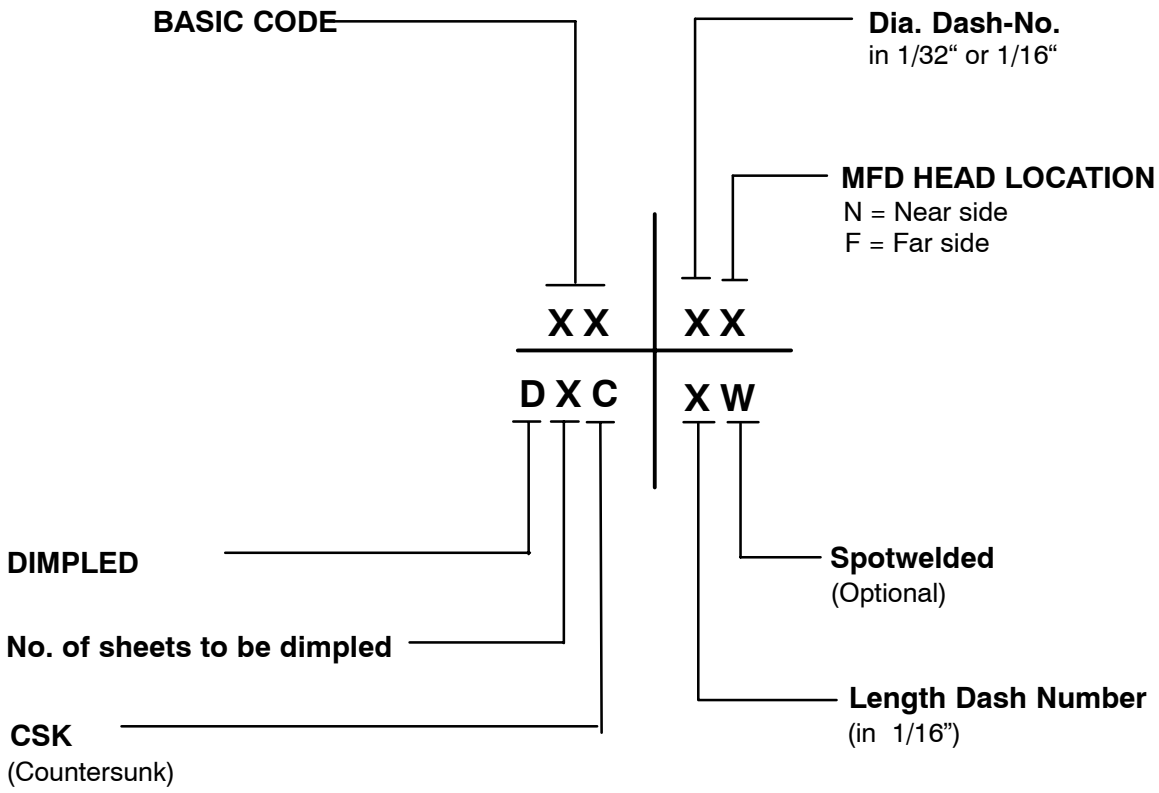


Figure 27 Fastener Symbol acc. to NAS524 (1)

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

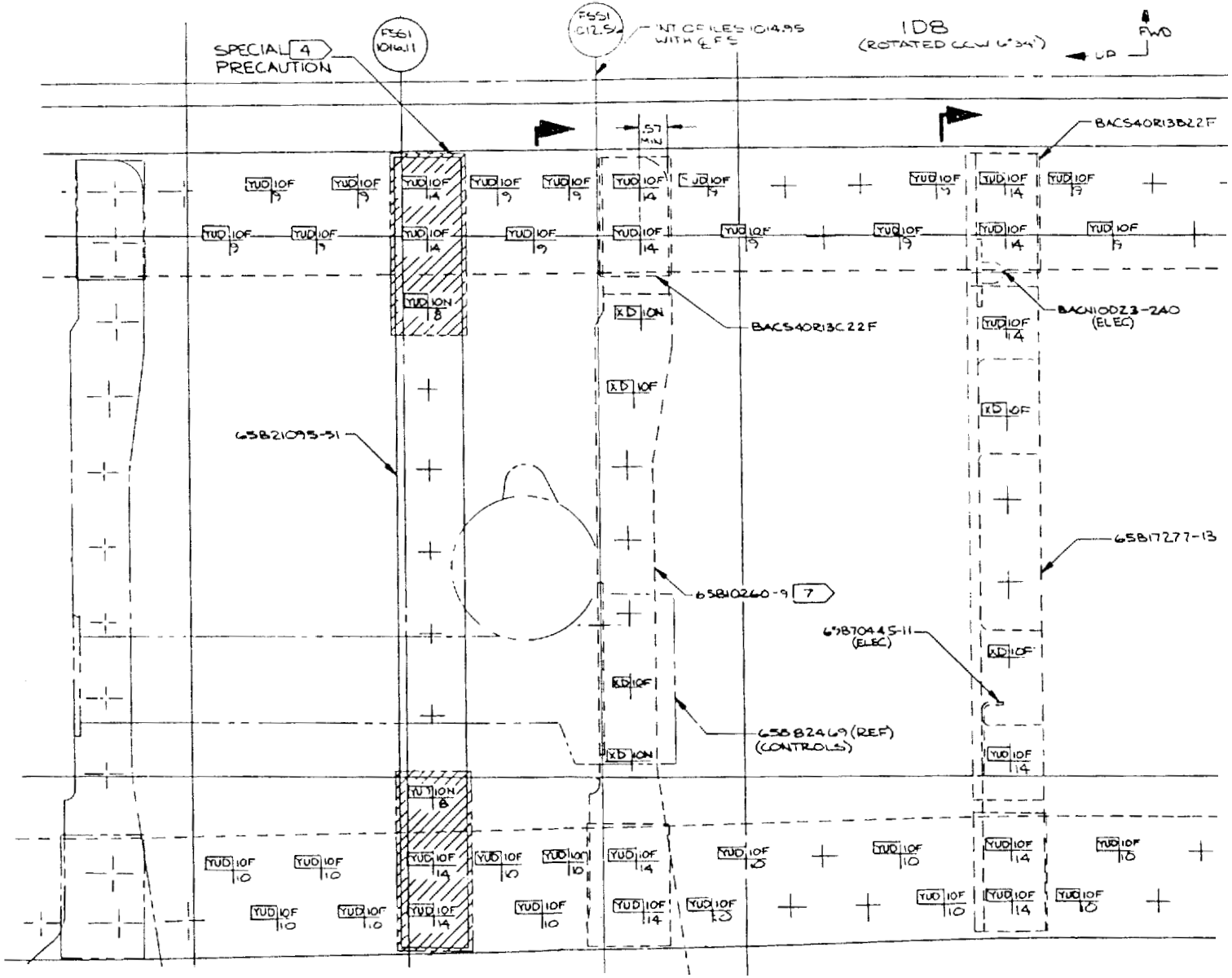
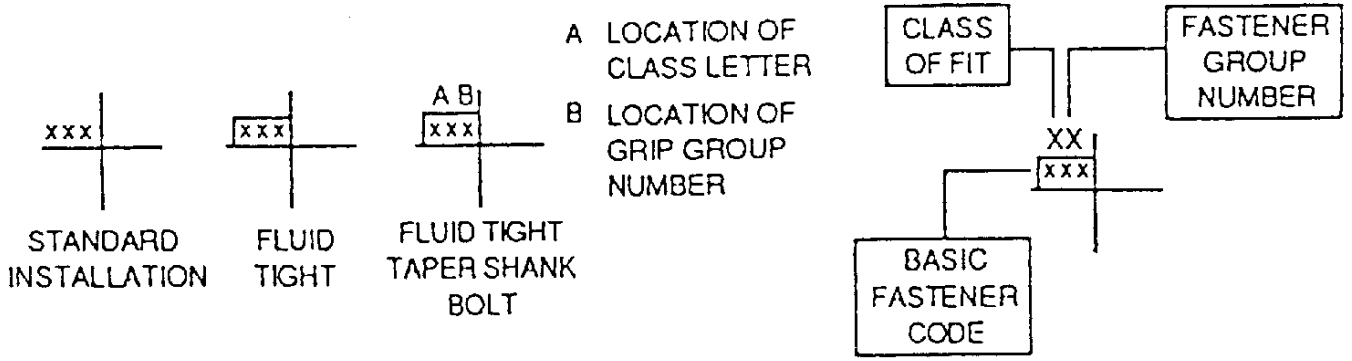


Figure 28 Fastener Symbol acc. to NAS524 (2)

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training



NOTE: A box around the drawing code indicates fluid-tight installation is required.

BAC - Boeing Aircraft Company

BACB30 - Bolt
BACR15 - Rivet
BACN10 - Nut or Nutplate
BACC30 - Collar
BACW10 - Washer

Part No.	Code	Material
BACR15BA•A•	XZE	A - 1000-F
BACRA5BA•AD•	XA	AD - 2117-T3
BACR16BA•B•	XZF	B - 5056-H32
BACR15BA•D•	XZG	D - 2017-T3
BACR15BA•DD•	XB	DD - 2024-T31
BACR15BA•KE•	YPC	KE - 7050-T73

Figure 29 Fastener Symbol acc. to NAS524 (3)

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

DRAWING SYMBOLS

General

Beside the use of fastener symbols (fastener cross), the airplane manufacturer uses drawing symbols more and more, when the amount of fasteners is low, and especially for repair drawings.

At this, simple symbols such as circles, pitch circles, triangles, squares etc. are used, and every single symbol represents one fastener type.

Examples of the used symbols are:

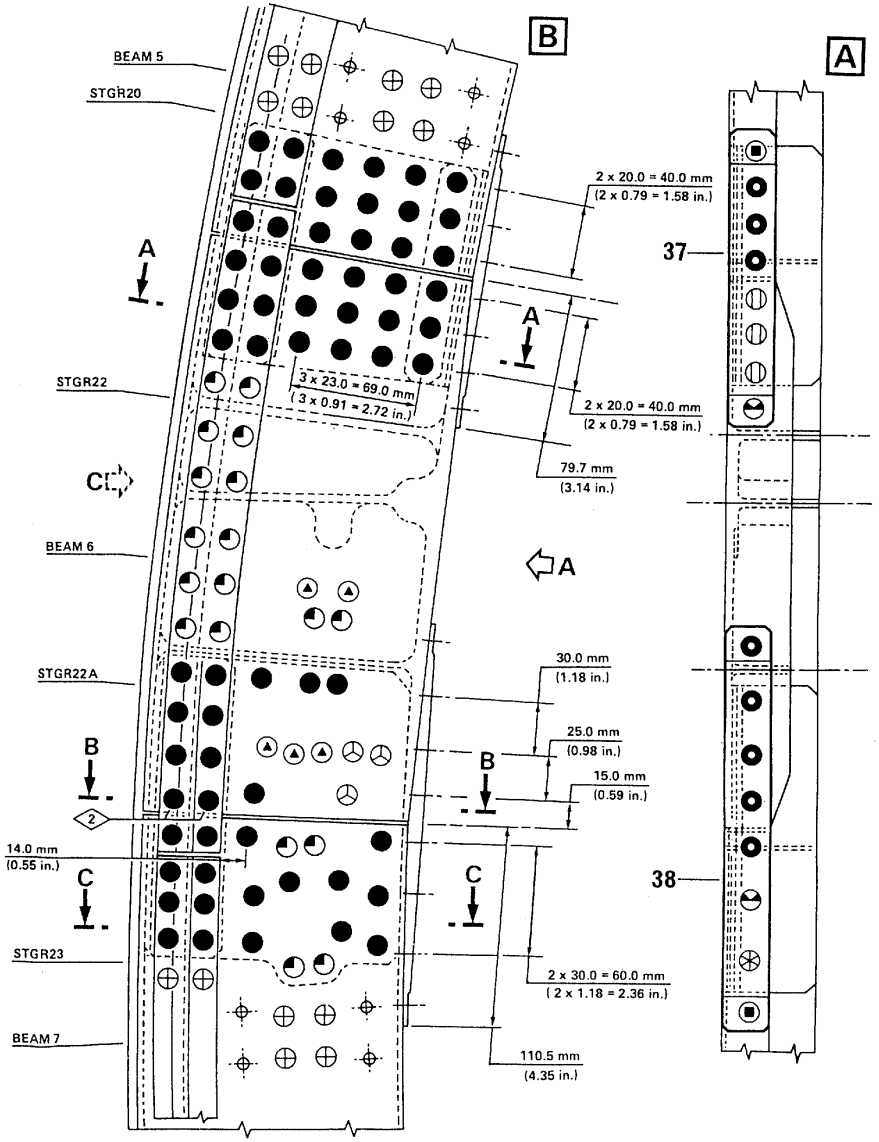


Procedure

Within the drawing, the symbol for the fastener is implemented at the fastener location. This symbol can be decoded to the part-no. of the fastener by using the associated parts list.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training



ITEM	SYMBOL	PART NUMBER	ITEM	SYMBOL	PART NUMBER
19		MS20470DD6–16	29		HL12VF6–7 WITH COLLAR HL86–6, ITEM 28
20		MS20470DD5–16	30		HL12VF6–8 WITH COLLAR HL86–6, ITEM 28
21		NAS1097DD5–16	31		HL12VF6–6 WITH COLLAR HL86–6, ITEM 28
22		NAS1097DD6–16	32		HL12VF6–5 WITH COLLAR HL86–6, ITEM 28
23		HL113VF6–10 WITH COLLAR HL87–6 ITEM 24	33		HL112VF6–7 WITH COLLAR HL87–6, ITEM 24
25		HL113VF6–7 WITH COLLAR HL87–6 ITEM 24	34		HL112VF6–6 WITH COLLAR HL87–6, ITEM 24
26		MS20426DD6–10	35		HL112VF6–5 WITH COLLAR HL87–6, ITEM 24
27		HL12VF6–4 WITH COLLAR HL86–6, ITEM 28	47		MS20426AD3–5
					EXISTING HI–LOK PINS AND RIVETS

Figure 30 Symbols Used for Fasteners (Europ. Drawing)

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

STANDARDS

Overview

Standards are consensus agreements between (inter-) national delegations representing all the economic stakeholders concerned – suppliers, users, government regulators and other interest groups, such as consumers.

Examples are specifications and criteria to be applied consistently in the classification of materials, in the manufacture and supply of products.

International Standards Organization

The International Standards Organization ISO is a network of national standards institutes from 148 countries working in partnership with international organizations, governments, industries, businesses and consumer representatives.

Aircraft Materials and Hardware

Specifications and standards for aircraft hardware are generally identified by the organization originating them. Some of the most common are:

AMS	Aeronautical Material Specifications
AN	Air Force-Navy
AND	Air Force-Navy Design
AS	Aeronautical Standard
ASA	American Standards Association
ASTM	American Society for Testing and Materials
DTD	Directorate of Technical Development
MS	Military Standard
NAF	Naval Aircraft Factory
NAS	National Aerospace Standard
SAE	Society of Automotive Engineers

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

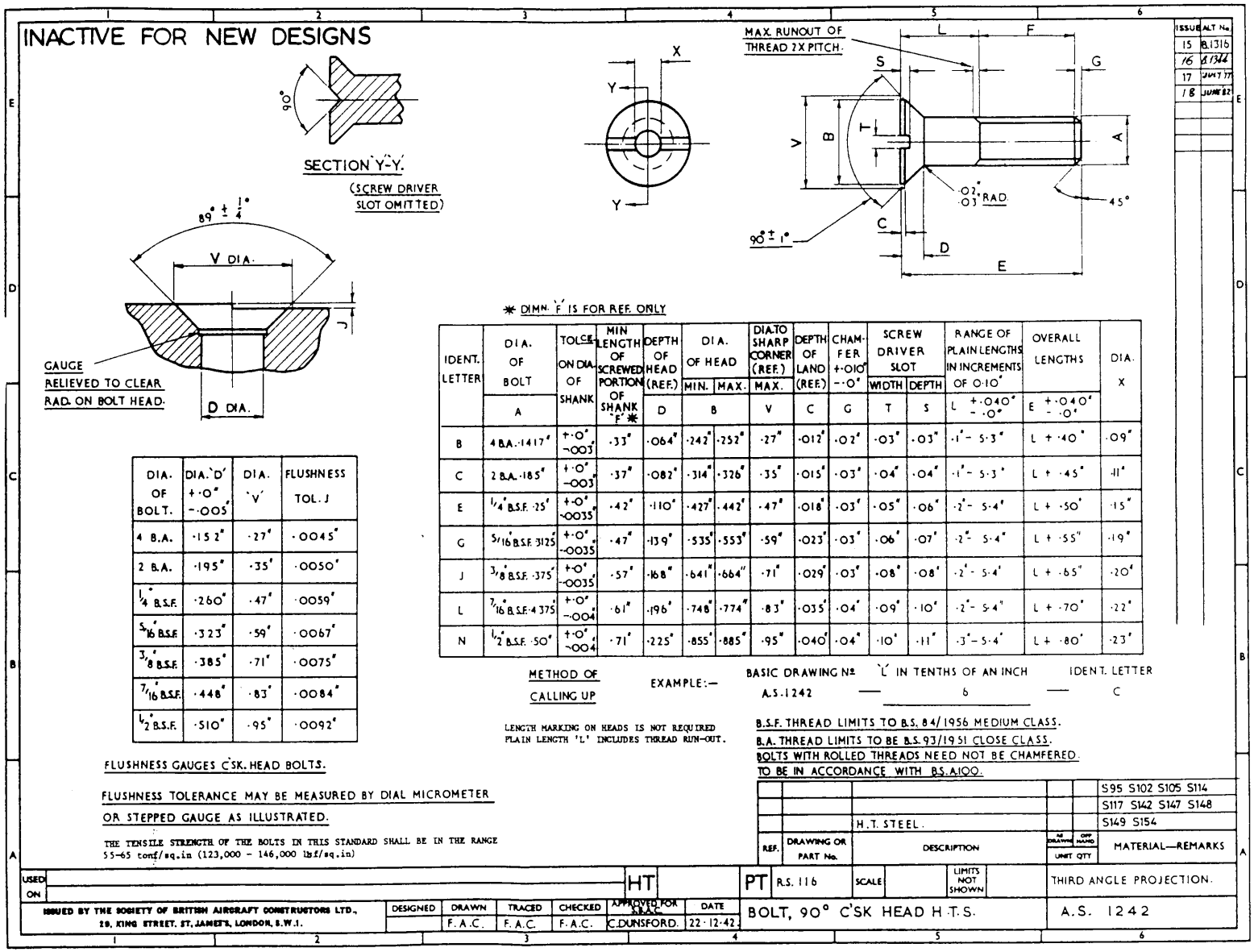


Figure 31 Example of the Standardisation of Bolts

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

DRAWING TITLE BLOCK INFORMATIONS

Title Block

Every print must have some means of identification. This is provided by the title block.

The title block consists of a drawing number and certain other data concerning the drawing and the object it represents. This information is grouped in the lower right–hand side of every sheet.

When a print is correctly folded, the title block is on the outside for easy reference.

The title block normally contains the following information:

- **DRAWING NUMBER**

  The number of the drawing
- **TITLE**

  The title of the drawing
- **SCALE**

  The scale of which the majority of views and sections are drawn is entered as a ratio. When various parts are drawn to different scales, or if there is no picture on Sheet One, the word ”NOTED” is entered.
- **DIMENSIONAL TOLERANCE NOTES**

  Preprinted here are the general tolerances to be used with the various drawing dimensions if a tolerance is not otherwise shown on the drawing.
- **SH n of n**

  The total number of sheets is shown with the consecutive sheet number such as SH 1 of 1, SH 1 of 4. On drawings with an automated parts list (APL), this entry does not include the total number of picture sheets. The application block of the separate parts list lists all applicable sheets for each item.
- **SIGNATURES**

  The ”signature” block Is a list of approval signatures for the drawing.
- **SECTION NO. (Boeing)**

  The section number of the aircraft shows where the item is installed. When an installation extends through several sections ”MS” is used for multi sections.

Zones

As can be seen on the diagram opposite, a drawing is bounded by a grid system similar to a map. Typically, the vertical divisions are marked with letters and the horizontal numbers.

A combination of a vertical and horizontal coordinate indicates a zone.

Revisions

From time to time, amendments are made to engineering drawings, for example if an item is modified in some way, or perhaps a new component is added.

This amendment must be recorded on the drawing, as it is important to be working from the latest issue of an engineering drawing.

This revision process is known as ’raising-in-issue’ and the drawing issue will increase by one character, e. g. from Issue A to Issue B.

Parts List (Bill of Materials)

On older aircraft drawings the list of all component parts on a drawing is located above the title block. It is also known as the ’Bill of Materials’.

To reduce clutter working with newer and extensive drawings but also for a more convenient working, today normally separated bills of materials are used.

In these lists all parts, their part numbers, their locations (zone) and their location in the aircraft is noted.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

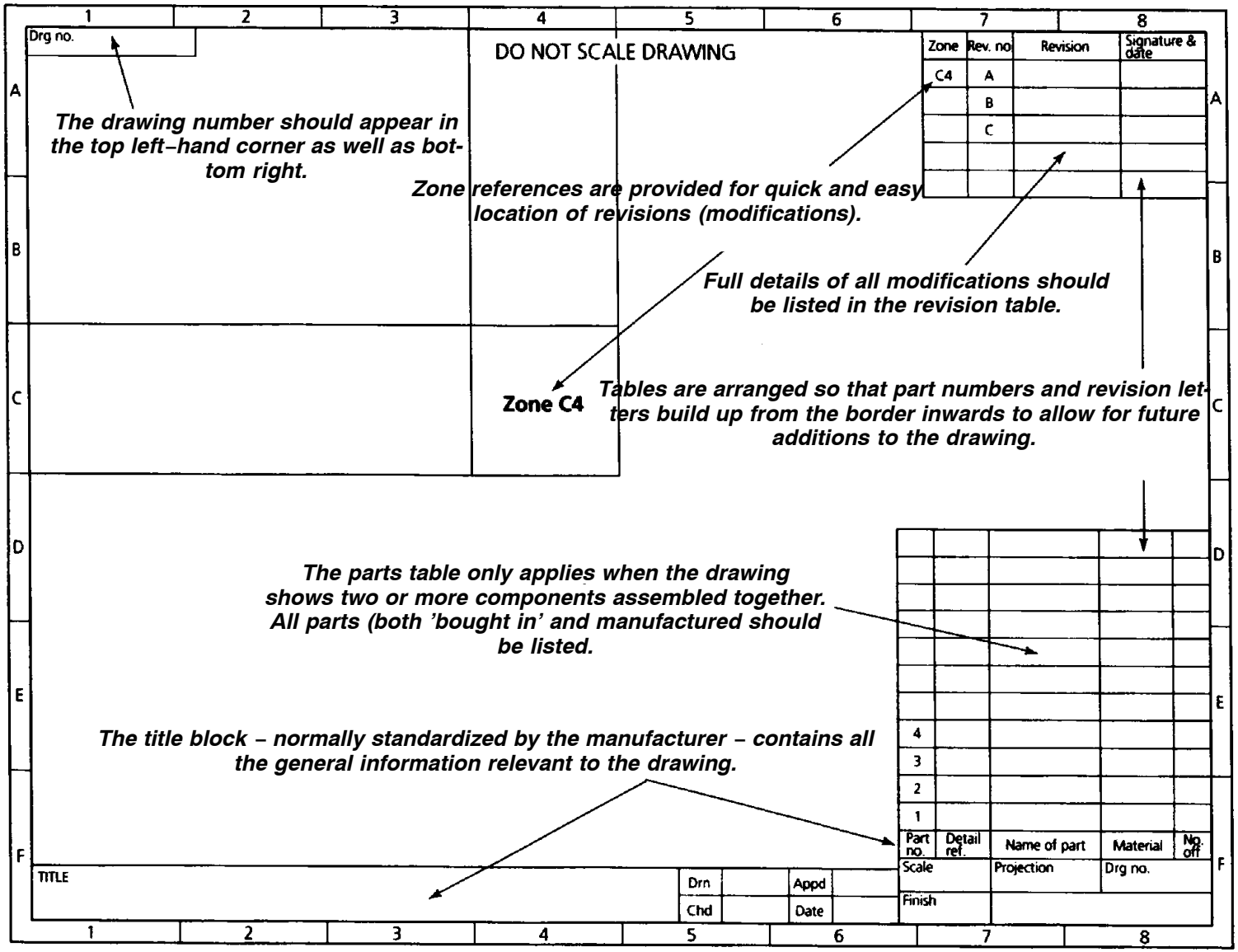


Figure 32 Engineering Drawing – Standard Layout

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

PRESENTATION OF DRAWINGS

Introduction

A complete set of engineering drawings of a modern aircraft consists out of 150.000 different drawings, in which the aircraft is shown in every detail.

Engineering drawings have historically been created on paper at 1:1 scale and were made available to the employees if required. This process was very complex and was displaced through a procedure in which the needed information is provided by a medium and then plotted.

Basically it has to be noticed the in hand drawing is not under a special revision service if engineering drawings and other technical documents are plotted.

Possible short changes of the drawing sets require the immediate destruction of used documentation. The risk of working in accordance to antiquated information is very high.

Aperture Cards

One method used to reduce drawings' physical size (and thus storage space) was to photograph them and mount the resultant slide onto a card. This card could be loaded into a viewer for ease of reading and a hard−copy subsequently printed off if necessary.

Microfilm

Instead of copies of each drawing being mounted in its own individual aperture card, hundreds could be stored onto a photographic film (microfilm). As with the aperture card, this microfilm could be loaded into a reader for ease of viewing and, if necessary, printing of hard−copies.

Computer Aided Design (CAD)

The advent of computers resulted in engineering drawing software development; computer aided design, or CAD.

The drawings can be stored digitally on data mediums. Amendments to drawings are a formality and hard−copies can be produced via a printer linked to the computer.

Through this digital storage and the deposition on a server the direct online access to the set of drawings at the aircraft producer like Boeing or Airbus is possible.

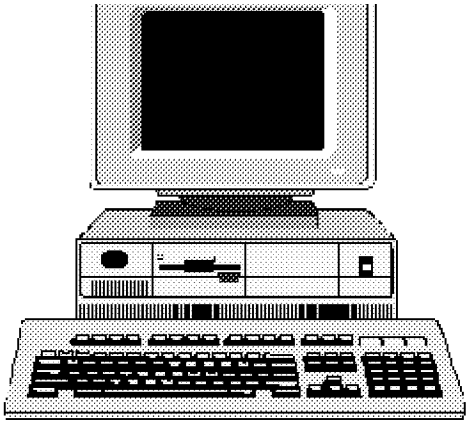
FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

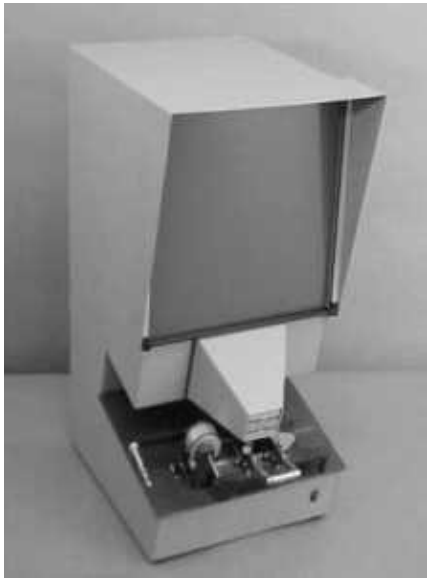




Aperture Cards



Online System



Microfilm Reader

Figure 33 Drawing Storage Methods

FOR TRAINING PURPOSES ONLY!

TABLE OF CONTENTS

M7 MAINTENANCE PRACTICES 1

M7.5 ENGINEERING DRAWINGS, DIAGRAMS AND STANDARDS 1

DRAWING TYPES, DIAGRAMS, SYMBOLS, DIMENSIONS, TOLERANCES AND PROJECTIONS 2
ENGINEERING DRAWINGS GENERAL 2
PROJECTION 6
SKETCHES AND PERSPECTIVES 12
DIMENSIONING FROM A COMMON DATUM 16
DRAWING READING FUNDAMENTALS 24
DETAIL DRAWINGS 26
ASSEMBLY DRAWINGS 28
INSTALLATION DRAWINGS 30
EXPLODED–VIEW DRAWINGS 32
SCHEMATIC DRAWINGS 34
ELECTRICAL WIRING DIAGRAMS 36
TYPES AND USE OF LINES 38
DRAWING SYMBOLS 40
SYMBOLS – CONVENTIONS 44
FASTENER SYMBOLS 48
STANDARDS 58
DRAWING TITLE BLOCK INFORMATIONS 60
PRESENTATION OF DRAWINGS 62

TABLE OF FIGURES

Figure 1 DIN „A“ Standard Paper-Sizes 3
Figure 2 Scale 5
Figure 3 Projections 7
Figure 4 Sectional View 9
Figure 5 Part-, Half- and Staggered Section 11
Figure 6 Perspective 13
Figure 7 Auxiliary View 15
Figure 8 Dimensioning 17
Figure 9 Dimensional Tolerance 19
Figure 10 Break Lines 21
Figure 11 Repetitive Information 23
Figure 12 Tool Drawing 25
Figure 13 Detail Drawing 27
Figure 14 Assembly Drawing 29
Figure 15 Installation Drawing 31
Figure 16 Explosion Drawing 33
Figure 17 Schematic Drawing 35
Figure 18 Wiring Diagram 37
Figure 19 Types and Use Of Lines 39
Figure 20 Common Drawing Symbols – Bores 41
Figure 21 Common Drawing Symbols – Recessed Bores 43
Figure 22 Typical Conventions and Abbreviations 45
Figure 23 Symbols 47
Figure 24 Fastener Symbol acc. to DAN3 49
Figure 25 Code List for Solid Rivets 50
Figure 26 Fastener Symbol acc. to prEN2544 51
Figure 27 Fastener Symbol acc. to NAS524 (1) 53
Figure 28 Fastener Symbol acc. to NAS524 (2) 54
Figure 29 Fastener Symbol acc. to NAS524 (3) 55
Figure 30 Symbols Used for Fasteners (Europ. Drawing) 57
Figure 31 Example of the Standardisation of Bolts 59
Figure 32 Engineering Drawing – Standard Layout 61
Figure 33 Drawing Storage Methods 63