2010 en	1	Principles
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Manufacturing Instructions SN 200	3	Thermal cutting and bending
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	6	Assembling
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	8	Labeling and shipping
SMS group	9	Packing
	10	Inspection

No guarantee can be given in respect of this translation.

In all cases the latest German version of this standard shall be taken as autoritative.

SMS Siemag Aktiengesellschaft
Normenstelle/Standards Office
Telephone: (0 27 33) 29-10 93 | (0 27 33) 29-39 64
Telefax: (0 27 33) 29-77 10 93 | (0 27 33) 29-77 39 64
E-mail: hueb@sms-siemag.com | zejo@sms-siemag.com

10th edition September 2010

SMS group

Manufacturing Instructions

Principles

SN 200-1

ICS 01.120

Supersedes
SN 200-1: 2007-02

1 Scope

The principles set out below apply to the manufacture and delivery of mechanical and fluid power products and materials of the SMS group. This standard is indicated as binding standard in drawing title blocks, contracts and/or ordering documents.

2 Normative references

The documents listed below are required for the application of this document. Dated references refer to the edition of the date indicated. Undated references refer to the latest edition of the respective document inclusive of all revisions.

SN 200-2:2010 Manufacturing Instructions - Materials
SN 200-3:2010 Manufacturing Instructions - Thermal cutting and bending
SN 200-4:2010 Manufacturing Instructions - Welding
SN 200-5:2010 Manufacturing Instructions - Machining
SN 200-6:2010 Manufacturing Instructions - Assembling
SN 200-7:2010 Manufacturing Instructions - Coating and preserving
SN 200-8:2010 Manufacturing Instructions - Labelling and shipping
SN 200-9:2010 Manufacturing Instructions - Packaging
SN 200-10:2010 Manufacturing Instructions - Inspection

3 Requirements

The requirements specified in the parts of SN 200 are minimum requirements and shall be met if no other requirements are made in drawings, ordering and/or other manufacturing documents.

4 Hazardous materials and environmental protection

4.1 Inadmissible hazardous materials

The following substances, preparations or constituents are absolutely prohibited in products or materials of the SMS group:
- Asbestos and/or mixed compounds containing asbestos,
- lead, cadmium or chromium (VI) compounds,
- solvents remaining in products or materials.

Other inadmissible hazardous materials are indicated in drawings, ordering and/or other manufacturing documents.
When inadmissible hazardous materials develop in the course of manufacture, e.g. emissions from welding, these shall be exhausted at the point at which they emerge.
The compliance with this specification shall be certified, see SN 200-10:2010.

4.2 Admissible hazardous materials

For admissible substances, materials or preparations which are used in our products and which are not subject to item 4.1, safety data sheets according to the Ordinance on Hazardous Substances according to EC Directive 98/24/EC or the resulting national regulations shall be attached to the supply stating the SMS group purchase order number for identification.
If safety data sheets are not available, the manufacturer/supplier undertakes to attach to the supply, in due time and in a well visible way, other product information which is relevant for environmental protection and safety to allow proper transport and handling, storage and disposal of the admissible hazardous materials by the SMS group or its customer in accordance with the regulations.

4.3 Radioactivity

All products and materials shall be free of ionising radiation which exceeds the natural characteristic radiation. Ionising radiation is considered to exceed the characteristic radiation when a radiation level is found during an examination which is higher than the level of the ambient radiation.
SMS group reserves the right of refusing the acceptance of products/materials found to possess such excess ionising radiation.

Edited by:
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5 Load carrying attachments

Design, manufacture and inspection of load-carrying attachments for which basic data are specified by SMS group shall be ordered from and carried out by specialist companies which possess the appropriate qualifications for load carrying attachments.
The basic requirements for load-carrying attachments designed by SMS group are specified in SN 195.

6 Tolerancing principle

All dimensional tolerances and tolerances on shape and parallelism are subject to the envelope principle according to DIN 7167 even if this is not expressly indicated on the drawing.

7 Reference surface

The marking of reference surfaces on drawings as shown in figure 1 is an SMS group specific drawing indication.
The reference triangle with reference letter R shown in a circle marks a reference surface from which dimensioning shall start and which shall be taken into account in the course of manufacture.

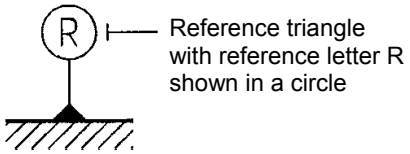


Fig. 1 – Reference surface

8 Residual magnetism

The residual magnetism of all parts shall not exceed a value of 800 A/m at the time of their delivery. Parts transported with lifting magnets and/or checked for surface defects with full-wave direct-current testers shall be demagnetised. The residual magnetism shall always be examined with an appropriate field intensity meter. The examination shall be proven and certified if so requested by SMS group.

9 Supplier evaluation system

The correctness and completeness of all supplies and services are recorded by SMS group in a supplier evaluation system. This evaluation includes quality, price, faithfulness to deadlines and completeness of the pertaining documents, test records and certificates.

10 Publication of the company standard

The company standard SN 200:2010 is available in the foreign languages in which it is required for manufacture and supply and is published both on the SMS group Intranet and in the form of a bound paper copy.

Referenced technical standards, codes and regulations

DIN 7167	Relationship between dimensional tolerances and form and parallelism tolerances; Envelope principle without drawing indication
SN 195	Load carrying attachments - Guidelines on design and manufacture; Inspection instruction
SN 200-10:2010	Manufacturing Instructions; Inspection
EC Directive 98/24/EC	Protection of the health and safety of workers from the risks related to chemical agents at work

Revision of September 2010

Adaptation to SN 104.
Validity for SMS group.
Passage on reference surface newly added.
Editorial revision.

SMS group

Manufacturing Instructions

Materials

SN 200-2

ICS 25.020

Dimensions in mm

Supersedes
SN 200-2:2007-02

Table of contents

Page

1 Scope

Unless otherwise specified in design, ordering and manufacturing documents, the requirements in this part of SN 200 apply to cast or forged blanks and semi-finished products which are used as materials for products of SMS group.

Edited by:
SMS Siemag
Standards Office

2 Casting

The manufacturing method of casting is one of the primary shaping processes. Casting is a process in which liquid steel, iron or non-ferrous metals are filled in a mould to produce parts of defined geometry and properties and of a shape which is close to the finished dimensions. Castings shall be produced in compliance with parts 1 to 3 of DIN EN 1559.

2.1 Surface qualities

Unless otherwise indicated on the drawings, the following surface qualities apply according to DIN EN 1370:1997-02:

For cast steel and non-ferrous metals	For cast iron
4S1 for blasted surfaces	3S1 for blasted surfaces
4S2 for ground surfaces	3S2 for ground surfaces

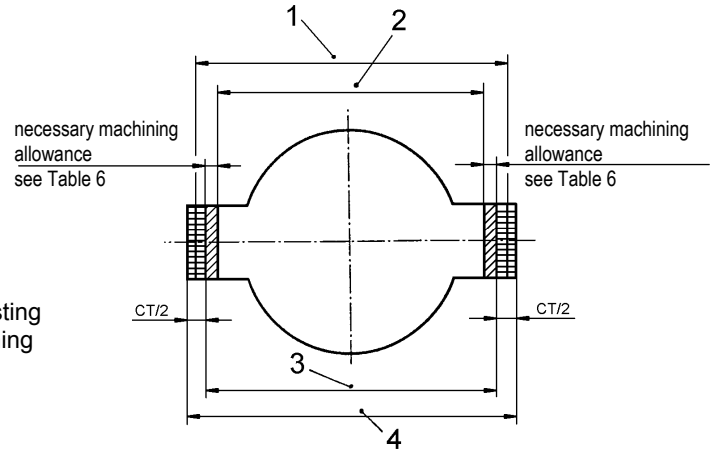
2.2 General tolerances

The authoritative standard for the definition of the general tolerances is DIN ISO 8062:1998-08. The general tolerances apply to unmachined surfaces of raw castings. Half the respective general casting tolerance is applicable to a dimension between a machined surface and an unmachined surface. The values of the general tolerances are shown in Tables 1 and 2 in the columns of the selected tolerance grade CT.

2.2.1 Degrees of accuracy

The values shown in shaded boxes in Tables 1 and 2 are the standard values for the respective nominal dimension range as SMS group specific regulation. The CT grade is determined on the basis of the biggest dimension of the workpiece. Proceed from the nominal dimension range of the biggest workpiece dimension to find the CT grade which is applicable to the workpiece. Once this CT grade has been determined, the values for all other dimensions are taken from the column of this CT grade. It is hence not the values in the shaded boxes which apply to the smaller workpiece dimensions, but the values in the column of the very CT grade which was found applicable to the workpiece on the basis of its biggest dimension.

When smaller casting tolerances are required, they shall be indicated on the drawing at the respective nominal dimension. The tolerance limits are defined in figure 1.



Key
1 nom. dimension of the raw casting
2 dimensions after finish-machining
3 minimum limit of size
4 maximum limit of size

Fig. 1 – Tolerance limits

Table 1 – General tolerances for castings made of cast steel

Nom. dimension of raw casting		Overall casting tolerance [a]															
		Casting tolerance grade CT															
		For linear dimensions [b]								For wall thicknesses							
Above	Up to and including	8	9	10	11	12	13	14	15	9	10	11	12	13	14	15	16
-	25	1,2	1,7	2,4	3,2	4,6	6	8	10	1,7	2,4	3,2	4,6	6	8	10	12
25	40	1,3	1,8	2,6	3,6	5	7	9	11	1,8	2,6	3,6	5	7	9	11	14
40	63	1,4	2	2,8	4	5,6	8	10	12	2	2,8	4	5,6	8	10	12	16
63	100	1,6	2,2	3,2	4,4	6	9	11	14	2,2	3,2	4,4	6	9	11	14	18
100	160	1,8	2,5	3,6	5	7	10	12	16	2,5	3,6	5	7	10	12	16	20
160	250	2	2,8	4	5,6	8	11	14	18	2,8	4	5,6	8	11	14	18	22
250	400	2,2	3,2	4,4	6,2	9	12	16	20	3,2	4,4	6,2	9	12	16	20	25
400	630	2,6	3,6	5	7	10	14	18	22	3,6	5	7	10	14	18	22	28
630	1000	2,8	4	6	8	11	16	20	25	4	6	8	11	16	20	25	32
1000	1600	3,2	4,6	7	9	13	18	23	29	4,6	7	9	13	18	23	29	37
1600	2500	3,8	5,4	8	10	15	21	26	33	5,4	8	10	15	21	26	33	42
2500	4000	4,4	6,2	9	12	17	24	30	38	6,2	9	12	17	24	30	38	49
4000	6300	-	7	10	14	20	28	35	44	7	10	14	20	28	35	44	56
6300	10000	-	-	11	16	23	32	40	50	-	11	16	23	32	40	50	64

[a] The tolerance zone shall be arranged symmetrically to the nominal dimension.
[b] Lengths, widths, heights, center distances, diameters and curvatures.

Table 2 – General tolerances for castings made of cast iron

Nom. dimension of raw casting		Casting tolerance [a]															
		Casting tolerance grade CT															
		For linear dimensions [b]								For wall thicknesses							
Above	Up to and including	8	9	10	11	12	13	14	15	9	10	11	12	13	14	15	16
-	25	1,2	1,7	2,4	3,2	4,6	6	8	10	1,7	2,4	3,2	4,6	6	8	10	12
25	40	1,3	1,8	2,6	3,6	5	7	9	11	1,8	2,6	3,6	5	7	9	11	14
40	63	1,4	2	2,8	4	5,6	8	10	12	2	2,8	4	5,6	8	10	12	16
63	100	1,6	2,2	3,2	4,4	6	9	11	14	2,2	3,2	4,4	6	9	11	14	18
100	160	1,8	2,5	3,6	5	7	10	12	16	2,5	3,6	5	7	10	12	16	20
160	250	2	2,8	4	5,6	8	11	14	18	2,8	4	5,6	8	11	14	18	22
250	400	2,2	3,2	4,4	6,2	9	12	16	20	3,2	4,4	6,2	9	12	16	20	25
400	630	2,6	3,6	5	7	10	14	18	22	3,6	5	7	10	14	18	22	28
630	1000	2,8	4	6	8	11	16	20	25	4	6	8	11	16	20	25	32
1000	1600	3,2	4,6	7	9	13	18	23	29	4,6	7	9	13	18	23	29	37
1600	2500	3,8	5,4	8	10	15	21	-	33	5,4	8	10	15	21	-	33	42
2500	4000	4,4	6,2	9	12	17	24	30	38	6,2	9	12	17	24	30	38	49
4000	6300	-	7	10	14	20	28	35	44	7	10	14	20	28	35	44	56
6300	10000	-	-	11	16	23	32	40	50	-	11	16	23	32	40	50	64

[a] The tolerance zone shall be arranged symmetrically to the nominal dimension.
[b] Lengths, widths, heights, center distances, diameters and curvatures.

2.2.2 Outer and inner curvatures

For outer and inner curvatures, the tolerance zones according to Tables 1 or 2 are arranged in such a way that the lower tolerance limit is always zero.
Example:
Nominal dimension of the curvature 20 mm, casting tolerance grade CT 13;
Table 1 states a tolerance of 6 mm; the lower tolerance limit applicable to the curvatures is 0, the upper limit is 6 mm.
To reduce the risk of cracking, the minimum values for the wall thicknesses in Table 3 shall be complied with for inner curvatures.

Table 3 – Inner curvatures

Wall thickness	Inner curvature min.
Up to 10	6
> 10 to 30	10
> 30	0,33 x wall thickness

2.2.3 Mould tapers

Mould tapers are tapers required on shaped elements to allow the separating of a model or casting from a mould; these tapers are specified in Tables 4 and 5. The deviations from the nominal shape and dimensions of the raw casting that are due to mould tapers are not considered as failure to meet the tolerances. The mould taper shall be averaged in relation to the nominal dimension (mould taper ±). Mould tapers on surfaces to be machined shall be arranged on the raw casting in such a way that the finished dimensions are met.

Table 4 – Mould tapers for inner and outer surfaces

Height	Up to 18	>18 to 30	>30 to 50	>50 to 80	>80 to 180	>180 to 250	>250 to 315	>315 to 400	>400 to 500	>500 to 630	>630 to 800	>800 to 1000	>1000 to 1250	>1250 to 1600	>1600 to 2000	>2000 to 2500	>2500 to 3150	>3150 to 4000
Taper	in degrees (°)					in mm												
	2,0	1,5	1,0	0,75	0,5	1,5	2,0	2,5	3,0	3,5	4,5	5,5	7,0	9,0	11,0	13,5	17,0	21,0

Table 5 – Mould tapers for core prints

Height	Up to 70	> 70
Taper	5°	3°

2.2.4 Offset

Unless otherwise specified, the offset of the casting surfaces shall be within the tolerances stated in Tables 1 and 2.

2.2.5 Wall thicknesses

Wall thicknesses use a CT according to Tables 1 and 2 which is one grade higher than the CT grade determined for the linear dimensions.

2.3 Machining allowances

Machining allowances on raw castings are excess material which is removed by subsequent machining to eliminate defects resulting from casting from the surface and to achieve the desired surface condition and the necessary dimensional accuracy.

The amount of material to be removed by machining also depends on the actual dimensions of the raw casting. These actual dimensions may vary within the range of the specified and permissible general tolerances or the tolerance indicated for a dimension. Allowance is to be understood as allowance for every surface to be machined, this means that the allowance is required two times on rotational bodies or for machining on two sides.

Unless otherwise specified, the necessary machining allowance as in Table 6 applies to the entire raw casting. The machining allowance depends on the biggest outside dimension of the raw casting and not on the casting tolerance grade CT.

The specifications made in Table 6 are based on experience gathered by SMS group; the values deviate from the machining allowances given in DIN EN ISO 8062-3.

Irrespective of Table 6, the casting shop is responsible for providing sufficient machining allowance to obtain the condition specified on the drawing and surfaces which are free of dross.

Table 6 – Machining allowances for castings (SMS group specific)

<table>
<tr><th rowspan="2">Nominal dimension range
(biggest length, width, height or diameter of the casting)</th><th colspan="2">Cast steel GS</th><th colspan="2">Cast iron EN-GJL</th><th colspan="3">Cast iron EN-GJS</th></tr>
<tr><th>Per surface</th><th>for upper faces or faces in vertical position in the mould (taper) additionally</th><th>Per surface</th><th>for upper faces or faces in vertical position in the mould (taper) additionally</th><th>Per surface</th><th>for faces in vertical position (taper) additionally</th><th>for upper faces additionally (dross layer)</th></tr>
<tr><td>Up to 30</td><td>4</td><td rowspan="8">2</td><td rowspan="4">4</td><td rowspan="11">2</td><td rowspan="4">4</td><td rowspan="11">2</td><td rowspan="8">5 to 45</td></tr>
<tr><td>> 30 to 50</td><td>5</td></tr>
<tr><td>> 50 to 80</td><td rowspan="3">6</td></tr>
<tr><td>> 80 to 120</td></tr>
<tr><td>> 120 to 180</td><td rowspan="4">5</td><td rowspan="4">5</td></tr>
<tr><td>> 180 to 250</td><td rowspan="2">7</td></tr>
<tr><td>> 250 to 315</td></tr>
<tr><td>> 315 to 400</td><td rowspan="2">8</td></tr>
<tr><td>> 400 to 500</td><td rowspan="3">3</td><td rowspan="3">3</td></tr>
<tr><td>> 500 to 630</td><td rowspan="2">10</td><td>6</td><td>6</td><td rowspan="2">20 to 110</td></tr>
<tr><td>> 630 to 800</td><td rowspan="2">8</td><td rowspan="2">8</td></tr>
<tr><td>> 800 to 1000</td><td rowspan="2">12</td></tr>
<tr><td>> 1000 to 1250</td><td rowspan="3">4</td><td rowspan="3">4</td></tr>
<tr><td>> 1250 to 1600</td><td>14</td><td>10</td><td>10</td><td rowspan="3">50 to 240</td></tr>
<tr><td>> 1600 to 2000</td><td rowspan="2">16</td><td>12</td><td>3</td><td>12</td><td>3</td></tr>
<tr><td>> 2000 to 2500</td><td rowspan="3">5</td><td rowspan="3">5</td></tr>
<tr><td>> 2500 to 3150</td><td>18</td><td>15</td><td rowspan="3">4</td><td>15</td><td rowspan="3">4</td><td rowspan="3">110 to 500</td></tr>
<tr><td>> 3150 to 4000</td><td>20</td><td rowspan="2">17</td><td rowspan="2">17</td></tr>
<tr><td>> 4000 to 6300</td><td>25</td></tr>
<tr><td>> 6300 to 10.000</td><td>30</td><td>7</td><td>20</td><td>5</td><td>20</td><td>5</td><td></td></tr>
<tr><td>Hole not cored by foundry</td><td colspan="2">Up to dia. 100 mm</td><td colspan="5">Up to dia. 80 mm</td></tr>
</table>

2.4 Inspections

2.4.1 Basic specifications

Tables 7 to 9 show SMS group specific requirements made on the basis of DIN EN 12680-1:2003-06. Where no requirements are specified, DIN EN 12680-1: 2003-06 shall be applied. When required, the specifications with regard to severity levels are indicated on the drawing or in product-specific SN standards. The minimum requirement for components supplied by SMS group is severity level 4 according to DIN EN 12680-1: 2003-06, severity level 5 is not applicable.

2.4.2 Inspections of cast steel

2.4.2.1 Internal condition

Table 7 – Requirements for ultrasonic testability

Wall thickness	Smallest detectable flat-bottomed hole diameter according to DIN EN 12680-1: 2003-06, item 5.2
≤ 300	3
> 300 to ≤ 400	4
> 400 to ≤ 600	6
> 600	8

Table 8 – Recording levels for reflectors, based on a 2 MHz ultrasonic probe

Wall thickness	Area tested	Reflectors without measurable extent, diameter of equivalent flat-bottomed hole, min.	Reflectors with measurable extent, diameter of equivalent flat-bottomed hole, min.	Back wall echo reduction >dB [a]
≤ 300	Surface and core zones	4	3	12
> 300 to ≤ 400	Surface and core zones	6	4	12
> 400 to ≤ 600	Surface and core zones	6	6	12
> 600	Surface and core zones	8	8	12
	Special surface zone	3	3	12

[a] SMS group specific

Table 9 – Acceptance limits for volumetric reflectors (SMS group specific)

Feature	Unit	Zone	Severity level								
			1	2			3			4	
Casting wall thickness in the area tested	**mm**		-	≤ 50	> 50 ≤ 100	> 100 ≤ 600	≤ 50	> 50 ≤ 100	> 100 ≤ 600	≤ 50	> 50 ≤ 100	> 100 ≤ 600
Reflectors without measurable extent												
Biggest diameter of equivalent flat-bottomed hole	mm	Surface [a]	3	8								
		Core										
Number of reflectors to be recorded within a frame of 100 mm x 100 mm	Pcs.	Surface [a]	3	3	5		6		6	Not used as criterion		
		Core		Not used as criterion						Not used as criterion		
Acceptance limit for back wall echo reduction	max dB		6	12								
Reflectors with measurable extent												
Biggest diameter of equivalent flat-bottomed hole	mm	Surface [a]	3	8								
		Core										
Max. extent of reflector in wall thickness direction	%	Surface [a]	Not permitted	15% of zone thickness								
		Core		15% of wall thickness								
Max. length without measurable width	mm	Surface [a]		75	75	75	75	75	75	75	75	75
		Core		75	75	100	75	75	120	100	100	150
Largest individual area [b]	mm²	Surface [a]		600	1000	1000	600	2000	2000	2000	2000	2000
		Core		10.000	10.000	15.000	15.000	15.000	20.000	15.000	15.000	20.000
Largest total area per reference area [b]	mm²	Surface [a]		10.000	10.000	10.000	10.000	10.000	10.000	10.000	15.000	15.000
		Core		10.000	15.000	15.000	15.000	15.000	20.000	15.000	20.000	20.000
Reference area	mm²			150.000 ≈ (390 mm x 390 mm)			100.000 ≈ (320 mm x 320 mm)					
Acceptance limit for back wall echo reduction	max dB		6	12								

Every reflector which exceeds the limits of one feature shall be treated as not acceptable.
Indications which exceed the acceptance limits shall be reported in writing to the SMS group Quality Inspection.

[a] Definitions of the zones: Surface zone = t/3 but max. 100 mm; t = wall thickness in test area; core zone = remaining core section

[b] Indications located at distances of less than 25 mm shall be regarded as one indication.

2.4.2.2 External condition

The external condition shall be examined in the areas marked on the drawing using the magnetic particle method as in DIN EN 1369 or penetrant testing as in DIN EN 1371-1. The specifications are given on the drawing or in product-specific SN standards.

2.4.3 Testing of spheroidal graphite cast iron

2.4.3.1 Internal condition

Ultrasonic testing used to determine the internal condition shall be in accordance with DIN EN 12680-3.
The requirements made on the internal condition of castings in spheroidal graphite cast iron are shown on the drawing or specified in product-specific SN standards.

2.4.3.2 External condition

The external condition shall be examined in the areas marked on the drawing using the magnetic particle method as in DIN EN 1369 or penetrant testing as in DIN EN 1371-1. The specifications are given on the drawing or in product-specific SN standards.

2.5 Production welds

Production welds are allowed provided that the material-specific requirements are fulfilled. For this purpose, proven welding methods, welding instructions and appropriately qualified welders must be available. Before the beginning of a production weld, the intended welding procedure shall be submitted to SMS group for approval in the form of a welding procedure specification (WPS). The following conditions can be agreed upon in ordering documents, drawings and company standards of SMS group.

- Production welds shall be communicated to SMS group in a welding documentation which is subsequently provided by the supplier.
- The supplier shall obtain approval from SMS group before the beginning of welding and shall subsequently submit a welding documentation on the production welds used.

3 Forging

3.1 Basic specifications

Forging is hot shaping of ingots in the form of die forging or open-die forging to obtain a shape which is close to the finished shape for the further processing of the component. The shaping process creates a largely uniform and dense structure over the whole cross-section.
If no particular requirements are made, the technical conditions of delivery and quality specifications shall be taken from the relevant DIN, EN, ISO or SEW material standards. When particular requirements have to be fulfilled, the quality specifications for forgings are shown on the drawing in the form of drawing stickers.
Heat treatment shall be carried out or arranged for by the forging and/or the manufacturing shop.

3.2 Inspections

3.2.1 Surface condition

Forgings supplied in as-forged condition shall be considered acceptable when the specified quality class can be fulfilled.

When forgings are supplied in machined condition, the surface quality shall correspond to the required quality class according to Table 10.

Table 10 – Surface qualities

Surface quality	**Quality class and roughness R_a**			
	1	**2**	**3**	**4**
	≤ 25 µm	**≤ 12,5 µm**	**≤ 12,5 µm**	**≤ 6,3 µm**
Machined surface	x	x	x	x
"x" marks the quality class which can be attained at the specified surface roughness.				

3.2.2 Internal condition

When examination of the internal condition is specified, this examination shall be made using ultrasonic testing according to DIN EN 10228-3:1998-07 or DIN EN 10228-4:1999-10.

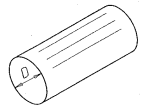
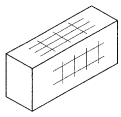
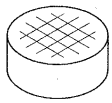
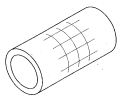
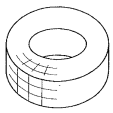
3.2.2.1 Performance of the examination

The examination shall be made using the manual contact pulse-echo technique, the sizes of reflectors shall be determined using the DGS (**d**istance-**g**ain-**s**ize) method. The necessary minimum scanning coverage depends on the type of the forging and on whether grid scanning or 100% scanning coverage is specified in the order or drawing.

Table 11 specifies the requirements for scanning coverage at perpendicular sound incidence of the forging types 1, 2 and 3.

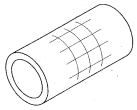
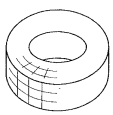
Table 12 specifies the requirements for scanning coverage at angular sound incidence for the forging types 3a and 3b which have an outside diameter to inside diameter ratio of less than 1,6. The depth which can be covered in circumferential scanning is limited by the angle of incidence and the diameter of the forging.

Table 11 – Scanning coverage at perpendicular sound incidence

Type	Grid scanning [a]			a) b) 100% scanning
	Shape	Diameter D in mm	Scanning paths [b]	
1	1a 	$D \leq 200$ $200 < D \leq 500$ $500 < D \leq 1000$ $D > 1000$	2 at 90° 3 at 60° 4 at 45° 6 at 30°	100% scan around at least 180° of the cylindrical surface
	1b 	Scanning along the lines of a square-link grid on two surfaces perpendicular to each other [c] [d]		100% scan on two surfaces at right angle to each other
2		Scanning along the lines of a square-link grid around 360° of the cylindrical surface and on one lateral surface.		100% scan around at least 180° on the cylindrical surface and 100% of one lateral surface
3	3a 	Scanning along the lines of a square-link grid around 360° on the outer surface area [d]		100% scan around 360° on the outer surface area
	3b and 3c [e] 	Scan along the lines of a square-link grid around 360° on the outer surface area and on one lateral surface [d]		100% scan around 360° on the outer cylindrical surface and on one lateral surface
4	The scanning coverage shall be specified in the enquiry and in the order.			

[a] Additional scanning (for example in both axial directions for type 3a) may be carried out if specified in the enquiry and the order.
[b] 100% means at least 10% overlap of the consecutive scanning paths.
[c] If a hole in the surface makes it impossible to reach the opposite surface, the number of scan lines shall be doubled for the types 1a and 1b by including the opposite test surfaces.
[d] The grid spacing shall be equal to the thickness of the component up to a maximum of 200 mm.
[e] 3b = expanded, 3c = ring rolled

Table 12 – Scanning coverage at angular sound incidence

Type	Grid scanning [a]		100% scanning [a] [b]
3	3a 	Scanning in both directions along 360° circumferential grid lines whose spacing shall be equal to the radial thickness up to a maximum of 200 mm	100% scan of the outer cylindrical surface in both circumferential directions
	3b 		
4	The scanning coverage shall be specified in the enquiry or order.		

[a] Additional scanning can be carried out if specified in the enquiry and the order.
[b] 100% means at least 10% overlap of the consecutive scanning paths.

3.2.2.2 Recording levels and acceptance criteria

The data in Tables 13 and 14 specify the recording levels and acceptance criteria to be met in the respective quality classes. The sensitivity of the testing system (testing unit, probe, cable) shall be sufficient to ensure the detection of the smallest discontinuities according to the requested recording and acceptance limits.

Table 13 – Quality classes, recording levels and acceptance criteria when using straight-beam probes

Quality class	1	2	3	4
Recording levels				
Flat bottomed holes (FBH) d_{eg} in mm of diameter	> 8	> 5	> 3	> 2
R ratio for abrupt attenuation of the backwall echo [a) b)]	≤ 0,1	≤ 0,3	≤ 0,5	≤ 0,6
Acceptance limits				
FBH in isolated point discontinuities d_{eg} in mm of diameter	≤ 12	≤ 8	≤ 5	≤ 3
FBH for discontinuities with extent or grouped discontinuities d_{eg} in mm of diameter	≤ 8	≤ 5	≤ 3	≤ 2

a) $R = \frac{Fn}{Fo,n}$ with n = 1 for t ≥ 60 mm and n = 2 for t < 60 mm
F_n amplitude (height on screen) of the n^{th} attenuated backwall echo
Fo,n amplitude (height on screen) of the n^{th} backwall echo in the nearest discontinuity-free section of the range of F_n.

b) When the backwall echo reduction is so heavy that the recording level is not attained, further examinations are required. Ratio *R* applies only if heavy backwall echo reduction is caused by the presence of a discontinuity.

Table 14 – Quality classes, recording levels and acceptance criteria when using angle-beam probes

Quality class	1 [a)]	2	3	4
Recording level				
Recording level of flat-bottomed holes FBH d_{eg} in mm	-	> 5	> 3	> 2
Acceptance limits				
FBH for isolated discontinuities d_{eg} in mm of diameter	-	≤ 8	≤ 5	≤ 3
FBH for discontinuities with extent or grouped discontinuities d_{eg} in mm of diameter	-	≤ 5	≤ 3	≤ 2

a) angular sound incidence is not applicable for quality class 1.

3.2.3 External condition

The external condition shall be examined in the areas marked on the workpiece using the magnetic particle method as in DIN EN 10228-1:1999-07 or the liquid penetrant method as in DIN EN 10228-2:1998-06. Unless otherwise specified on the drawing, the minimum requirement to be fulfilled is quality class 3 according to DIN EN 10228-1:1999-07 or DIN EN 10228-2:1998-06.

3.3 Inspection certificates

The data and results of the examinations and tests listed below shall be reported to SMS group by the forging shop (S) or the manufacturing shop (F) (see CAD stickers F1001 and F1002) in an inspection certificate 3.1 DIN EN 10204:2005-01.

- Chemical analysis of each heat contained in the supply.
- Result of hardness testing and the mechanical properties of every heat and heat-treatment unit.
- If demanded, the result of elevated-temperature tensile testing at maximum working temperature of the material for heat-resistant steels for every heat and heat-treatment unit.
- Results of the non-destructive tests as specified on the drawing.
- Results of other examinations/tests if so specified on the drawing.

4 Semi-finished products

4.1 Basic specifications

Semi-finished product is the collective term for materials of definite shape like sheets/plates, boards, panels, strips, rods, bars, pipes and sections produced by rolling, drawing, pressing or any other process and having at least one indefinite dimension.
The designation "St" is allowed for components in steel for which no particular strength requirements are made. The selection of the starting material and the semi-finished product for the manufacture of the component is left to the discretion of the workshop. Suitability for welding shall be taken into account.
The DIN and DIN EN standards for semi-finished products are the relevant standards with regard to the general tolerances of steel products.

4.2 Technical delivery conditions

The technical delivery conditions are specified in DIN EN 10021 and in the respective standards for semi-finished products.

The thickness and flatness deviations of the plates are subject to the specifications made in DIN EN 10029:1991-10, Table 1, class A, and Table 4, class N.
The permissible deviations given in DIN EN 10029:1991-10 for the nominal thickness range of 150 to 250 mm are also applicable to plate thicknesses over 250 mm.
Use shall be made of plates fulfilling the surface condition of class A as in DIN EN 10163-2:2005-03.

4.3 Inspection

The results of all semi-finished product (primary material) inspections set out below shall be certified in an inspection certificate 3.1 as specified in DIN EN 10204: 2005-01.
When the inspections below have been carried out on the semi-finished product, the component parts need not be inspected and certified again. It shall be ensured, however, that the components are made from the inspected semi-finished product.

Plate

Plate of a thickness ≥100 mm and having a yield point of at least 250 MPa related to the smallest standardised material thickness shall be ultrasonically tested as specified in DIN EN 10160:1999-09, quality class S2/E2, and tested for tensile strength or hardness.

Unalloyed steel

- Round bar of dia. ≥ 150 mm
- Square bar of a lateral length ≥ 150 mm
- Flat bar of a width ≥ 150 mm and a thickness ≥ 100 mm and having a yield point of at least 250 MPa related to the smallest standardised material thickness shall be ultrasonically tested according to DIN EN 10228-3:1998-07 (type 1 grid scanning, quality class 2) and tested for tensile strength or hardness.

Alloy steel

- Round bar of dia. ≥ 80 mm
- Square bar of a lateral length ≥ 80 mm
- Flat bar of a width ≥ 80 mm and a thickness ≥ 80 mm and having a yield point of at least 350 MPa related to the smallest standardised material thickness shall be chemically analysed and ultrasonically tested according to DIN EN 10228-3:1998-07 (type 1 grid scanning, quality class 2) and tested for tensile strength or hardness.

Heat-resistant steel

If specified in the order or drawing, semi-finished products made of heat-resistant steel shall, in addition to the chemical analysis, be tensile-tested at the maximum permissible working temperature of the steel for each heat and heat-treatment unit.

Pipe

For pipe of an outside diameter ≥ 38 mm and a wall thickness ≥ 5 mm, testing as required in the technical delivery conditions for the pipes concerned shall be certified.

Referenced technical standards, codes and regulations

DIN EN 1369	Founding; Magnetic particle inspection
DIN EN 1370:1997-02	Founding; Surface roughness inspection by visualtactile comparators
DIN EN 1371-1	Founding; Liquid penetrant inspection; Part 1: Sand, gravity die and low pressure die castings
DIN EN 1559-1	Founding, technical conditions of delivery, Part 1: General
DIN EN 1559-2	Founding; Technical conditions of delivery; Part 2: Additional requirements for steel castings
DIN EN 1559-3	Founding; Technical conditions of delivery, Part 3: Additional requirements for iron castings
DIN EN 10021	General technical delivery conditions for steel products
DIN EN 10029:1991-10	Hot rolled steel plate 3 mm thick or above; tolerances on dimension, shape and mass
DIN EN 10160:1999-09	Ultrasonic testing of steel flat products of thickness equal to or greater than 6 mm (reflection method)
DIN EN 10163-2:2005-03	Technical delivery conditions for the surface condition of hot rolled steel plate, wide flats and sections; Part 2: Plate and wide flats
DIN EN 10204:2005-01	Metallic products; Types of inspection documents
DIN EN 10228-1:1999-07	Non-destructive testing of steel forgings; Part 1: Magnetic particle inspection
DIN EN 10228-2:1998-06	Non-destructive testing of steel forgings; Part 2: Liquid penetrant inspection
DIN EN 10228-3:1998-07	Non-destructive testing of steel forgings; Part 3: Ultrasonic testing of ferritic and martensitic steel forgings
DIN EN 10228-4:1999-10	Non-destructive testing of steel forgings; Part 4: Ultrasonic testing of austenitic or austenitic-ferritic stainless steel forgings
DIN EN 12680-1:2003-06	Founding; Ultrasonic examination; Part 1: Steel castings for general purposes
DIN EN 12680-3	Founding; Ultrasonic examination; Part 3: Spheroidal graphite cast iron castings
DIN EN ISO 8062-3	Geometrical product specifications (GPS); Dimensional and geometrical tolerances for moulded parts; Part 3: General dimensional and geometrical tolerances and machining allowances for castings
DIN ISO 8062:1998-08	Castings; System of dimensional tolerances and machining allowances

Revision of September 2010

Layout according to SN 104.
New SMS group logo.
Standards with date indication.
New Table 8 on back wall echo.
New Table 9 on acceptance limits for back wall echo.
New passage on production welds.
Cancelling of table on reference line method.
Quality class 3 added in item 3.2.3.
Editorial revision.

SMS group

Manufacturing Instructions

Thermal cutting and bending

SN 200-3

ICS 25.020 Dimensions in mm Supersedes SN 200-3:2007-02

Table of contents

1 Scope

Unless otherwise specified in design, ordering or manufacturing documents, the requirements specified in this part of SN 200 apply to parts made by thermal cutting or bending and used as material for products of SMS group.

2 Thermal cutting

2.1 Oxyfuel flame cutting

Oxyfuel flame cutting is a thermal cutting process which uses a fuel gas-oxygen flame and cutting oxygen. The heat from the flame and the heat produced during combustion allow continuous combustion by means of the cutting oxygen. The oxides produced and laden with small amounts of molten metal, are blown out of the kerf through the kinetic energy of the cutting oxygen jet.
The specifications apply to flame cuts on workpieces of 3 mm to 400 mm in thickness.

2.2 Plasma arc cutting

Plasma arc cutting is a thermal cutting process in which a constricted arc is used. In the arc monatomic gases are ionised to some extent, polyatomic gases are dissociated and ionised to some extent. The plasma arc, which has a high temperature and high kinetic energy, melts the material or vaporises it to some extent and expels it. During this process the kerf is produced.
The specifications apply to plasma arc cuts on workpieces of 1 mm to 150 mm in thickness.

2.3 Laser beam cutting

Laser beam cutting is a thermal cutting process in which the energy required for cutting is supplied by a focused laser beam and converted into heat in the material. The cutting process is supported by a gas jet. There are three different methods of laser beam cutting: laser-beam oxygen cutting, laser beam fusion cutting and laser-beam sublimation cutting.
The specifications apply to laser cuts on workpieces of 0,5 mm to 40 mm in thickness.

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2.4 Cut surface quality

The cut surface quality is the distance between two parallel straight lines between which the cut surface profile lies within the theoretical angle (for example 90° for a vertical cut).
The perpendicularity or angularity tolerance includes both the straightness and the flatness deviations. Figure 1 - Vertical cut, and Fig. 2 - Bevel cut, show the maximum actual-value deviations within the tolerance class.
As an SMS group specific regulation, the values of Tables 1 to 4 also apply to cut thicknesses up to 400 mm.

2.4.1 Locations of the measuring points

The characteristic value of perpendicularity or angularity tolerance *u*, which his specified in Table 2, is determined only in a limited area of the cut surface. The area shall be reduced by the dimension ∆a according to Table 1 from the upper and the lower cut surface edges, see figures 1 and 2). The reason for the reduced cut face profile is to allow for the melting of the top edge of the cut.

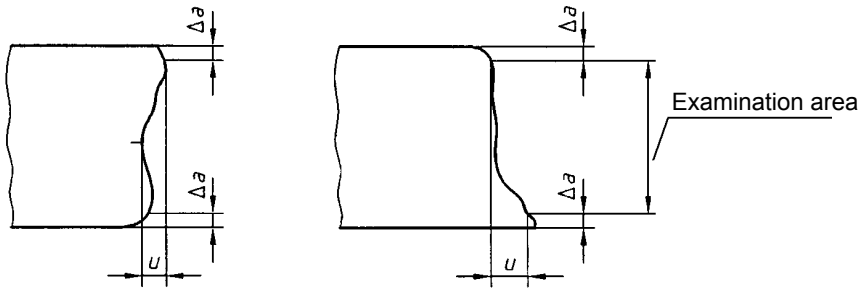


Fig. 1 – Vertical cut

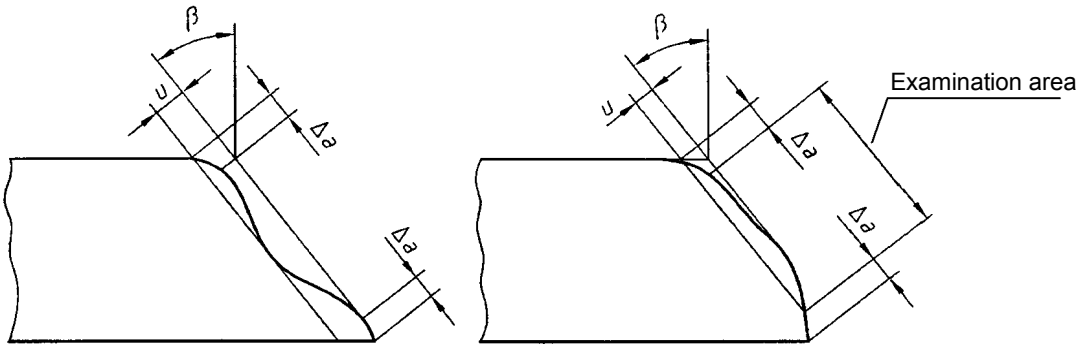


Fig. 2 – Bevel cut

Table 1 – Dimensions for ∆a

Cut thickness *a*	**∆a**
≤ 3	0,1a
> 3 ≤ 6	0,3
> 6 ≤ 10	0,6
> 10 ≤ 20	1
> 20 ≤ 40	1,5
> 40 ≤ 100	2
> 100 ≤ 150	3
> 150 ≤ 200	5
> 200 ≤ 250	8
> 250 ≤ 400	10

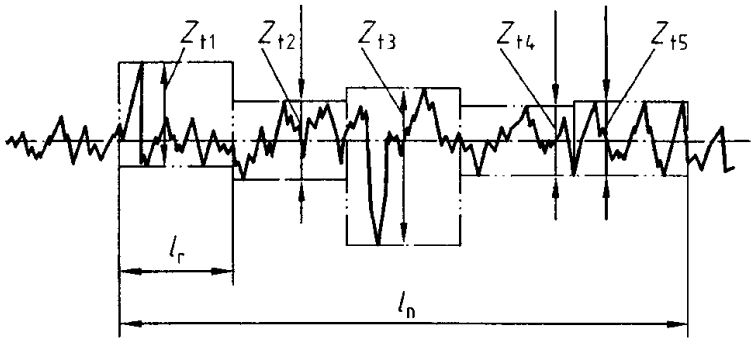
Table 2 – Perpendicularity or angularity tolerance

Cut thickness a	Up to 20	>20 to 40	>40 to 60	>60 to 80	>80 to 100	>100 to 120	>120 to 140	>140 to 160	>160 to 180	>180 to 200	>200 to 220	>220 to 240	>240 to 260	>260 to 280	>280 to 400
u [a)]	1,3	1,6	1,9	2,2	2,5	2,8	3,1	3,4	3,7	4,0	4,3	4,6	4,9	5,2	5,5

[a)] Values up to 140 mm comply with range 4 according to DIN EN ISO 9013:2003-07, values above 140 mm are SMS group specific.

2.4.2 Mean height of the profile

The mean height of the profile R_{Z5} is the arithmetic mean of the single profile elements of five bordering single measured distances, see Fig. 3 and Table 3.



Key

l_n	evaluation length
Z_{t1} to Z_{t5}	single profile elements
l_r	single sampling length (1/5 of l_n)

Fig. 3 – Mean height of the profile

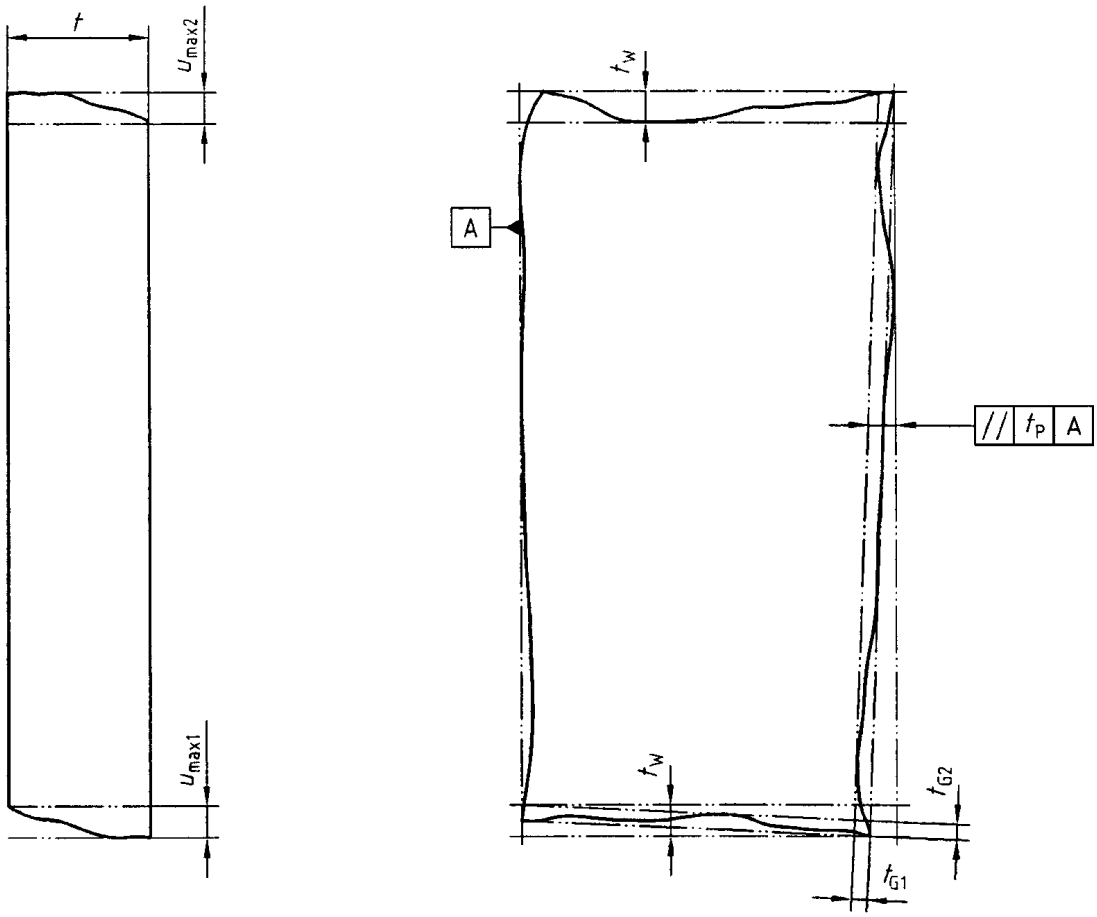
Table 3 – Mean height of the profile

Cut thickness a	Up to 20	>20 to 40	>40 to 60	>60 to 80	>80 to 100	>100 to 120	>120 to 140	>140 to 160	>160 to 180	>180 to 200	>200 to 220	>220 to 240	>240 to 260	>260 to 280	>280 to 400
R_{Z5} [a)]	0,146	0,182	0,218	0,254	0,290	0,326	0,362	0,398	0,434	0,470	0,506	0,542	0,578	0,614	0,650

[a)] Values up to 140 mm comply with range 4 according to DIN EN ISO 9013:2003-07, values above 140 mm are SMS group specific.

2.4.3 Form and location tolerances

Figure 4 shows the maximum permissible actual-value deviations within the tolerance zones.
The drawing dimension shall be taken as the nominal dimension. The actual dimensions shall be measured on the cut surfaces after cleaning. The limit deviations for nominal dimensions stated in Table 4 apply to dimensions without tolerance indications.
The limit deviations comply with tolerance class 1 according to DIN EN ISO 9013:2003-07.



a) Through thickness b) Flat

Key

t_{G1} straightness tolerance (see DIN EN ISO 1101:2008-08, item 18.1) for cut length;
t_{G2} straightness tolerance (see DIN EN ISO 1101:2008-08, item 18.1) for cut width;
t_w perpendicularity tolerance (see DIN EN ISO 1101:2008-08, item 18.10) for cut width referred to A;
t_p parallelism tolerance (see DIN EN ISO 1101:2008-08, item 18.9) for cut width referred to A on sheet level;
U perpendicularity tolerance (see DIN EN ISO 1101:2008-08, item 18.10) in cutting beam direction;

Fig. 4 – Form and location tolerances (shown on two views of a sheet)

Table 4 – Limit deviations for nominal dimensions

Workpiece thickness	Nominal dimensions							
	> 0 < 3	≥ 3 < 10	≥ 10 < 35	≥ 35 < 125	≥ 125 < 315	≥ 315 < 1000	≥ 1000 < 2000	≥ 2000 < 4000
	Limit deviations							
> 0 ≤ 1	± 0,04	± 0,1	± 0,1	± 0,2	± 0,2	± 0,3	± 0,3	± 0,3
> 1 ≤ 3,15	± 0,1	± 0,2	± 0,2	± 0,3	± 0,3	± 0,4	± 0,4	± 0,4
> 3,15 ≤ 6,3	± 0,3	± 0,3	± 0,4	± 0,4	± 0,5	± 0,5	± 0,5	± 0,6
> 6,3 ≤ 10	-	± 0,5	± 0,6	± 0,6	± 0,7	± 0,7	± 0,7	± 0,8
> 10 ≤ 50	-	± 0,6	± 0,7	± 0,7	± 0,8	± 1	± 1,6	± 2,5
> 50 ≤ 100	-	-	± 1,3	± 1,3	± 1,4	± 1,7	± 2,2	± 3,1
> 100 ≤ 150	-	-	± 1,9	± 2	± 2,1	± 2,3	± 2,9	± 3,8
> 150 ≤ 200	-	-	± 2,6	± 2,7	± 2,7	± 3	± 3,6	± 4,5
> 200 ≤ 250	-	-	-	-	-	± 3,7	± 4,2	± 5,2
> 250 ≤ 400	-	-	-	-	-	± 4,4	± 4,9	± 5,9

3 Bending

3.1 Bending of flat products

In the cold bending of flat products longitudinally to the direction of rolling of steel grades having a minimum tensile strength R_m of 390 MPa, the permissible bending radii and leg lengths according to Table 5 and figure 5 shall be observed.

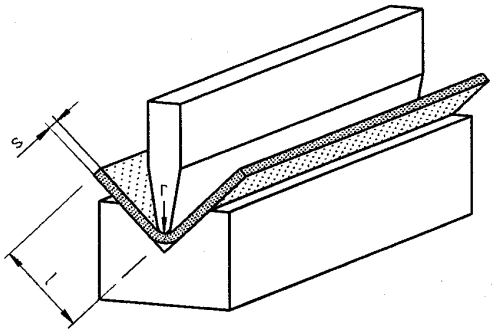


Fig. 5 – Arrangement for bending

Table 5 – Bending radii and leg lengths for a bending angle of 90°

Plate thickness		s	1	1,5	2	2,5	3	4	5	6	8	10	12	15	20	25	30	35	40
Bending radius	min.	r	2,5				3	6	8	10	16	20	24	30	40	50	60	70	100
Leg length	min.	l	10				16	24	32	40	64	80	96	120	160	200	240	280	320

3.2 Bending of pipes

Cold bending of pipes shall be preferred to the use of welding elbows. If drawings show welding elbows which can be replaced with cold-bent pipes taking into account the larger bending radii, the manufacturing workshop is free to use the cold-bent pipe.
When pipes are shown on isometric drawings, compliance with the drawing indications shall be ensured.

3.2.1 Bending radii

Bending radii for cold-bent pipes are specified in Table 6.
A roundness deviation of the pipe of max. 2 % is permissible according to DIN EN 13480-3:2002-08.

Table 6 – Bending radii of pipes

Outside pipe diameter	Bending radius
≥ 6 to 12	min. 2 x outside pipe diameter for wall thicknesses >1,0
> 12 to 48,3	min. 2 x outside pipe diameter for all wall thicknesses
> 48,3 to 114,3	min. 2,5 x outside pipe diameter for all wall thicknesses

3.2.2 General tolerances

The general tolerances are specified in Table 7 according to DIN EN ISO 13920:1996-11. These general tolerances correspond to the welding tolerances and shall be applied to bent parts by analogy.

Tolerance category B according to Table 7 applies to completely dimensioned pipe lines (e. g. pipe detail, isometric drawing) and to workpieces produced by the bending of flat products. Tolerance category C according to Table 7 applies to not completely dimensioned and freely laid pipe lines.
Linear dimensions are defined as outside, inside, and stepped dimensions, bending diameters and bending radii.

Table 7 – Tolerances on linear dimensions

Tolerance class	Nominal dimension range										
	2 to 30	> 30 to 120	> 120 to 400	> 400 to 1000	> 1000 to 2000	> 2000 to 4000	> 4000 to 8000	> 8000 to 12000	> 12000 to 16000	> 16000 to 20000	> 20000
B	± 1	± 2	± 2	± 3	± 4	± 6	± 8	± 10	± 12	± 14	± 16
C	± 1	± 3	± 4	± 6	± 8	± 11	± 14	± 18	± 21	± 24	± 27

3.2.3 General tolerances for angular dimensions

The general tolerances for angular dimensions are specified in SN 200-4:2010, item 9.2.3.

4 Inspection

Flame-cut and bent parts shall be checked by the manufacturer for compliance with the specified dimensions and angles. The manufacturer shall also examine the surface quality (height of the profile R_{z5}) of flame-cut surfaces. Documenting of the inspections is not required.

Referenced technical standards, codes and regulations

DIN EN 13480-3:2002-08	Metallic industrial piping; Part 3: Design and calculation
DIN EN ISO 1101:2008-08	Geometrical product specifications (GPS); Geometrical tolerancing; tolerances of form, orientation, location and run-out
DIN EN ISO 9013:2003-07	Thermal cutting; Classification of thermal cuts; Geometrical product specification and quality tolerances
DIN EN ISO 13920:1996-11	Welding; General tolerances for welded constructions; Dimensions for lengths and angles, shape and position
SN 200-4:2010	Manufacturing Instructions – Part 4: Welding

Revision of September 2010

Adapted to SN 104.
Validity for SMS group.
Standards indicated with year and month.
Instructions on bending added.
Editorial revision.

SMS group

Manufacturing Instructions

Welding

SN 200-4

ICS 25.160 Dimensions in mm Supersedes SN 200-4:2007-02

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Page

1 Scope

Unless otherwise specified in design, ordering or manufacturing documents, the requirements specified in this part of SN 200 apply to parts produced with the help of welding procedures and used as starting material and/or manufacturing material in products/material of SMS group.

2 Representation of weld joints in drawings

2.1 Indication of welding symbols on drawings

The following welding symbols are shown and used on the basis of DIN EN 22553:1997-03.

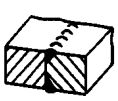
2.1.1 Symbols for weld categories

The various weld categories are each characterised by a symbol which, in general, is similar to the shape of the weld to be made. The symbols characterise shape, preparation and execution of the welds, see Table 1. The symbols do not determine the welding process to be used. Where necessary, combinations of elementary symbols are used for representation. Typical examples are given in Table 2.

Table 1 – Elementary symbols for weld categories

Designation	Representation	Symbol	Designation	Representation	Symbol	Designation	Representation	Symbol
Square butt weld			Single-bevel butt weld with broad root face			Fillet weld		
Single-V butt weld			Single-U-butt weld			Steep-flanked single–V butt weld		
Single-bevel butt weld			Single-J butt weld (J groove weld)			Steep-flanked single-bevel butt weld		
Single-V butt weld with broad root face			Backing run (sealing run)			Surfacing		

Table 2 – Combinations of elementary symbols

Designation	Representation	Symbol	Designation	Representation	Symbol	Designation	Representation	Symbol
Double-V butt weld (X-weld)			Double-bevel butt weld with broad root face (double-bevel tee butt weld)			Single-V and single-U butt weld		
Double-bevel butt weld (K-shape)			Double-U butt weld			Single-V butt weld and backing run		
Double-V butt weld with broad root face			Double-J butt groove weld (double-J weld)			Dual fillet weld		

2.1.2 Supplementary symbols

Elementary symbols may be completed by a symbol characterising the shape of the surface or the shape of the weld. The absence of a supplementary symbol means that the shape of the surface shall comply with the weld quality indicated. Combinations using more than two supplementary symbols are not allowed. Supplementary symbols, complementary symbols and examples of application are shown in Tables 3 to 5.

Table 3 – Supplementary symbols

Shape of weld surface	Symbol	Execution of weld	Symbol
Flat	—	Toes blended smoothly	
Convex		Use permanent backing strip	M
Concave		Use removable backing strip	MR

Table 4 – Complementary symbols

Meaning	Symbol
Circumferential weld	
Site weld	
SMS group regulation	Workshop / assembly weld

Table 5 – Examples of application of supplementary symbols

Designation	Representation	Symbol	Designation	Representation	Symbol
Flat (flush) single-V butt weld			Single-V butt weld with broad root face and backing run		
Convex double-V weld			Flush finished single-V butt weld		
Concave fillet weld			Fillet weld with smooth blended face		
Flat (flush) single-V butt weld with flat (flush) backing run					

2.2 Representation on drawings

Welds shall be shown on the drawings according to DIN EN 22553:1997-03. For simplification, the use of the symbols shall be preferred to the sectional view.

2.2.1 Material penetration

When welds are shown in cross-sectional representation and require full material penetration, the instruction "full penetration" is indicated at the weld as SMS group specific regulation. full penetration

2.2.2 Welds for subsequent machining

When machining takes place after welding, the weld depth shall be dimensioned from the side opposite to the surface to be machined, see Fig. 1. Thus it is ensured that the desired weld depth is attained after machining.

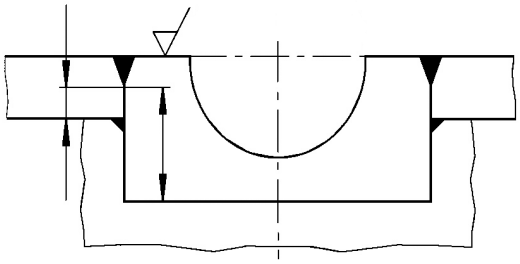


Fig. 1 – Drawing indication

2.2.3 Deposit welding

For deposit welding, see SN 402.

2.2.4 Fillet welds

Fillet welds are represented by a filled black triangle or a welding symbol (see 2.1.1 and 2.1.2) shown at the weld joints in the sectional view or in the view of the part. All fillet welds shall be continuous welds without interruption.

2.2.5 Butt welds, partly and fully bevelled welds

Butt welds, partly and fully bevelled welds are represented on drawings in the sectional view or in the view with symbols (see 2.1.1 and 2.1.2) and with indication of the weld depth s.

2.2.6 Welds on pipe lines

The operating pressure of the pipe line shall be indicated. Symbols (see 2.1.1 and 2.1.2) or indications according to Table 10 on page 12 shall be used only in exceptional cases.

2.3 Reference symbols on drawings

2.3.1 Reference symbol

The elements of the reference symbol and the indications made at the symbol are shown in figure 2.

Elements of the reference symbol:

1 Weld joint

2 Arrow line

3a Reference line (solid line)

3b Reference line (dashed line)

4 Forked line for supplementary indications (shown only when needed)

Indications at the reference symbol:

① Main dimensions of weld thickness

② = Symbol

③ Weld length dimensions

④ Indications for welding process, quality level, welding position, filler metal

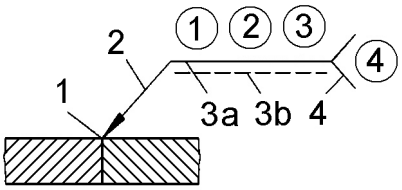


Fig. 2 – Reference symbol

2.3.2 Positioning of the symbol relative to the reference line

The symbol is placed either above or below the reference line.

- When the symbol is shown on the side of the solid reference line, the weld is on the arrow side of the joint, see Fig. 3.
- When the symbol is shown on the side of the dashed reference line, the weld is on the opposite side of the joint, see Fig. 4.
- When the welds are symmetrical, the dashed line is not used, see Fig. 5.

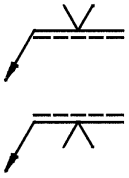


Fig. 3 – Weld on arrow side

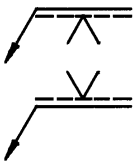


Fig. 4 – Weld on opposite side

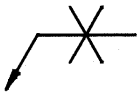


Fig. 5 – Symmetrical weld

2.3.3 Position and relation between arrow line and joint

The side of the joint to which the arrow line points is called the arrow side. The other side of the joint is called the opposite side. The arrow line shall preferably point to the ”upper workpiece surface”. The terms are explained in figures 6 and 7. When the butt welds are not symmetrical, the arrow line shall always point to the non-vertical flank of the joint, i.e. to the workpiece on which groove preparation is required. An example is given in Fig. 10b.

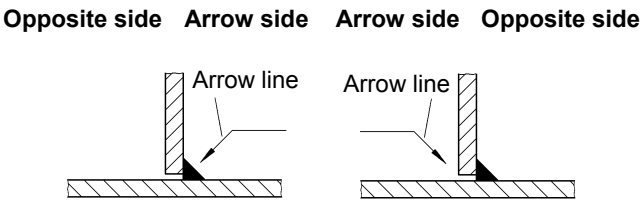


Fig. 6 – T-joint with one fillet weld

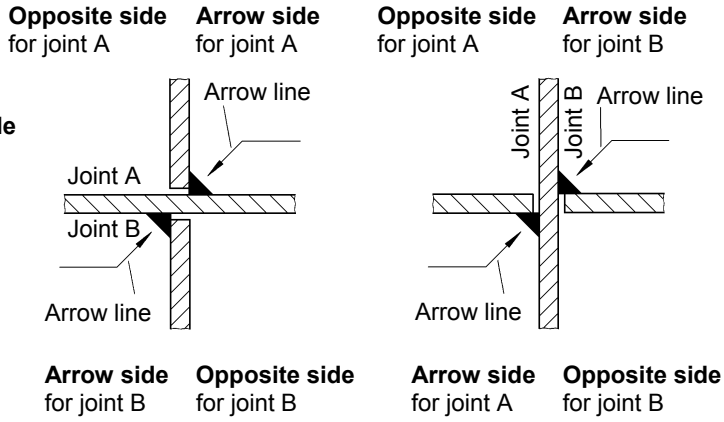


Fig. 7 – Cruciform joint with two fillet welds

2.3.4 Examples of application

Fillet welds are shown in figures 8 and 9, butt welds, in figures 10a and 10b. For further examples of application, refer to DIN EN 22553:1997-03.

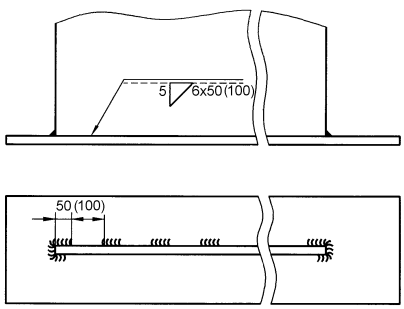


Fig. 8 – Interrupted fillet weld

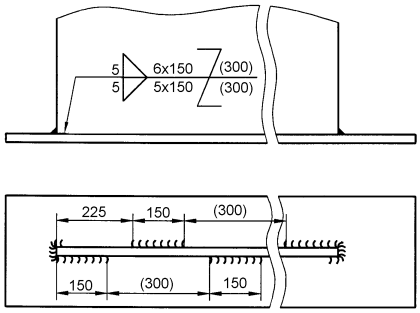


Fig. 9 – Staggered interrupted fillet weld

Illustration Symbolic representation

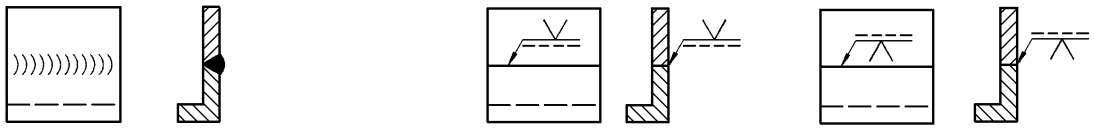


Fig. 10a – Butt weld

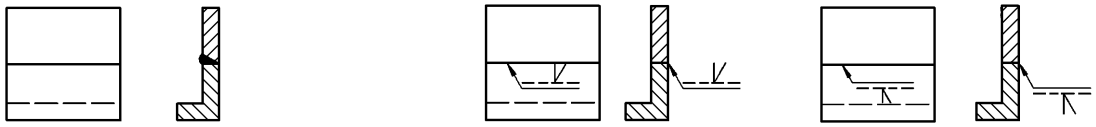


Fig. 10b – Butt weld

3 Requirements made on the manufacturer

Based on the requirements for the components and the legal regulations, the requirements to be fulfilled by the workshops are classified as shown below in Table 6 for equipment/buildings subject to construction supervision and in Table 7 for equipment/buildings not subject to construction supervision. The assignment to the range of equipment/buildings subject to construction supervision or to Directive 97/23/EC on Pressure Equipment and to the Water Resources Management Law is shown on the drawings.

Table 6 – Equipment/buildings subject to construction supervision

Components	Place of manufacture	Place of use	Requirements made on the manufacturer
Buildings subject to construction supervision (halls, chimneys etc.) Machinery and equipment intended for permanent presence of persons (control pulpits, casting platforms, stair towers etc.)	Worldwide	Germany	DIN 18800-1 to 5 DIN 18800-7:2008-11
	Germany	Worldwide	
	Worldwide	Worldwide	National regulations of user country
Cranes, lifting equipment and load-carrying equipment (C-hooks, dismantling beams etc., see also SN 195)	Worldwide	Germany	DIN 18800-7:2008-11 Class E DIN 15018-1 and -2
	Germany	Worldwide	
	Worldwide	Worldwide	National regulations of user country
Pressure vessels	Worldwide	Europe	Directive 97/23/EC on pressure equipment
	Germany	Outside Europe	National regulations of user country
	Worldwide	Outside Europe	National regulations of user country

Table 7 – Equipment not subject to construction supervision

Components	Quality of weld DIN EN ISO 5817:2006-10	Requirements [a] made on the manufacturer DIN EN ISO 3834-1 to -4:2006-03
Machinery and related equipment not subject to construction supervision (strand guide segments, shears, millstands, millstand platforms, converters, pipe lines)	D	**Basic requirements** - Suitable welding equipment - Proof of welders' qualification according to DIN EN 287-1; in case of doubt, proof of qualification by trial welds - Proof of filler-metal storage and handling in accordance with suppliers' recommendations
	B and C	**Extended requirements** - Fulfillment of the above basic requirements - Welding supervision by supervisory personnel according to DIN EN ISO 14731 - Suitable storage of base materials to maintain their marking - Prior to manufacture, presentation of welding procedures acknowledged in DIN EN ISO 15610 - Keeping available of welding and working instructions - Use of qualified personnel according to DIN EN 473 for quality inspections

[a] If a manufacturing shop does not fulfil the above requirements, other national or international regulations/permits (e. g. ASME) are accepted. Proof of their equivalence shall be furnished by the workshop before the beginning of manufacture.

4 Filler metals

4.1 Basic specifications

Filler metals require approval on the basis of suitability testing. All filler metals shall be stored and handled with care and in compliance with DIN EN 1011-1:2009-07, item 6.1, and DIN EN 1011-2:2001-05, item 7.
Detailed information on the properties of suitable filler metals can be found in the following standards:
DIN 8555-1:1983-11 (continues to be valid for SMS group), DIN EN 1600, DIN EN 12536, DIN EN 14700, DIN EN ISO 2560 and DIN EN ISO 14341.

4.2 Mixed joints

The term of mixed joints is used for black-white joints (ferritic-austenitic dissimilar steel joints) established between unalloyed or alloy structural steels and austenitic chromium-nickel steels by welding with CrNi (Mn, Mo) filler metals. Mixed joints between steels and nickel or nickel alloys are also regarded as black-white joints because of the use of filler metals on nickel basis. Mixed joints shall be welded in accordance with the specific regulations and with the use of filler metals approved for the material combination.

5 Welding processes

Welding processes and their associated individual processes according to ISO 4063:2009-08:

- 11 Metal arc welding without gas protection;
  - 111 E $\triangleq$ arc welding;
- 12 Submerged arc welding;
- 13 Gas-shielded metal arc welding;
  - 135 MAG welding;
  - 136 MAG with cored wire;
- 14 Gas-shielded welding with non-consumable electrode;
  - 141 TIG (tungsten inert gas arc) welding;
- 15 Plasma arc welding;
- 31 Oxy-fuel gas welding (only for steel).
- 72 RES $\triangleq$ electroslag welding

6 Execution of welding on machine-building components

6.1 Weld preparation

6.1.1 Basic specifications

The weld preparation (preparation angle, root face thickness etc.) shall be carried out by the workshop as required for the welding process to be applied. Deviations from the drawing indications are allowed only if the specified weld-depth and weld-quality requirements are fulfilled. The weld preparation shall be selected according to Table 8 based on
DIN EN ISO 9692-1:2004-05.
Prior to assembling, the surfaces in the weld area shall be cleaned to remove scale, slag, rust, paint, oil, grease, electro-deposited (e. g. zinc) coats, and moisture.
To avoid stray welding currents and their effects (destruction of electric protective conductors etc.), the welding current return line shall be connected direct to the workpiece to be welded or to the workpiece support (e. g. welding table, welding grids, assembly plates). Steel structures, rails, pipe lines, bars and similar objects shall not be used as current conductors unless they are the workpiece to be welded.
Tack-welds shall be at least 40 mm long. All cracks, lack-of-fusion spots and clusters of pores in tack welds shall be removed before welding.

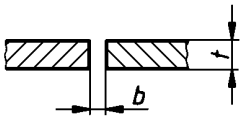
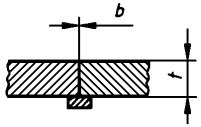
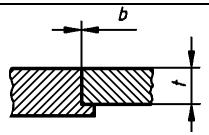
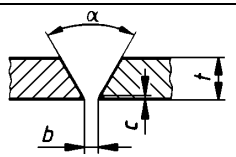
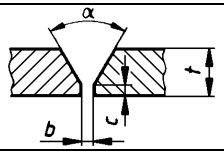
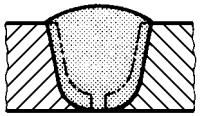
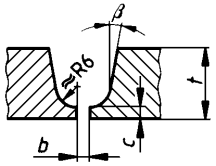
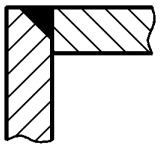
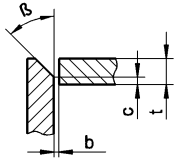
6.1.2 Pre-heating of weldable steels

The welding areas shall be pre-heated as required for the respective material composition. The minimum pre-heat temperature shall be determined according to DIN EN 1011-2:2001-05 on the basis of the carbon equivalent CET. When multi-pass welds are used, the term “minimum pre-heat temperature” is synonymous with the term “minimum interpass temperature”.
The measuring of the pre-heat, interpass and maintenance temperatures shall be in accordance with
DIN EN ISO 13916:1996-11.

This formula is applicable up to a carbon content of ≤ 0,5

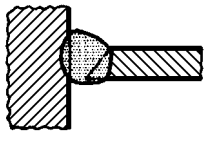
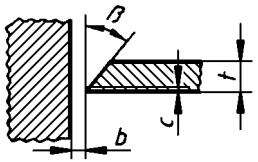
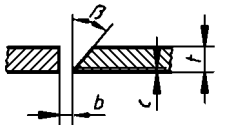
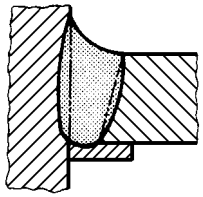
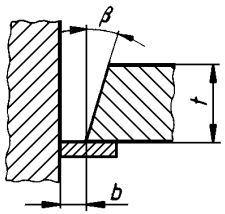
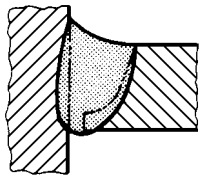
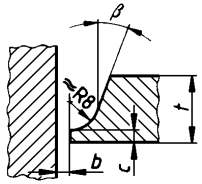
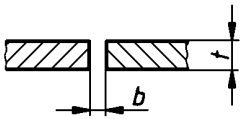
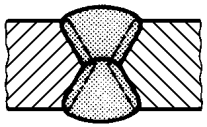
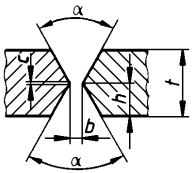
$$CET = C + \frac{Mn + Mo}{10} + \frac{Cr + Cu}{20} + \frac{Ni}{40} \quad \text{in} \quad (\%)$$

Table 8 – Groove shapes for butt welds (extract from DIN EN ISO 9692-1: 2004-05)

Weld					Groove shape						
						Dimensions					
Ref. No.	Material thickness t	Designation	Symbol (acc. to ISO 2553: 1992-10)	Representation	Section	Angle α, β	Gap *b*	Root face thickness *c*	Groove face height *h*	Recommended welding process (as in ISO 4063: 2009-08) [b]	Remarks
1.2.1	≤ 4	Square preparation	II			-	b ≈ t	-	-	3 111 141	-
1.2.2	3 < t ≤ 8						6 ≤ b ≤ 8			13	With backing strip
							≈ t			141	
	≤ 15						≤ 1			52	
							0				
1.2.3	≤ 100	Square preparation with backing				-	- 30 [a]	-	-	51 72 [a]	-
1.2.4		Square preparation with centering lip									
1.3	3 ≤ t ≤ 10	Single-V preparation	V			40° ≤ α ≤ 60°	≤ 4	≤ 2	-	3 111 13 141	With backing strip where applicable
	8 < t ≤ 12					6° ≤ α ≤ 8°	-			52	
1.5	5 ≤ t ≤ 40	Single-V preparation with broad root face	Y			α ≈ 60°	1 ≤ b ≤ 4	2 ≤ c ≤ 4	-	111 13 141	-
1.8	> 12	Single-U preparation	Y			8° ≤ β ≤ 12°	≤ 4	≤ 3	-	111 13 141	-
[a] -	10 ≤ t ≤ 25	Single-bevel preparation	V			8° ≤ β ≤ 12°	35 ≤ b ≤ 60	1 ≤ c ≤ 2	-	-	-

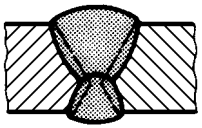
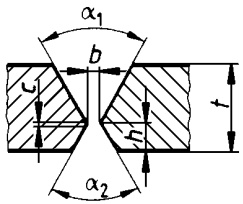
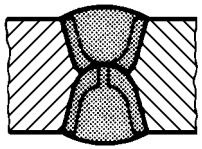
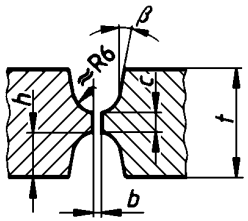
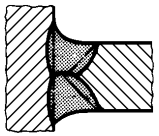
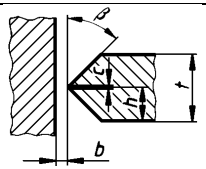
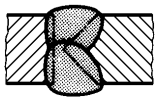
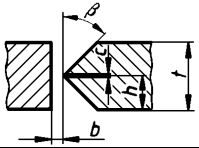
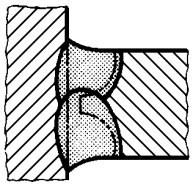
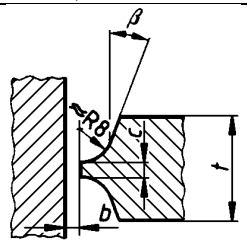
[a] SMS group regulation
[b] See section 5

Table 8 – Groove shapes for butt welds (extract from DIN EN ISO 9692-1: 2004-05) (continued)

Weld					Groove shape					Recommended welding process (as in ISO 4063: 2009-08) [b]	Remarks
Ref. No.	Material thickness t	Designation	Symbol (acc. to ISO 2553: 1992-10)	Representation	Section	Dimensions: Angle α, β	Gap b	Root face thickness c	Groove face height h		
1.9.1	3 < t ≤ 10	Single-bevel preparation	V			35° ≤ β ≤ 60°	2 ≤ b ≤ 4	1 ≤ c ≤ 2	-	111 13 141	-
1.9.2											
1.10	> 16	Steep-flanked single bevel preparation	L			15° ≤ β ≤ 60°	6 ≤ b ≤ 12	-	-	111	With backing strip
							≈ 12			13 141	
1.11	> 16	Single-J preparation (J-groove)	Y			10° ≤ β ≤ 20°	2 ≤ b ≤ 4	1 ≤ c ≤ 2	-	111 13 141	-
2.1	≤ 8	Square preparation	II			-	$\approx \frac{t}{2}$	-	-	111 141	-
	≤ 15						$\leq \frac{t}{2}$	-	-	13	
							0			52	
2.5.1	> 10	Double-V preparation (X-groove)	X			α ≈ 60°	1 ≤ b ≤ 3	≤ 2	$\approx \frac{t}{2}$	111 141	-
						40° ≤ α ≤ 60°				13	

[b] See section 5

Table 8 – Groove shapes for butt welds (extract from DIN EN ISO 9692-1: 2004-05) (continued)

Weld					Groove shape					Recommended welding process (as in ISO 4063: 2009-08) [b]	Remarks
						Dimensions					
Ref. No.	Material thickness t	Designation	Symbol (acc. to ISO 2553: 1992-10)	Representation	Section	Angle α, β	Gap *b*	Root face thickness *c*	Groove face height *h*		
2.5.2	> 10	Asymmetrical double-V preparation	X			$\alpha_1 \approx 60°$ $\alpha_2 \approx 60°$	$1 \le b \le 3$	≤ 2	$\approx \frac{t}{3}$	111 141	
						$40° \le \alpha_1 \le 60°$ $40° \le \alpha_2 \le 60°$				13	
2.7	≥ 30	Double-U preparation	Y			$8° \le \beta \le 12°$	≤ 3	≈ 3	$\approx \frac{t-c}{2}$	111 13 141	This groove can also be asymmetrical, similar to the asymmetrical double-V preparation.
2.9.1	> 10	Double-bevel preparation (K-groove)	K			$35° \le \beta \le 60°$	$1 \le b \le 4$	≤ 2	$h = \frac{t}{2}$ or $h = \frac{t}{3}$	111 13 141	
2.9.2											
2.11	> 30	Double-J preparation	J			$10° \le \beta \le 20°$	≤ 3	≥ 2	$= \frac{t-c}{2}$	111 13 141	
								< 2	$\approx \frac{t}{2}$		

[b] See section 5

6.2 Stiffening with ribs and webs

Notches shall be used as follows:

- according to figure 11 for ribs and webs,
- according to figures 12 and 13 for ribs and webs without notches when b ≤ 100/200 mm. For reasons of strength and in seal welding, ribs and webs of this type shall be avoided.

The dimension l or R in Table 9 has been selected big enough to allow welding through underneath the stiffening rib. The types of notches are shown on the drawings without dimensioning.

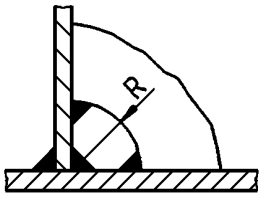


Fig. 11 – With notch

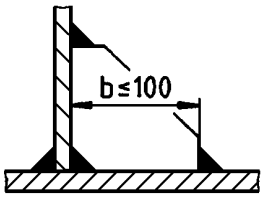


Fig. 12 – Without notch when b ≤ 100 mm

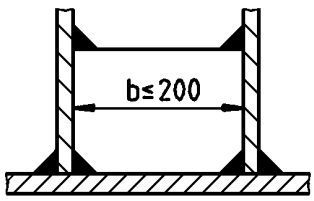


Fig. 13 – Without notch when b ≤ 200 mm

Table 9 – Notches

Plate thickness of rib	R
Up to 30	40
Over 30	50

6.3 Execution of welds

6.3.1 Basic specifications

Unless otherwise specified in the drawing, weld seams shall be closed around all corners.
Shrinkage stresses resulting from the welding-on of parts on one side shall be compensated by counter heating.
If accessible, the roots of two-sided welds having full material penetration shall be gouged, checked for cracks and counter-welded.

Safety instruction
When postweld heat treatment is made, the welding shop shall open all hermetically closed hollows prior to annealing by drilling a 10 mm round hole in a suitable place on the neutral axis, even if such measure is not expressly indicated on the drawing. After heat treatment, these round holes shall be closed again. When plates are welded on, a short section shall be left without weld and then closed by welding after heat treatment.

6.3.2 Material penetration

For full material penetration, refer to item 2.2 Representation on drawings.

6.3.3 Additionally required weld joints

Additionally required weld joints are weld joints on plates and sections of the same shape which are not indicated on the drawings; such weld joints are allowed only on consultation with the responsible designer or the purchaser. These additional weld joints shall always be produced with full material penetration according to DIN EN ISO 5817: 2006-10 quality level B, even if this is not indicated on the drawing. Details on evaluation of the weld and scope of inspection are given in section 9.4

6.3.4 Slot welding

The slot width "b", see figure 14, depends on the plate thickness dimensions t_1 and t_2 and the necessary weld junction;
for $t_1 \leq 15$ mm, b is min. 0,5 x t_1, but at least 4 mm,
for $t_1 > 15$ mm, b is min. 15 mm.

6.3.5 Plug welding

Plug welding is allowed only for plate thicknesses $t_1 \leq 40$ mm.
The hole diameter corresponds to t_1, but shall be at least 20 mm.

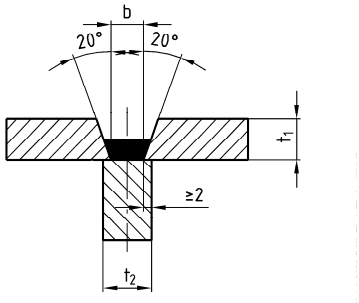


Fig. 14 – Slot welding

6.3.6 Butt and fillet welds

6.3.6.1 Weld reinforcement of butt welds, fillet welds, partly and fully bevelled welds

Here the weld thickness shall correspond to the weld depth. The max. weld reinforcement (ü) of butt and fillet welds is determined by the weld quality.
The reinforcement (ü) of partly and fully bevelled welds is ca. 0,3 x weld depth (s) for single-bevel and double-bevel welds, and ca. 0,2 x weld depth (s) for single-J, double-J and square-edge butt welds.

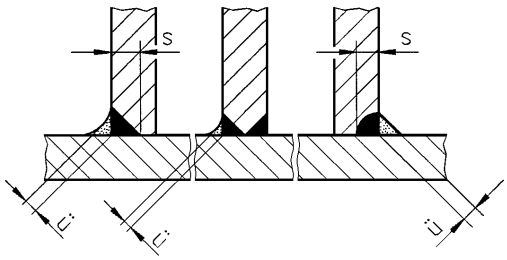


Fig. 15 – Partly and fully bevelled welds

6.3.6.2 Thickness of fillet welds

The weld shall be made as shown in figure 16. If the leg length is decisive for the execution of the weld, this dimension shall be shown on the drawing using the letter z as in figure 17 (e. g. z = 5). Dimension (a) depends upon the thinner of the parts to be joined and shall not exceed 12 mm; above 12 mm, partly or fully bevelled welds shall be used.
Contrary to DIN EN 22553:1997-03 (ISO 2553:1992-10), the indication (a) for fillet weld thickness are not made on drawings of SMS group.

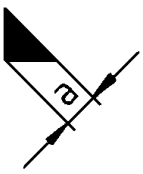


Fig. 16 – Weld thickness

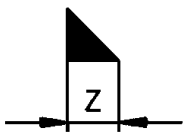


Fig. 17 – Leg length

If the inner joint of a two-sided joint is not accessible and cannot be welded, the design department shall be consulted. As SMS group specific regulation, fillet welds shall be made as follows:

fillet welds on both sides: a = 0,3 x smallest plate thickness;

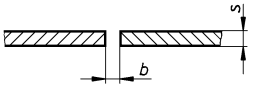
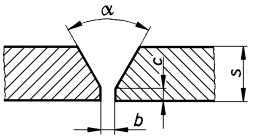
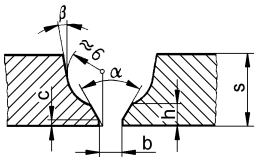
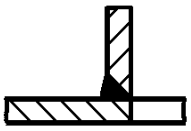
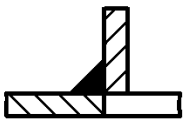
fillet welds on one side: a = 0,6 x smallest plate thickness, but max. 12 mm.

7 Welding on fluid-carrying components

7.1 Weld preparation

The surfaces in the weld areas of fluid-carrying components such as pipe lines and vessels, shall be cleaned to remove scale, slag, rust, paint, oil, grease and moisture prior to assembling. Cracks, lack-of-fusion areas and clusters of pores in tack welds shall be removed before welding over.
The weld preparation (preparation angle, root face thickness etc.) shall be made by the workshop as required for the welding process to be applied. Deviations from the drawing indications are allowed only if the specified weld-depth and weld-quality requirements are fulfilled.
The weld preparation for butt joints and corner joints shall be made according to Table 10.
This is an SMS group specific regulation.
For the edge misalignment on joints established between pipes of different wall thicknesses, the values of the required quality level apply according to DIN EN ISO 5817:2006-10, imperfection No. 3.1, related to the smaller wall thickness. If the edge misalignment exceeds the permissible values, a tapered transition of $\leq 10°$ is required, refer to DIN 2559-2 and -3:2007-09 and DIN 2559-4:1994-07.

Table 10 – Weld preparation for butt and corner joints

Wall thickness s	Designation	Symbol [a]	Groove shapes section	α	β	Root opening b [b]	Root face height c	Groove face height h
				Degree				
Up to 2	Square butt weld			-	-	0 to 3	-	-
Over 2 to 25	Single-V butt weld			≈ 60	-	2 to 4	Up to 2	-
Over 25	U-butt weld on V-root			≈ 60	≈ 15	2 to 3	2	≈ 4
All	Single-bevel butt weld			-	-	-	-	-
All (permitted only up to max. PN 25)	Fillet weld			-	-	-	-	-

[a] For supplementary symbols, see DIN EN 22553:1997-03.
[b] Dimensions apply to tack-welded condition.

7.2 Execution of the weld

7.2.1 Basic specifications

Welding spatter is not allowed on the inner walls of pipelines, it is therefore recommended using TIG welding to produce the root pass.

The reduction of pipe cross-section due to root reinforcement of the weld (Table 16, No. 1.11) shall not exceed 20 % on pipes ≤ 25 mm outside diameter and shall not exceed 15 % on pipes > 25 mm outside diameter related to the cross-section of flow of the pipe.
Compliance with the above shall be ensured by visual inspection and, if necessary, excess reinforcement shall be removed, e. g. by grinding.

All welds in the interiors of vessels and chambers shall be continuous welds without interruption.

Pipelines in stainless and acid-resistant steels shall be flooded with forming gas (e. g. N = 90 %, H = 10 %) both during tack-welding and welding of the root pass (observe DVS-Merkblatt 0937/DVS Reference Sheet 0937). Forming gases are used to remove the oxygen in the air from the heated weld areas and thus reduce oxidation. They also have a favourable effect on the forming of the root geometry and on the surface quality and prevent the formation of pores.

7.2.2 Fluid-carrying steel components

Unless otherwise specified on the drawing, butt welds shall be made as full penetration welds.

For pressures up to 2,5 MPa, all corner joints shall be made at least as fillet welds, for pressures > 2,5 MPa, single-bevel butt welds shall be used.

7.2.3 Fluid-carrying components in stainless and acid-resistant steels

Unless otherwise specified on the drawing, all weld joints shall be full penetration welds.
The corrosion probability of stainless and acid-resistant steels which are exposed to water can be considerably reduced when gaps are avoided in design and welding, see DIN EN 12502-4:2005-03. A gap width over 0,5 mm and a gap depth of less than half the gap width can usually be regarded as uncritical.

8 Heat treatment

8.1 Basic specifications

When postweld heat treatment is made, the welding shop shall open all hermetically closed hollows prior to annealing by drilling a 10 mm round hole in a suitable place on the neutral axis, even if such measure is not expressly indicated on the drawing. After heat treatment, these round holes shall be closed again. Shrinkage stresses resulting from the welding-on of parts on one side shall be compensated by counter heating.

Postweld heat treatment (e. g. stress relieving anneal) which is required for functional reasons shall be indicated in the drawing by the designer.

Postweld heat treatment required for reasons of manufacturing sequence (e. g. stresses resulting from machining) shall be made/arranged for by the contracting workshop.

Heat treatment on quenched and tempered steels shall be made at temperatures 20 to 30 K (Kelvin) below the tempering temperature. The contracting workshop shall obtain information on the tempering temperature used for the material.

Heat treatment required from a welding viewpoint shall be carried out by the manufacturing shop in its own responsibility.

All heat treatments shall be proven by annealing diagrams with inspection certificates type 3.1 as in DIN EN 10204:2005-01.

The use of other methods of stress relief (e. g. vibratory stress relief) shall be previously agreed with SMS group.

8.2 Unalloyed structural steels

The annealing temperature shall be between 550 °C and 600 °C, for S355, it shall not be higher than 580 °C.
The heating rate shall not exceed 50 K per hour.
The holding time shall be at least 1 minute for each millimeter of material thickness (e. g. 120 minutes for 120 mm thickness).
The cooling rate should not exceed 50 K per hour.

8.3 Austenitic steels

Austenitic steels shall never be heat treated.
Heat post treatment is allowed only in justified cases and upon consultation with SMS group.
The heat treatment data such as annealing temperature, holding time and cooling rate shall be agreed upon with SMS group.

8.4 Mixed joints

Heat treatment of black-white joints shall be made according to the specifications in section 8.3.
If a component for which stress relief annealing is required has to be provided with non-detachable austenitic steel parts, these parts shall be welded on or in only after annealing.

9 Inspection

9.1 Basic specifications

The inspections shall be made by the welding shop.

When intermediate inspection is specified, the readiness for such inspection shall be reported to the quality assurance department of SMS group.

Dimensions having closer tolerances than the general tolerances stated in section 9.2 require documentation of the inspection stating the desired and the actual dimensions.
Pressure or leak tests shall be documented stating kind of test, test pressure, testing time and pressure fluid.

When there is no suitable method of non-destructive testing to prove the quality of the weld and the flow cross-section, the acceptance inspector of our quality inspection department reserves the right to sever the pipelines at suitable points for inspection of those welds which are not visible from outside.

9.2 General tolerances

The general tolerance classes to be applied are specified in the tables 11 and 12. They correspond to the general tolerances of DIN EN ISO 13920:1996-11.
A drawing indication is made only if the general tolerance classes do not apply.

9.2.1 Linear dimensions

The tolerances of tolerance class B stated in Table 11 apply to linear dimensions (external dimensions, inside dimensions, stepped dimensions, widths and central lengths).

Table 11 – Tolerances on linear dimensions

Tolerance class	Nominal dimension range										
	2 to 30	> 30 to 120	> 120 to 400	> 400 to 1000	> 1000 to 2000	> 2000 to 4000	> 4000 to 8000	> 8000 to 12,000	>12,000 to 16,000	>16,000 to 20,000	> 20,000
B	± 1	± 2	± 2	± 3	± 4	± 6	± 8	± 10	± 12	± 14	± 16

9.2.2 Straightness, flatness and parallelism

The tolerances of tolerance class F stated in the Table 12 apply to the overall dimensions of a welded part, a welded assembly and to partial lengths.

Table 12 – Straightness, flatness and parallelism tolerances

Tolerance class	Nominal dimension range (length of longer side of the surface)									
	> 30 to 120	> 120 to 400	> 400 to 1000	> 1000 to 2000	> 2000 to 4000	> 4000 to 8000	> 8000 to 12,000	>12,000 to 16,000	>16,000 to 20,000	>20,000
F	1	1,5	3	4,5	6	8	10	12	14	16

9.2.3 Angular dimensions

For the tolerances on angular dimensions, the shorter leg of the angle is used as reference leg. The leg length can also be measured from a particular reference point; in this case the point shall be shown on the drawing, examples are given in figure 18. For conversion of angular dimensions into linear dimensions for measuring purposes, the limit deviations of the angles in Table 13 are additionally indicated as tangent values.
The maximum permissible deviation in mm is calculated by multiplying the tangent value by the length of the shorter leg.

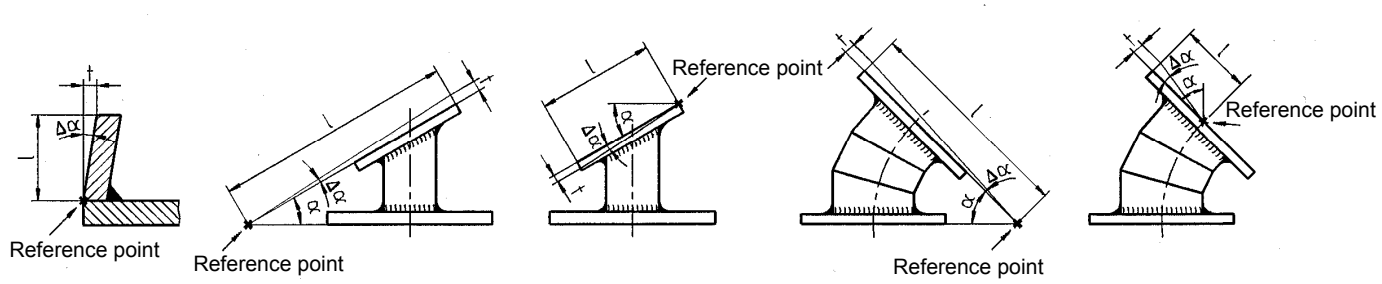


Fig. 18 – Examples of angle tolerances

Table 13 – Tolerances on angular dimensions

Tolerance class	Nominal dimension range (length of the shorter leg)					
	Up to 400	> 400 to 1000	> 1000	Up to 400	> 400 to 1000	> 1000
	Permissible deviations in degrees and minutes			Permiss. deviations in terms of tangent values		
B	± 0°45'	± 0°30'	± 0°20'	0,013	0,009	0,006

9.3 Types of tests/examinations

All tests/examinations listed below shall be certified in an inspection document type 3.1 according to DIN EN 10204: 2005-01.

- Visual examinations according to DIN EN 970
- Ultrasonic examinations according to DIN EN 1712, DIN EN 1713 and DIN EN 1714
- Radiographic examinations according to DIN EN 12517-1 and DIN EN 1435
- Magnetic particle testing according to DIN EN 1290 and DIN EN 1291
- Liquid penetrant testing according to DIN EN 1289
- Pressure testing according to DIN EN 13480-5
- Leak tightness testing according to DIN 50104

9.4 Inspection and weld evaluation on machine-building components

9.4.1 Basic specifications

The limits for imperfections are specified in Table 16 on the basis of quality levels.

Unless otherwise specified on the drawing, quality level D is the SMS group standard. The restrictions shown in Table 14 shall be observed.

Pressure or leakage testing is compulsory when:
- components consist of several separate chambers or hollows. Testing shall be made on every individual chamber or hollow.
- the weld seams have undergone machining treatment. Upon previous consultation with the SMS-group department of quality inspection, crack detection can be used instead of leakage testing.

For all other welds on components, pressure or leakage testing is not required provided the welds have been properly executed in the demanded weld quality.

9.4.2 Additionally required weld joints

Additional weld joints on plates and sections shall be executed as full penetration welds in quality level B. The quality of the weld shall be proven by ultrasonic or radiographic examination and surface crack testing. The scope of ultrasonic, radiographic and surface crack testing is 100 % of the weld and the heat affected zone.

9.4.3 Deposit welding

For deposit welding, quality level D, limited to the imperfections according to Table 16, Nos. 1.1, 1.2, 2.3 to 2.6 and 2.12, is the SMS group standard. The specifications of SN 402 shall be complied with in addition.

Table 14 – Scope of inspection of welds, general

Quality level DIN EN ISO 5817:2006-10			**Stringent B**	**Intermediate C**	**Moderate D SMS group standard**
Cons. No. as in DIN EN ISO 5817: 2006-10			All	All	All
Without full material penetration	Drawing indication required		Yes	Yes	No
	Proof of quality required		Yes	Yes	No, see 9.6
	Required examinations and testing [a]	Visual examination	Yes	Yes	Yes
		Ultrasonic testing	-	--	--
		Crack detection	≥ 25 % [b]	≥ 10 % [b]	--
		Pressure testing	Only in exceptional cases, see section 9.4.1. Drawing indication is required.		
		Leak testing			
Cons. No. as in DIN EN ISO 5817: 2006-10			All	All	All, but 2.12 and 2.13 acc. to C
With full material penetration	Drawing indication required		Yes	Yes	Yes
	Proof of quality required		Yes	Yes	Yes
	Required examinations and testing [a]	Visual examination	Yes	Yes	Yes
		Ultrasonic testing	≥ 50 %	≥ 25 %	≥ 10 %
		Crack detection	≥ 25 %	≥ 10 %	--
		Pressure testing	Only in exceptional cases, see section 9.4.1. Drawing indication is required.		
		Leak testing			

[a] The percentage indication of the scope of testing refers to the length of each individual weld.
[b] Welded-on lifting devices shall be examined by 100 % crack detection of the weld and the heat affected zone.

9.5 Weld evaluation and scope of inspection on fluid-carrying components

Unless otherwise specified on the drawing, quality level D is the SMS group standard. The restrictions shown in Table 15 shall be observed.

Table 15 – Scope of weld inspection on fluid-carrying components

Quality level DIN EN ISO 5817:2006-10		**Stringent B**	**Intermediate C**	**Moderate D SMS group standard**
Cons. No. as in DIN EN ISO 5817:2006-10		All	All	All, but 2.13 acc. to C
Execution for pressure stage		[c)]	> 2,5 MPa	≤ 2,5 MPa
Drawing indication required		Yes	Yes	No
Proof of quality required		Yes	Yes	No
Required examinations and testing [a)]	Visual examination	Yes	Yes	Yes
	Non-destructive testing, e .g. radiographing	≥ 25 %	≥ 10 % [b)]	--
	Pressure testing	Only in exceptional cases, see section 9.4.1. Drawing indication is required.		
	Leak testing			

[a)] The percentage indication of the scope of testing refers to the length of each individual weld.

[b)] Radiographing can be replaced with equivalent methods of testing of the internal condition. These tests are required only if the contracting workshop has not proved and documented the qualification of its personnel by suitable statistical methods and procedures. The approval by SMS group shall be obtained before the beginning of manufacture.

[c)] Quality level B shall be applied for particular requirements irrespective of the pressure stage.

9.6 Weld evaluation and scope of inspection on load-bearing welds with partial or full material penetration

These specifications apply to load-bearing welds for which the drawing indicates welding with partial material penetration. Load-bearing welds can be identified by the drawing indication of the quality levels B and C at the weld. At least 10 % of all load-bearing welds with partial material penetration shall be inspected. If no defects are found, this scope of inspection may be reduced upon previous agreement with the SMS group department of quality inspection. If defects are found, the SMS group inspector may extend the scope of inspection to up to 100 %.
The welds shall be examined at the front side at a depth corresponding to weld depth + 5 mm (s + 5 mm) using the magnetic-particle method.
Inspection is by partial grinding of the seam prior to closing at the front side, if necessary, closed welds shall be opened for inspection at the front side.
The instructions given are applicable by analogy to load-bearing full-penetration welds if non-destructive testing is impossible or possible only to a limited extent because of the degree of accessibility.
Welded-on lifting devices shall be examined by 100 % crack detection of the weld and the heat affected zone. Extent of inspection 100 %, evaluation according to quality level C.

9.7 Evaluation of imperfections

Table 16 states the limits of imperfections for the different quality levels. The terms are explained in Annex A. Table 16 is an extract from DIN EN ISO 5817:2006-10.

If microscopic examination is used for the detection of imperfections, only those imperfections shall be considered which can be detected using at the most tenfold magnification. Excluded herefrom are micro lacks of fusion, see Table 16, No. 1.5, and micro cracks, see Table 16, No. 2.2.

Systematic imperfections (for definition, refer to Annex A, page 34) are permitted only in quality level D provided that other requirements made in Table 14 are fulfilled.

Every weld shall be evaluated separately for every possible imperfection, see Table 16, Nos. 1.1 to 3.2.

When different types of imperfections are found in a weld section, special evaluation is required, see Table 16, No. 4.1.

The evaluation limits for multiple imperfections shall be used only if the requirements for the other imperfections are not exceeded.

Any two adjacent imperfections separated by a distance which is smaller than the major dimension of the smaller imperfection shall be regarded as one single imperfection.

Table 16 – Limits for imperfections

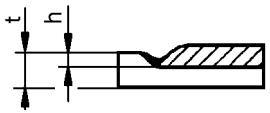
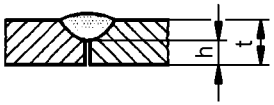
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
1 Surface imperfections							
1.1	100	Crack	-	≥ 0,5	Not permitted	Not permitted	Not permitted
1.2	104	Crater crack	-	≥ 0,5	Not permitted	Not permitted	Not permitted
1.3	2017	Surface pore	Maximum dimension of a single pore for - butt welds - fillet welds	0,5 to 3	d ≤ 0,3 s d ≤ 0,3 a	Not permitted	Not permitted
			Maximum dimension of a single pore for - butt welds - fillet welds	> 3	d ≤ 0,3 s, but max. 3 mm d ≤ 0,3 a, but max. 3 mm	d ≤ 0,2 s, but max. 2 mm d ≤ 0,2 a, but max. 2 mm	Not permitted
1.4	2025	End crater pipe		0,5 to 3	h ≤ 0,2 t	Not permitted	Not permitted
				> 3	h ≤ 0,2 t, but max. 2 mm	h ≤ 0,1 t, but max. 1 mm	Not permitted
1.5	401	Lack of fusion (incomplete fusion)	-	≥ 0,5	Not permitted	Not permitted	Not permitted
		Micro lack of fusion	Only detectable by micro examination		Permitted	Permitted	Not permitted
1.6	4021	Incomplete root penetration	Only for single-side butt welds 	≥ 0,5	Short imperfection: h ≤ 0,2 t, but max. 2 mm	Not permitted	Not permitted

Table 16 – Limits for imperfections (continued)

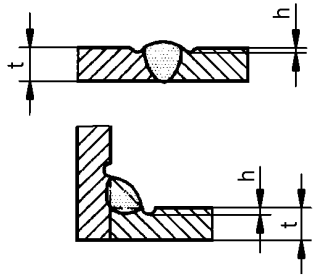
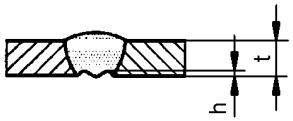
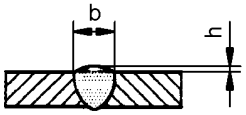
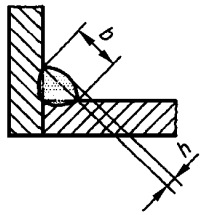
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
1.7	5011 5012	Continuous weld undercut Intermittent weld undercut	Smooth transition is required. Not regarded as systematic imperfection. 	0,5 to 3	Short imperfection: $h \leq 0{,}2\ t$	Short imperfection: $h \leq 0{,}1\ t$	Not permitted
				> 3	$h \leq 0{,}2\ t$, but max. 1 mm	$h \leq 0{,}1\ t$, but max. 0,5 mm	$h \leq 0{,}05\ t$, but max. 0,5 mm
1.8	5013	Shrinkage groove	Smooth transition is required. 	0,5 to 3	$h \leq 0{,}2$ mm + $0{,}1\ t$	Short imperfection: $h \leq 0{,}1\ t$	Not permitted
				> 3	Short imperfection: $h \leq 0{,}2\ t$, but max. 2 mm	Short imperfection: $h \leq 0{,}1\ t$, but max. 1 mm	Short imperfection: $h \leq 0{,}05\ t$, but max. 0,5 mm
1.9	502	Excess weld metal (butt weld)	Smooth transition is required. 	≥ 0,5	$h \leq 1$ mm + $0{,}25\ b$, but max. 10 mm	$h \leq 1$ mm + $0{,}15\ b$, but max. 7 mm	$h \leq 1$ mm + $0{,}1\ b$, but max. 5 mm
1.10	503	Excessive convexity (fillet weld)		≥ 0,5	$h \leq 1$ mm + $0{,}25\ b$, but max. 5 mm	$h \leq 1$ mm + $0{,}15\ b$, but max. 4 mm	$h \leq 1$ mm + $0{,}1\ b$, but max. 3 mm

Table 16 – Limits for imperfections (continued)

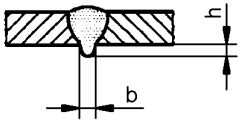
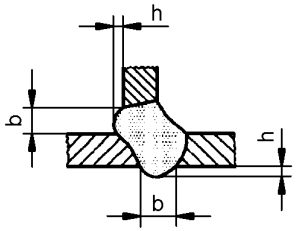
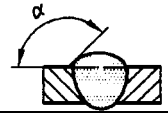
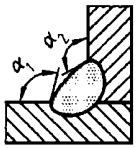
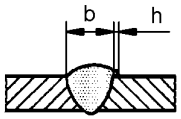
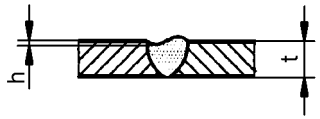
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
1.11	504	Excessive root reinforcement		0,5 to 3	$h \leq 1\ mm + 0{,}6\ b$	$h \leq 1\ mm + 0{,}3\ b$	$h \leq 1\ mm + 0{,}1\ b$
				> 3	$h \leq 1\ mm + 1{,}0\ b$, but max. 5 mm	$h \leq 1\ mm + 0{,}6\ b$, but max. 4 mm	$h \leq 1\ mm + 0{,}2\ b$, but max. 3 mm
1.12	505	Incorrect weld toe	- butt welds 	≥ 0,5	$\alpha \geq 90°$	$\alpha \geq 110°$	$\alpha \geq 150°$
			- fillet welds  $a_1 \geq \alpha$ $a_2 \geq \alpha$	≥ 0,5	$\alpha \geq 90°$	$\alpha \geq 100°$	$\alpha \geq 110°$
1.13	506	Overlap		≥ 0,5	$h \leq 0{,}2\ b$	Not permitted	Not permitted
1.14	509	Sagging	Smooth transition is required. 	0,5 to 3	Short imperfection: $h \leq 0{,}25\ t$	Short imperfection: $h \leq 0{,}1\ t$	Not permitted
	511	Incompletely filled groove		> 3	Short imperfection: $h \leq 0{,}25\ t$ but max. 2 mm	Short imperfection: $h \leq 0{,}1\ t$ but max. 1 mm	Short imperfection: $h \leq 0{,}05\ t$ but max. 0,5 mm
1.15	510	Burn through	-	≥ 0,5	Not permitted	Not permitted	Not permitted

Table 16 – Limits for imperfections (continued)

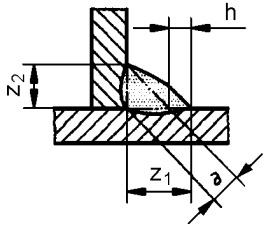
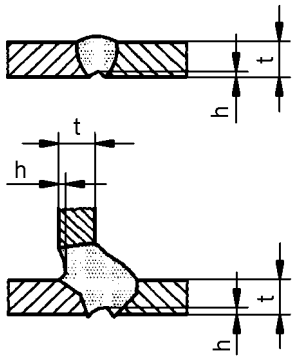
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
1.16	512	Excessive asymmetry of fillet weld (excessive unequal leg length)	In cases where an asymmetric fillet weld has not been specified. 	≥ 0,5	h ≤ 2 mm + 0,2 a	h ≤ 2 mm + 0,15 a	h ≤ 1,5 mm + 0,15 a
1.17	515	Root concavity	Smooth transition is required. 	0,5 to 3	h ≤ 0,2 mm + 0,1 t	Short imperfection: h ≤ 0,1 t	Not permitted
				> 3	Short imperfection: h ≤ 0,2 t, but max. 2 mm	Short imperfection: h ≤ 0,1 t, but max. 1 mm	Short imperfection: h ≤ 0,05 t, but max. 0,5 mm
1.18	516	Root porosity	Spongy formation at the root of a weld due to bubbling of the weld metal at the moment of solidification. (e.g. lack of gas backing)	≥ 0,5	Locally permitted	Not permitted	Not permitted
1.19	517	Poor restart	-	≥ 0,5	Permitted. The limit depends on the type of imperfection occurred due to restart.	Not permitted	Not permitted

Table 16 – Limits for imperfections (continued)

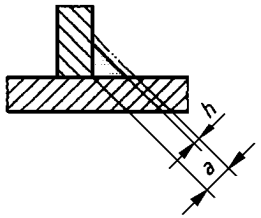
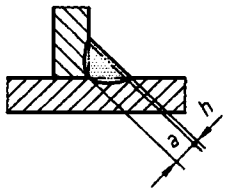
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
1.20	5213	Insufficient throat thickness	Not applicable to processes with proof of greater depth of penetration. 	0,5 to 3	Short imperfection: $h \leq 0{,}2$ mm + 0,1 a	Short imperfection: $h \leq 0{,}2$ mm	Not permitted
				> 3	Short imperfection: $h \leq 0{,}3$ mm + 0,1 a, but max. 2 mm	Short imperfection: $h \leq 0{,}3$ mm + 0,1 a, but max. 1 mm	Not permitted
1.21	5214	Excessive throat thickness	The actual throat thickness of the fillet weld is too large. 	≥ 0,5	Permitted	$h \leq 1$ mm + 0,2 a, but max. 4 mm	$h \leq 1$ mm + 0,15 a, but max. 3 mm
1.22	601	Stray arc	-	≥ 0,5	Permitted if the parent-metal properties are not affected.	Not permitted	Not permitted
1.23	602	Welding spatter	-	≥ 0,5	Acceptance depends on application, e.g. material, corrosion protection		

Table 16 – Limits for imperfections (continued)

No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
2 Internal imperfections							
2.1	100	Crack	All types of cracks, except micro cracks and crater cracks.	≥ 0,5	Not permitted	Not permitted	Not permitted
2.2	1001	Micro crack	A crack usually only visible under the microscope. (50 x).	≥ 0,5	Permitted	Acceptance depends on the type of parent metal with particular reference to crack sensitivity.	2.2
2.3	2011 2012	Gas pore Uniformly distributed porosity	The following conditions and limits for imperfections shall be fulfilled; see also DIN EN ISO 5817:2006-10 Annex B for information.				
			a1) Maximum dimension of the area of the imperfection (including systematic imperfection) related to the projected area NOTE: The porosity in the projected area depends on the number of layers (volume of the weld)	≥ 0,5	For single layer: ≤ 2,5 % For multi-layer: ≤ 5 %	For single layer: ≤ 1,5 % For multi-layer: ≤ 3 %	For single layer: ≤ 1 % For multi-layer: ≤ 2 %
			a2) Maximum dimension of the cross-section area of the imperfection (incl. systematic imperfection) related to the fracture area (only applicable to production, welder or procedure tests)	≥ 0,5	≤ 2,5 %	≤ 1,5 %	≤ 1 %
			b) Maximum dimension of a single pore for - butt welds - fillet welds	≥ 0,5	d ≤ 0,4 s, but max. 5 mm d ≤ 0,4 a, but max. 5 mm	d ≤ 0,3 s, but max. 4 mm d ≤ 0,3 a, but max. 4 mm	d ≤ 0,2 s, but max. 3 mm d ≤ 0,2 a, but max. 3 mm

Table 16 – Limits for imperfections (continued)

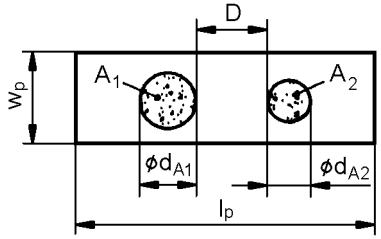
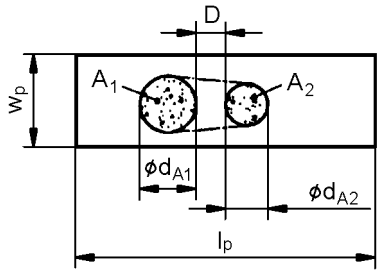
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
2.4	2013	Clustered (localized) porosity	Case 1 ($D > d_{A2}$)  Case 2 ($D < d_{A2}$)  Sum of the different pore areas ($A_1 + A_2 + \ldots$) related to the evaluation area $l_p \times w_p$ (case 1). The reference length for l_p is 100 mm. If D is less than d_{A1} or d_{A2} , whichever is smaller, the envelope surrounding the porosity areas $A_1 + A_2$ shall be considered as one area of imperfection (case 2).				

Table 16 – Limits for imperfections (continued)

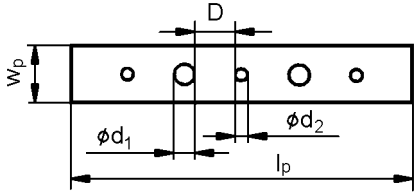
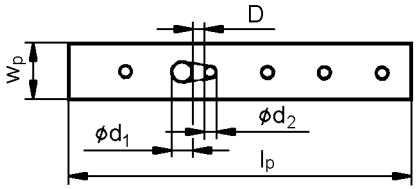
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
2.4	2013	Clustered (localized) porosity	The following conditions and limits for imperfections shall be fulfilled; see also DIN EN ISO 5817:2006-10 Annex A for information. a) Maximum dimension of the summation of the projected area of the imperfection (incl. systematic imperfection) b) Maximum dimension of a single pore for - butt welds - fillet welds	 ≥ 0,5 ≥ 0,5	 ≤ 16 % d ≤ 0,4 s, but max. 4 mm d ≤ 0,4 a, but max. 4 mm	 ≤ 8 % d ≤ 0,3 s, but max. 3 mm d ≤ 0,3 a, but max. 3 mm	 ≤ 4 % d ≤ 0,2 s, but max. 2 mm d ≤ 0,2 a, but max. 2 mm
2.5	2014	Linear porosity	Case 1 ($D > d_2$)  Case 2 ($D < d_2$)  The sum of the different pore areas $\left(\frac{d_1^2 \cdot \pi}{4} + \frac{d_2^2 \cdot \pi}{4} + \ldots\right)$ related to the evaluation area l_p x w_p (case 1). When D is smaller than the smallest diameter of a neighbouring pore, the full connected area of the two pores shall be applied to the sum of the imperfection (case 2).				

Table 16 - Limits for imperfections (continued)

No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	T mm	Limits for imperfections for quality level D	 C	 B
2.5	2014	Linear porosity	The following conditions and limits for imperfections shall be fulfilled; see also DIN EN ISO 5817:2006-10 Annex A for information.				
			a1) Maximum dimension of the area of the imperfection (incl. systematic imperfection) related to the projected area NOTE: The porosity in the projected area depends on the number of layers (volume of the weld)	≥ 0,5	For single layer: ≤ 8 % For multi-layer: ≤ 16 %	For single layer: ≤ 4 % For multi-layer: ≤ 8 %	For single layer: ≤ 2 % For multi-layer: ≤ 4 %
			a2) Maximum dimension of the cross-section area of the imperfection (incl. systematic imperfection) related to the fracture area (only applicable to production, welder or procedure tests)	≥ 0,5	≤ 8 %	≤ 4 %	≤ 2 %
			b) Maximum dimension of a single pore for - butt welds - fillet welds	≥ 0,5	d ≤ 0,4 s, but max. 4 mm d ≤ 0,4 a, but max. 4 mm	d ≤ 0,3 s, but max. 3 mm d ≤ 0,3 a, but max. 3 mm	d ≤ 0,2 s, but max. 2 mm d ≤ 0,2 a, but max. 2 mm

Table 16 – Limits for imperfections (continued)

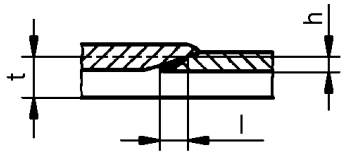
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
2.6	2015 2016	Elongated cavity Wormhole	- butt welds	≥ 0,5	h ≤ 0,4 s, but max. 4 mm l ≤ s, but max. 75 mm	h ≤ 0,3 s, but max. 3 mm l ≤ s, but max. 50 mm	h ≤ 0,2 s, but max. 2 mm l ≤ s, but max. 25 mm
			- fillet welds	≥ 0,5	h ≤ 0,4 a, but max. 4 mm l ≤ a, but max. 75 mm	h ≤ 0,3 a, but max. 3 mm l ≤ a, but max. 50 mm	h ≤ 0,2 a, but max. 2 mm l ≤ a, but max. 25 mm
2.7	202	Shrinkage cavity	-	≥ 0,5	Short imperfection permitted, but not breaking of the surface - butt welds: h ≤ 0,4 s, but max. 4 mm - fillet welds: h ≤ 0,4 a, but max. 4 mm	Not permitted	Not permitted
2.8	2024	Crater pipe	 The bigger of the dimensions h or l shall be measured.	0,5 to 3 > 3	h or l ≤ 0,2 t h or l ≤ 0,2 t, but max. 2 mm	Not permitted	Not permitted
2.9	300 301 302 303	Solid inclusion Slag inclusion Flux inclusion Oxide inclusion	- butt welds	≥ 0,5	h ≤ 0,4 s, but max. 4 mm l ≤ s, but max. 75 mm	h ≤ 0,3 s, but max. 3 mm l ≤ s, but max. 50 mm	h ≤ 0,2 s, but max. 2 mm l ≤ s, but max. 25 mm
			- fillet welds	≥ 0,5	h ≤ 0,4 a, but max. 4 mm l ≤ a, but max. 75 mm	h ≤ 0,3 a, but max. 3 mm l ≤ a, but max. 50 mm	h ≤ 0,2 a, but max. 2 mm l ≤ a, but max. 25 mm
2.10	304	Metallic inclusion other than copper	- butt welds	≥ 0,5	h ≤ 0,4 s, but max. 4 mm	h ≤ 0,3 s, but max. 3 mm	h ≤ 0,2 s, but max. 2 mm
			- fillet welds	≥ 0,5	h ≤ 0,4 a, but max. 4 mm	h ≤ 0,3 a, but max. 3 mm	h ≤ 0,2 a, but max. 2 mm
2.11	3042	Copper inclusion	-	≥ 0,5	Not permitted	Not permitted	Not permitted

Table 16 – Limits for imperfections (continued)

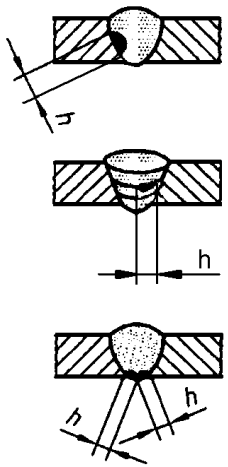
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
2.12	401 4011 4012 4013	Lack of fusion (incomplete fusion) Lack of side wall fusion Lack of inter-run fusion Lack of root fusion		≥ 0,5	Short imperfection permitted. - butt welds: $h \leq 0{,}4\ s$, but max. 4 mm - fillet welds: $h \leq 0{,}4\ a$, but max. 4 mm	Not permitted	Not permitted

Table 16 – Limits for imperfections (continued)

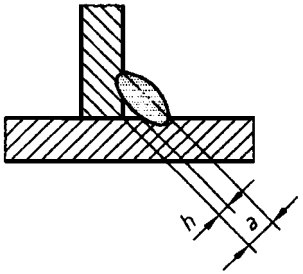
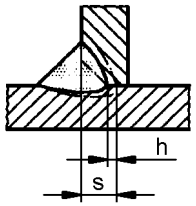
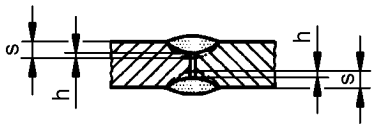
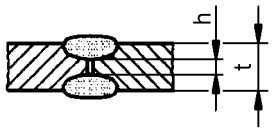
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
2.13	402	Lack of penetration	 T-joint (fillet weld)	> 0,5	Short imperfection: $h \leq 0{,}2\ a$, but max. 2 mm	Not permitted	Not permitted
			 T-joint (partial penetration)				
			 Butt joint (partial penetration)	≥ 0,5	Short imperfection: - butt joint: $h \leq 0{,}2\ s$, but max. 2 mm - T-joint: $h \leq 0{,}2\ a$, but max. 2 mm	Short imperfection: - butt weld: $h \leq 0{,}1\ s$, but max. 1,5 mm - fillet weld: $h \leq 0{,}1\ a$, but max. 1,5 mm	Not permitted
			 Butt joint (full penetration)	≥ 0,5	Short imperfection: $h \leq 0{,}2\ t$, but max. 2 mm	Not permitted	Not permitted

Table 16 – Limits for imperfections (continued)

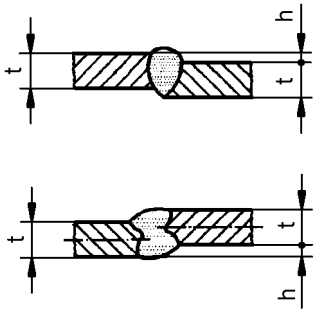
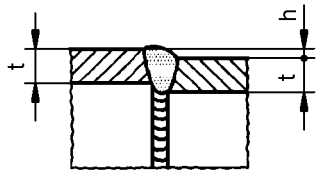
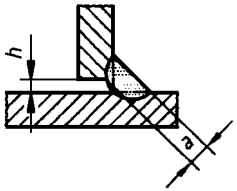
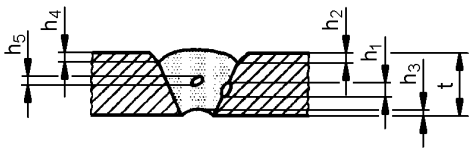
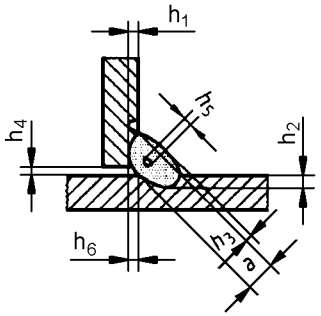
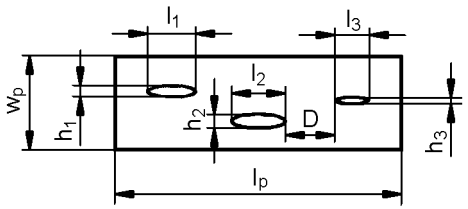
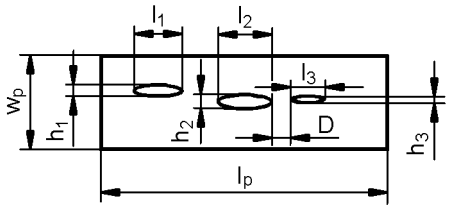
No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
3 Imperfections in joint geometry							
3.1	507	Linear misalignment	The limits relate to deviations from the correct position. Unless otherwise specified, the position is correct when the centerlines coincide (see also Section 1). t refers to the smaller thickness.  Fig. A: Plates with longitudinal welds	0,5 to 3	h ≤ 0,2 mm + 0,25 t	h ≤ 0,2 mm + 0,15 t	h ≤ 0,2 mm + 0,1 t
				> 3	h ≤ 0,25 t, but max. 5 mm	h ≤ 0,15 t, but max. 4 mm	h ≤ 0,1 t, but max. 3 mm
			 Fig. B: Circumferential welds	≥ 0,5	h ≤ 0,5 t, but max. 4 mm	h ≤ 0,5 t, but max. 3 mm	h ≤ 0,5 t, but max. 2 mm

Table 16 – Limits for imperfections (continued)

No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
3.2	617	Incorrect root gap for fillet welds	A gap between the parts which are joined. Gaps exceeding the permitted limit may in special cases be compensated by appropriate additional fillet weld thickness.  	0,5 to 3	$h \leq 0{,}5$ mm + 0,1 a	$h \leq 0{,}3$ mm + 0,1 a	$h \leq 0{,}2$ mm + 0,1 a
				> 3	$h \leq 1$ mm + 0,3 a, but max. 4 mm	$h \leq 0{,}5$ mm + 0,2 a, but max. 3 mm	$h \leq 0{,}5$ mm + 0,1 a, but max. 2 mm
4	**Multiple imperfections**						
4.1	None	Multiple imperfections in any cross-section [a]	 $h_1 + h_2 + h_3 + h_4 + h_5 = \sum h$  $h_1 + h_2 + h_3 + h_4 + h_5 = \sum h$	0,5 to 3	Not permitted	Not permitted	Not permitted
				> 3	Maximum total height of imperfections $\sum h \leq 0{,}4$ t or $\leq 0{,}25$ a	Maximum total height of imperfections $\sum h \leq 0{,}3$ t or $\leq 0{,}2$ a	Maximum total height of imperfections $\sum h \leq 0{,}2$ t or $\leq 0{,}15$ a

[a] See Annex A (normative)

Table 16 – Limits for imperfections (continued)

No.	Ref. No. acc. to ISO 6520-1: 1998	Imperfection Designation	Remarks	t mm	Limits for imperfections for quality level D	 C	 B
4.2	None	Projected or cross-section area in longitudinal direction	Case 1 ($D > l_3$)  $h_1 \times l_1 + h_2 \times l_2 + h_3 \times l_3 = \sum h \times l$ Case 2 ($D < l_3$)  $h_1 \times l_1 + h_2 \times l_2 + \left(\frac{h_2 + h_3}{2}\right) \times D + h_3 \times l_3 = \sum h \times l$ The sum of the areas $\sum h \times l$ shall be calculated as a percentage of the evaluation area $l_p \times w_p$ (case 1). When D is smaller than the shorter length of one of the neighbouring imperfections, the full connection of the two imperfections shall be applied to the sum of imperfections (case 2). NOTE: For information, see also DIN EN ISO 5817:2006-10, Annex A	≥ 0,5	$\sum h \times l \leq 16\ \%$	$\sum h \times l \leq 8\ \%$	$\sum h \times l \leq 4\ \%$

Referenced technical standards, codes and regulations

DIN 2559-2:2007-09	Edge preparation for welding – Part 2: Matching of inside diameter for circumferential welds on seamless pipes
DIN 2559-3:2007-09	Edge preparation for welding – Part 3: Matching of inside diameters for circumferential welds on welded pipes
DIN 2559-4:1994-07	Preparation of welds – Part 4: Matching of inside diameters for circumferential welds on seamless pipes of stainless steels
DIN 8555-1	Filler metals used in surfacing; filler wires, filler rods, wire electrodes, covered electrodes; Designation, technical delivery conditions
DIN 15018-1	Cranes; steel structures; verification and analyses
DIN 15018-2	Cranes – Structures of steel, design principles
DIN 18800-1	Steel structures – Part 1: Design and construction
DIN 18800-2	Steel structures – Part 2: Stability – Buckling of bars and skeletal structures
DIN 18800-3	Steel structures – Part 3: Stability – Buckling of plates
DIN 18800-4	Steel structures – Part 4: Stability – Analysis of safety against buckling of shells
DIN 18800-5	Steel structures – Part 5: Composite structures of steel and concrete – Design and construction
DIN 18800-7:2008-11	Steel structures - Part 7: Execution and constructor's qualification
DIN 50104	Testing of hollow bodies by internal pressure; leak detection up to a certain pressure value; General specifications
DIN EN 287-1	Approval testing of welders, fusion welding – Part 1: Steel
DIN EN 473	Non-destructive testing - Qualification and certification of NDT personnel; General principles
DIN EN 970	Non-destructive examination of fusion welds; Visual examination
DIN EN 1011-1:2009-07	Welding; Recommendations for welding of metallic materials – Part 1: General guidance for arc welding
DIN EN 1011-2:2001-05	Welding; Recommendations for welding of metallic materials – Part 2: Arc welding of ferritic steels
DIN EN 1289	Non-destructive testing of welds – Penetrant testing of welds – Acceptance levels
DIN EN 1290	Non-destructive testing of welds – Magnetic particle testing of welds
DIN EN 1291	Non-destructive examination of welds, Magnetic particle examination of welds; Acceptance levels
DIN EN 1435	Non-destructive testing of welds - Radiographic testing of welded joints
DIN EN 1600	Welding consumables - Covered electrodes for manual metal arc welding of stainless and heat-resisting steels
DIN EN 1712	Non-destructive examination of welds- Ultrasonic examination of welded joints - Acceptance levels
DIN EN 1713	Non-destructive examination of welds – Ultrasonic examination – Characterization of indications in welds
DIN EN 1714	Non-destructive examination of welds - Ultrasonic examination of welded joints
DIN EN 10204:2005-01	Metallic products – Types of inspection documents
DIN EN 12502-4:2005-03	Protection of metallic materials against corrosion – Guidance on the assessment of corrosion likelihood in water distribution and storage systems – Part 4: Influencing factors for stainless steels
DIN EN 12517-1	Non-destructive testing of welds – Part 1: Evaluation of welded joints in steel, nickel, titanium and their alloys by radiography – Acceptance levels
DIN EN 12536	Welding consumables; Rods for gas welding of non alloy and creep-resisting steels; Classification
DIN EN 13480-5	Metallic industrial piping - Part 5: Inspection and testing
DIN EN 14700	Welding consumables; Welding consumables for hard-facing
DIN EN 22553:1997-03	Welded, brazed and soldered joints; symbolic representation on drawings

DIN EN ISO 2560	Welding consumables - Covered electrodes for manual metal arc welding of non-alloy and fine grain steels - Classification
DIN EN ISO 3834-1:2006-03	Quality requirements for fusion welding of metallic materials – Part 1: Criteria for the selection of the appropriate level of quality requirements
DIN EN ISO 3834-2:2006-03	Quality requirements for fusion welding of metallic materials - Part 2: Comprehensive quality requirements
DIN EN ISO 3834-3:2006-03	Quality requirements for fusion welding of metallic materials - Part 3: Standard quality requirements
DIN EN ISO 3834-4:2006-03	Quality requirements for fusion welding of metallic materials; Part 4: Elementary quality requirements
DIN EN ISO 5817:2006-10	Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded); Quality levels for imperfections
DIN EN ISO 9692-1:2004-05	Welding and allied processes; Recommendations for joint preparation; Manual metal-arc welding, gas-shielded metal-arc welding, gas welding, TIG welding and beam welding of steels
DIN EN ISO 13916:1996-11	Welding – Guidance on the measurement of the preheat, interpass and preheat maintenance temperatures
DIN EN ISO 13920:1996-11	Welding - General tolerances for welded constructions; dimensions for lengths and angles, shape and position
DIN EN ISO 14341	Welding consumables - Wire electrodes and deposits for gas-shielded arc welding of non-alloy and fine-grain steels - Classification
DIN EN ISO 14731	Welding coordination - Tasks and responsibilities
DIN EN ISO 15610	Specification and qualification of welding procedures for metallic materials – Qualification based on tested welding consumables
DVS-Merkblatt 0937	DVS Reference Sheet 0937 on root shielding in gas-shielded welding
ISO 2553:1992-10	Welded, brazed and soldered joints; symbolic representation on drawings
ISO 4063:2000-04	Welding and allied processes; Nomenclature of processes and reference numbers
ISO 6520-1:1998-10	Welding and allied processes – Classification of geometric imperfections in metallic materials – Part 1: Fusion welding
SN 195	Load carrying attachments - Guidelines on design and manufacture; Inspection instruction
SN 402	Deposit welding
97/23/EG	Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment
WHG	Water Resources Management Law

Revision of September 2010

Adapting to SN 104.
Validity for SMS group.
Standards indicated with year and month.
Table 6: "Worldwide" instead of "Outside Germany".
Table 7: DIN EN 729 replaced with DIN EN ISO 3834.
DIN EN 719 replaced with DIN EN ISO 14731.
6.1.2 Illustration removed.
6.3.3 "Additionally required weld joint" added.
6.3.4 Slot welding: change of figure 14.
Table 10: addition of root face height c for wall thickness over 25.
9.3: addition of "Visual examinations shall be documented".
Addition of pressure testing.
Addition of leak tightness testing.
9.4.2: addition of 100% examination of additionally required weld joints.
Editorial revision.

Annex A (normative) **Explanations on Table 16**

A.1 Terms

The following terms are used for the application of DIN EN ISO 5817:2006-10:

A.1.1 Quality level

Description of the quality of a weld on the basis of types, sizes and quantities of selected imperfections.

A.1.2 Fitness-for-purpose

Ability of a product, process or service to serve a defined purpose under special conditions.

A.1.3 Short imperfection

In welds of 100 mm length or more, imperfections are considered to be short imperfections when the total length of the imperfections is not greater than 25 mm in a 100 mm weld length in which the most imperfections occur.
In welds of less than 100 mm length, imperfections are considered to be short imperfections when the length of the imperfection does not exceed 25% of the weld length.

A.1.4 Systematic imperfection

Imperfections which are distributed at regular distances in the weld over the weld length examined, with the sizes of the single imperfections being within the limits of acceptance.

A.1.5 Projected area

Area in which the imperfections distributed throughout the volume of the weld under consideration are imaged in two-dimensional form.

Note
In contrast to the cross-sectional area, the occurrence of imperfections in radiographic exposure depends on the thickness of the weld, see Fig. A.1.

Key

1 Direction of X-ray
2 4 pores per unit of volume
3 6-fold thickness
4 3-fold thickness
5 2-fold thickness
6 Single thickness

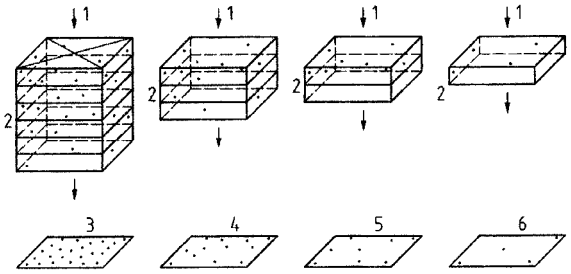


Figure A.1 – Radiographic films of specimens showing the same frequency of pores per unit of volume

The following letter symbols are used in Table 16:

a	nominal throat thickness of the fillet weld (see also ISO 2553:1992-10)
A	pore surrounding area
b	width of weld reinforcement
d	gas pore diameter
d_A	diameter of pore surrounding area
h	height or width of the imperfection
l	length of the imperfection in longitudinal direction of the weld
l_p	length of the projected or cross-sectional area
s	nominal throat thickness of the butt weld (see also ISO 2553:1992-10)
t	pipe-wall or plate thickness (nominal size)
w_p	width of the weld or width/height of a cross-sectional area
z	leg length of a fillet weld (see also ISO 2553: 1992-10)
α	angle of weld toe
β	angle of angular misalignment

SMS group

Manufacturing Instructions

Machining

SN 200-5

ICS 25.020 | Dimensions in mm | Supersedes SN 200-5:2007-02

Table of contents

Edited by:
SMS Siemag
Standards Office

1 Scope

Unless otherwise specified in design, ordering or manufacturing documents, the requirements specified in this part of SN 200 apply to parts which are used as starting material and/or manufacturing material in products of SMS group and treated by machining.

2 Representation in drawings

2.1 Basic specifications

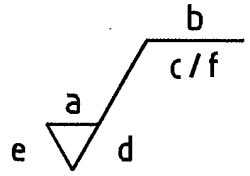
Drawing indication of the surface quality shall be made according to DIN ISO 1302:1993-12. The preferred measured variable in the drawings of SMS group is the centerline average roughness R_a, only the roughness value itself is indicated.

2.2 Symbols

2.2.1 Positions of the surface indications at the symbol

Table 1 shows the indications made at the surface symbol.

Table 1 – Surface indications

Symbol	Description	Explanation
	a = roughness value R_a in µm	SMS group standard indication
	b = manufacturing process, surface treatment	Indications shall be made only if indispensable for functional reasons.
	c = reference length	
	d = groove direction	
	e = machining allowance	
	f = other measured roughness variables, such as R_z, R_{max}	

2.2.2 Surface quality indication at the symbol

Symbols used for surface quality indication are shown in Table 2. The use of summarising symbols shall be avoided.

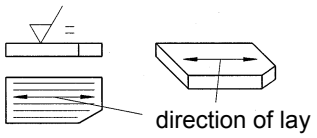
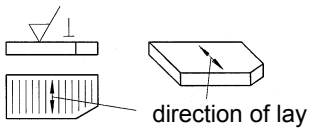
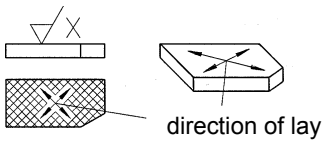
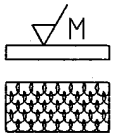
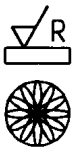
Table 2 – Surface quality

Symbol	Description
	Basic symbol. Additional information is required for definition.
	The surface may be produced by any process within the center line average value of $R_a \leq 3{,}2$ µm.
	The surface shall be produced by a metal-cutting process (machining); no specification of center line average roughness.
	The surface shall be produced by a metal-cutting process (machining) within the average roughness of $R_a \leq 3{,}2$ µm
	No working of the surface. The surface shall remain in delivery condition.

2.2.3 Symbols for indication of the surface lay

The surface lay and the direction of lay produced by the machining process (e. g. traces left by tools) are shown in Table 3.

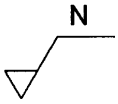
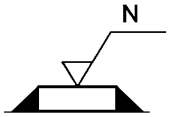
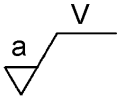
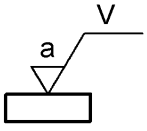
Table 3 – Indication of surface lay

Symbol	Explanation	Pictorial representation
=	Grooves parallel to the plane of projection of the view in which the symbol is used.	
⊥	Grooves perpendicular to the plane of projection of the view in which the symbol is used.	
X	Grooves crossed in two oblique directions relative to the plane of projection of the view in which the symbol is used.	
M	Multidirectional grooves.	
C	Grooves approximately circular to the center of the surface to which the symbol applies.	
R	Grooves approximately radial to the center of the surface to which the symbol applies.	

2.2.4 Symbols for mechanical processing

The indication of machining to be made before or after welding and the indication of free choice of tool are SMS group specific stipulations; the symbols used here are shown in Table 4.

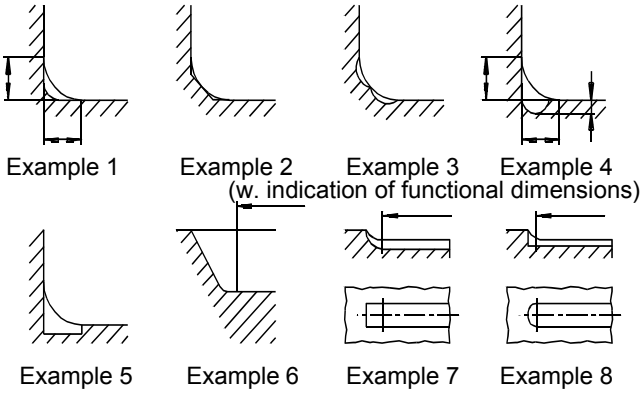
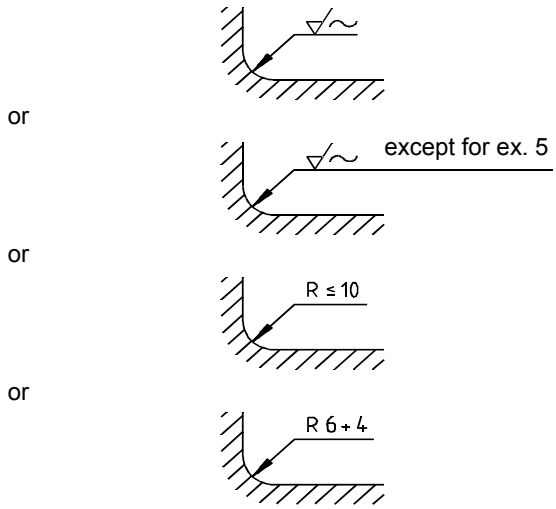
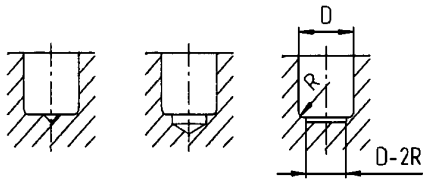
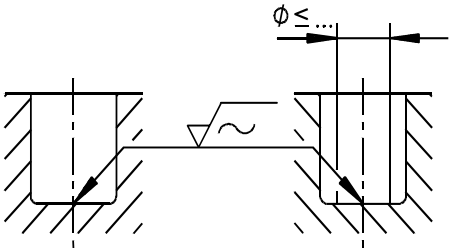
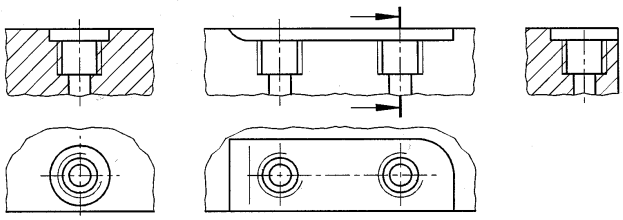
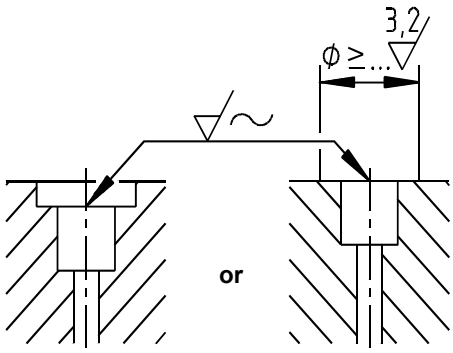
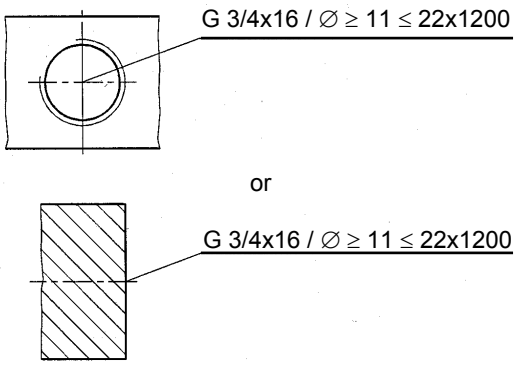
Table 4 – Mechanical processing

Symbol	Explanation	Example of drawing indication
	Machining to be made after welding-in or welding-on.	
	Machining to be made before welding-in or welding-on.	 a = roughness value R_a in µm
	Free choice of tool (see section 2.3).	—

2.3 Free choice of tool

As an SMS group specific regulation, curvatures, chamfers, keyways, bore mouths and end faces of recesses can be produced as required for the tool contour as explained in Table 5. Drawing indication is required and shall be made as shown in the following examples.

Table 5 – Free choice of tool

Situation	Necessary drawing indications
Curvatures and chamfers on turned and milled parts Possible tool contours:  Example 1 Example 2 Example 3 Example 4 (w. indication of functional dimensions) Example 5 Example 6 Example 7 Example 8	
Drilling tool runout The following drilling tool runouts are possible:  Example 9 Example 10 Example 11	
End faces of recesses Milling of a joint recess area for several individual recesses is allowed. The following end faces are possible:  Example 12	
Choice of drilling tool for stepped holes Unless indicated in detail in the drawings, the manufacturer is free to choose the drilling tool for the production of stepped (or smooth) holes depending on which drilling tool is available.	

2.4 Form and location tolerances

The form and location tolerances are specified on the basis of the functional requirements.
Tolerancing of form and location may also be influenced by manufacturing and inspection requirements.

2.4.1 Tolerance frame

The requirements shall be indicated in a rectangular frame consisting of two or more compartments as shown in figures 1 to 3.
When a tolerance applies to more than one element, this shall be indicated above the tolerance frame by the number of elements followed by the symbol "x", see figure 2.

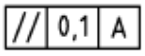


Fig. 1 – Length tolerance frame

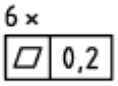


Fig. 2 – Form tolerance frame

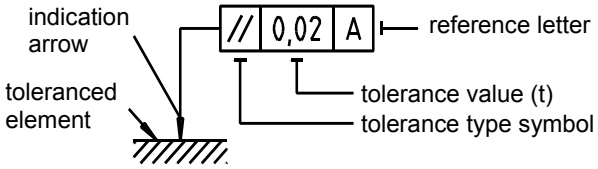


Fig. 3 – Elements of a tolerance indication frame for two or more elements

2.4.2 Tolerance zone

The tolerance zone is a space which is limited by one or more lines or surfaces of theoretically exact geometrical form and characterised by a linear dimension, called the tolerance.
Unless otherwise specified, the width of the tolerance zone is applied perpendicular to the specified geometrical shape of the component.
Depending on the feature to be toleranced and the kind of dimensioning used, the tolerance zone can be

- the space within a circle;
- the space between two concentric circles;
- the space between two equidistant lines or two parallel straight lines;
- the space within a cylinder;
- the space between two coaxial cylinders;
- the space between two equidistant surfaces or two parallel planes;
- the space within a sphere.

2.4.3 Tolerance zone and CZ indication

When a tolerance zone is applied to two or more individual elements, this requirement shall be indicated by adding CZ (for **c**ommon **z**one) in the tolerance frame after the tolerance value.

In the example shown in figure 4, all three surfaces are required to lie within a common tolerance zone. Given this requirement, they are also symmetrical to each other within the tolerance of 0,1 mm.

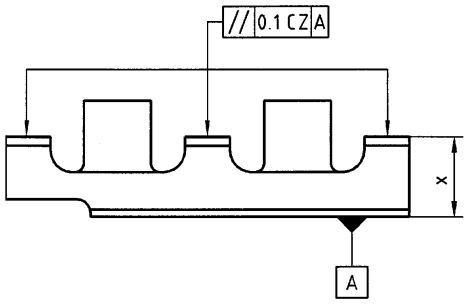


Figure 4 – Common zone

2.4.4 References

A reference constituted by a single element shall be indicated by a capital letter in a reference frame, see figure 5. The same letter which is used to identify the reference shall be shown in the tolerance frame, see figure 3.

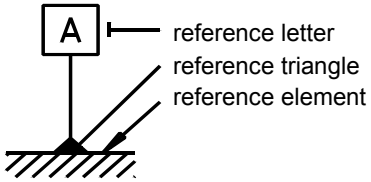


Fig. 5 – Indication

2.4.4.1 Reference triangle

The reference triangle with reference letter is shown as extension of the dimension line if reference is made to the centerline, the central plane, or to an appropriately dimensioned point, see figures 6 to 8. If there is not sufficient space for two dimensional arrows, one of the arrows can be replaced with the reference triangle.

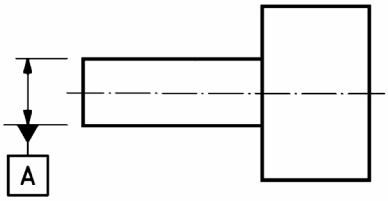


Fig. 6 – Reference triangle, example A

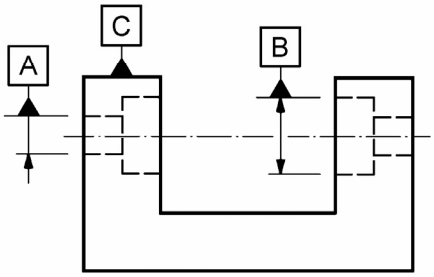


Fig. 7 – Reference triangle, example B

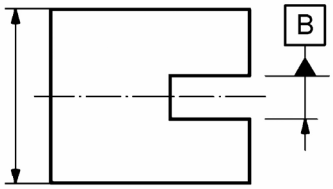


Fig. 8 – Reference triangle, example C

2.4.4.2 Common references

A common reference consisting of two elements shall be indicated with two capital letters separated by a vertical line, see figure 9.

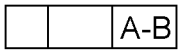


Figure 9 – Common reference

2.4.4.3 Multiple references

When the reference system consists of two or three elements, i.e. when it has multiple references, the capital letters shall be indicated in separate compartments from left to right by order of their importance, see figure 10.

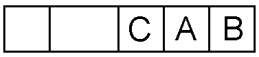


Fig. 10 – Multiple reference

2.4.4.4 Restrictive specifications

The tolerance in figure 11 refers to the overall dimension of the element concerned. If the tolerance applies to a restricted length in any position, the value of the restricted length shall be indicated after the tolerance value and separated from it by an oblique stroke, see figure 12.
If the tolerance applies to a restricted part of the element, the restriction shall be shown as a wide dash-dot line and provided with dimensioning, see figure 13.

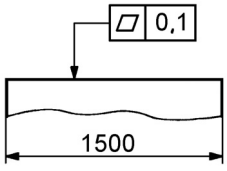


Fig. 11 – Tolerance for overall dimension

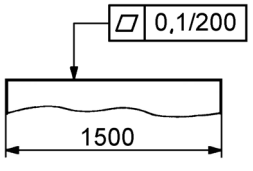


Fig. 12 – Tolerance for partial length

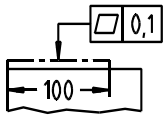


Fig. 13 – Tolerance for a limited area

2.4.4.5 Tolerance zones of cylindrical or circular shape

The tolerance zone is of cylindrical or circular shape if the tolerance value is preceded by the symbol "Ø" (for diameter), see figure 14. When this symbol is not indicated, the tolerance zone is delimited by two lines or surfaces whose distance in the direction of the indication arrow is equal to the tolerance value.

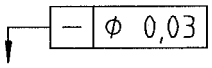


Fig. 14 – Tolerance zone of cylindrical or circular shape

2.4.4.6 Theoretically exact dimensions

When tolerances of position, direction or profile shape are specified for an element or a group of elements, the dimensions which define the theoretically exact position, direction or profile are called theoretically exact dimensions, see figure 15. Theoretically exact dimensions shall be shown in a frame without tolerance indication.

Fig. 15 – Theoretically exact dimension

2.4.4.7 Elements

The form and location tolerance of an element defines the zone within which this element shall lie. An element is a defined part of a workpiece, like a point, a line or a surface. These elements can be physically existing real elements (e. g. a cylindrical surface) or derived elements (e. g. a centerline or center surface) (see DIN EN ISO 14660-1:1999-11).

2.4.4.8 Toleranced elements

The tolerance frame shall be connected to the toleranced element by a leader line starting from either side of the frame. At the end of the leader line, an arrowhead shall be shown pointing to the outline of the element or an extension of the outline (clearly separated from the dimension line) when the tolerance refers to the line or the surface itself, see figures 16 and 17. The leader line shall point against the dimension line when the tolerance refers to the centerline or the center, see figure 18.

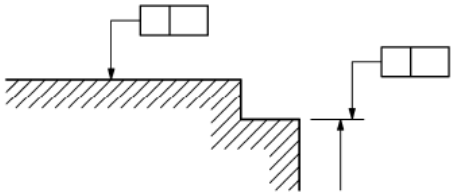


Fig. 16 – Example A

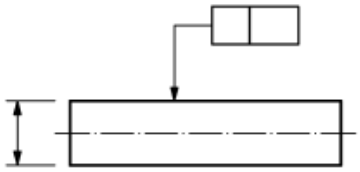


Fig. 17 – Example B

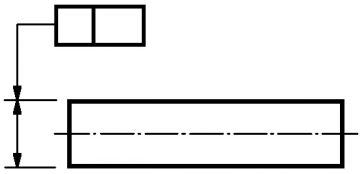


Fig. 18 – Example C

2.5 Definition of the tolerance zone and the drawing indication

Table 6 shows various form and location tolerances according to DIN EN ISO 1101:2008-08 with their tolerance zones, gives examples, and explains the relevant drawing indication.

Table 6 – Form and location tolerances

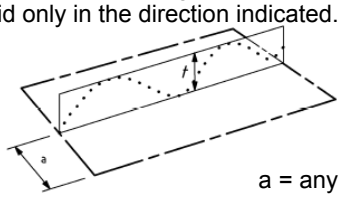
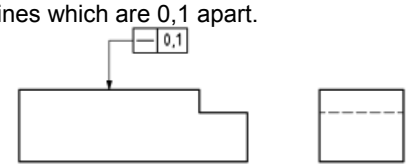
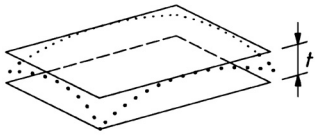
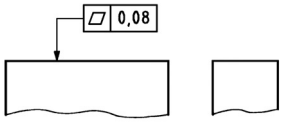
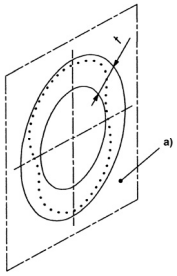
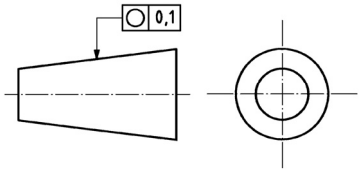
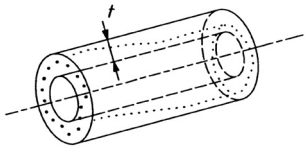
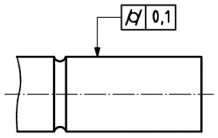
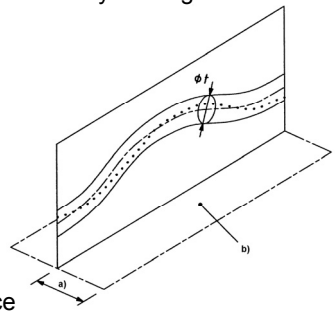
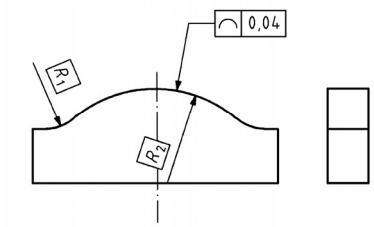
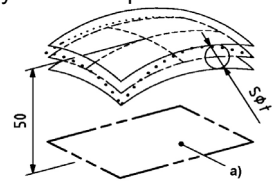
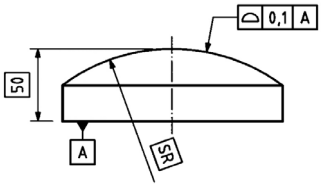
Symbol	Tolerance zone definition	Drawing indication and explanation
Straightness tolerance —	The tolerance zone in the plane being considered is limited by two parallel straight lines a distance *t* apart and is valid only in the direction indicated.  a = any distance	Any extracted (actual) line on the upper surface which is parallel to the plane of projection in which the indication is shown shall lie between two parallel straight lines which are 0,1 apart. 
Flatness tolerance ⏥	The tolerance zone is limited by two parallel planes a distance *t* apart. 	The extracted (actual) surface shall lie between two parallel planes which are 0,08 apart. 
Roundness tolerance ○	The tolerance zone in the cross-section being considered is limited by two concentric circles with a difference in radii of *t*.  a) Cross-sections	The extracted (actual) circumferential line in any cross-section of the conical surface shall lie between two co-planar concentric circles with a difference in radii of 0,1. NOTE: The definition of an extracted circumferential line has not been standardised. 
Cylindricity tolerance ⌭	The tolerance zone is limited by two coaxial cylinders with a difference in radii of *t*. 	The extracted (actual) cylindrical surface shall lie between two coaxial cylinders with a difference in radii of 0,1. 
Profile tolerance of a line without reference ⌒	The tolerance zone is limited by two lines enveloping circles of diameter *t* the centers of which are situated on a line of theoretically exact geometrical form.  a) Any distance b) Plane perpendicular to the drawing plane	In each section parallel to the plane of projection in which the indication is shown, the extracted (actual) profile line shall lie between two equidistant lines which envelope circles of diameter 0,04 whose centers are situated on a line of theoretically exact geometrical form. 
Profile tolerance of a surface related to a reference ⌓	The tolerance zone is limited by two surfaces enveloping spheres of diameter *t* the centers of which are situated on a surface of theoretically exact geometrical form. The location of the surface is determined by reference plane A.  a) Reference A	The extracted (actual) surface shall lie between two equidistant surfaces enveloping spheres of diameter 0,1 whose centers are situated on a surface of theoretically exact geometrical form. The location of the surface is determined by reference plane A. 

Table 6 – Form and location tolerances (continued)

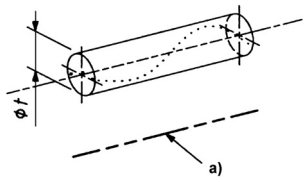
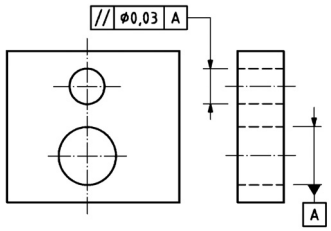
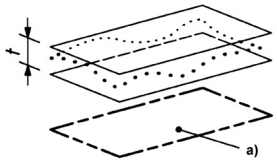
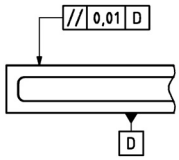
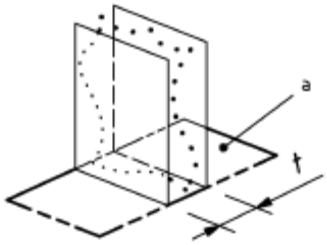
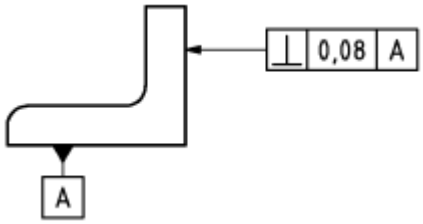
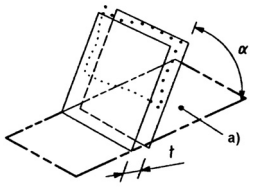
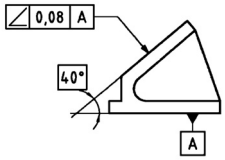
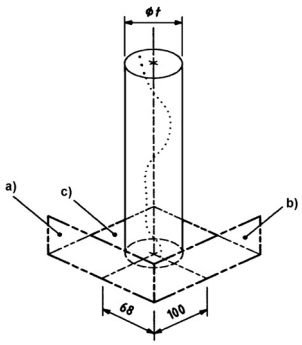
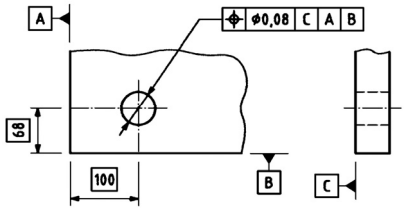
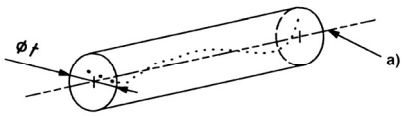
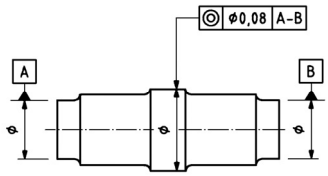
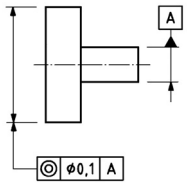
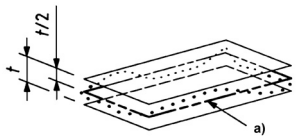
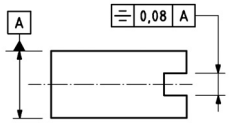
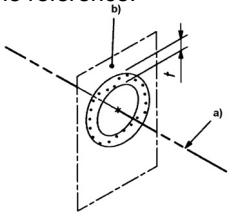
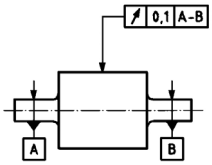
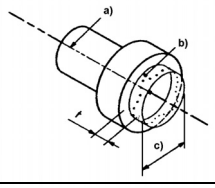
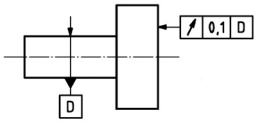
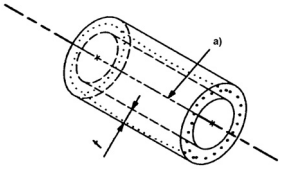
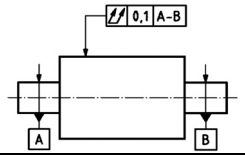
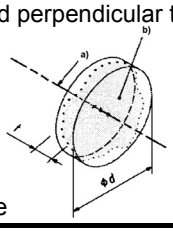
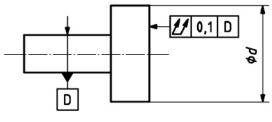
Symbol	Tolerance zone definition	Drawing indication and explanation
Parallelism tolerance of a line related to a reference line //	The tolerance zone is limited by a cylinder of diameter *t* parallel to the reference if the tolerance value is preceded by the symbol ∅ .  a) Reference A	The extracted (actual) median line shall lie within a cylindrical zone of diameter 0,03 parallel to reference axis A. 
Parallelism tolerance of a surface related to a reference surface //	The tolerance zone is limited by two planes a distance *t* apart and parallel to the reference plane.  a) Reference D	The extracted (actual) surface shall lie between two planes 0,01 apart which are parallel to reference plane D. 
Perpendicularity tolerance of a surface related to a reference surface ⊥	The tolerance zone is limited by two parallel planes a distance *t* apart and perpendicular to the reference.  a) Reference A	The extracted (actual) surface shall lie between two parallel planes 0,08 apart which are perpendicular to reference plane A. 
Angularity tolerance of a surface related to a reference surface ∠	The tolerance zone is limited by two planes a distance *t* apart and inclined at the specified angle to the reference.  a) Reference A	The extracted (actual) surface shall lie between two parallel planes 0,08 apart which are inclined at a theoretically exact angle of 40° to reference plane A. 
Position tolerance of a line ⌖	The tolerance zone is limited by a cylinder of diameter *t* if the tolerance value is preceded by the symbol ∅ . The axis of the tolerance cylinder is fixed by theoretically exact dimensions with respect to the references C, A and B.  a) Reference A b) Reference B c) Reference C	The extracted (actual) median line shall lie within a cylindrical tolerance zone of diameter 0,08 whose axis coincides with the theoretically exact position of the axis of the hole with respect to the reference planes C, A and B. 

Table 6 – Form and location tolerances (continued)

Symbol	Tolerance zone definition	Drawing indication and explanation
Coaxiality tolerance of an axis 	The tolerance zone is limited by a cylinder of diameter *t* if the tolerance value is preceded by the symbol ∅ . The axis of the cylindrical tolerance zone coincides with the reference axis.  a) Reference A-B	The extracted (actual) median line of the toleranced cylinder shall lie within a cylindrical tolerance zone of diameter 0,08 whose axis is the common reference straight line A-B.  The extracted (actual) median line of the large cylinder shall lie within a cylindrical tolerance zone of diameter 0,1 whose median line is the reference straight line A. 
Symmetry tolerance of a median plane 	The tolerance zone is limited by two planes a distance *t* apart and symmetrical to the reference median plane.  a) Reference	The extracted (actual) median surface shall lie between two parallel planes 0,08 apart which are symmetrically disposed about reference median plane A. 
Circular runout tolerance – radial (radial runout tolerance) 	The tolerance zone is limited within any cross-section perpendicular to the reference straight line by two concentric circles with a difference in radii of *t* whose centers coincide with the reference.  a) Reference b) Cross-section plane	The extracted (actual) line in any cross-section plane perpendicular to common reference straight line A-B shall lie between two coplanar concentric circles with a difference in radii of 0,1. 
Circular runout tolerance – axial (axial runout tolerance) 	The tolerance zone is limited in any cylindrical section by two circles a distance *t* apart which lie in a cylindrical section whose axis coincides with the reference axis.  a) Reference A b) tolerance zone c) Any diameter	The extracted (actual) line, in any cylindrical section whose axis coincides with reference straight line D, shall lie between two circles with a distance of 0,1. 
Total radial runout tolerance 	The tolerance zone is limited by two coaxial cylinders with a difference in radii of *t* whose axes coincide with the reference.  a) Reference A-B	The extracted (actual) surface shall lie between two coaxial cylinders with a difference in radii of 0,1 whose axes coincide with the common reference straight line A-B. 
Total axial runout tolerance 	The tolerance zone is limited by two parallel planes a distance *t* apart and perpendicular to the reference.  a) Reference D b) Extracted surface	The extracted (actual) surface shall lie between two parallel planes 0,1 apart which are perpendicular to reference axis D. 

3 Specifications for manufacture

3.1 General tolerances for lengths, angles, radii of curvature and chamfer heights

The general tolerances according to DIN ISO 2768-1:1991-06 and DIN ISO 2768-2:1991-04 as based on international specifications. They do not cover the national specifications in force so far; for this reason all missing data have been taken from DIN 7168:1991-04 and shown in shaded areas in Tables 7 and 8.

3.1.1 Scope

General tolerances according to DIN ISO 2768-1:1991-06 and DIN 7168:1991-04 for lengths, angles, radii of curvature and chamfer heights shall be applied to machined parts. They apply to dimensions without tolerance indication between two machined surfaces of a part made of any metallic material provided that no material-specific general tolerances are defined in other specifications.

When no individual tolerances are indicated for dimensions applied between an unmachined surface and a machined surface of a part, half the general tolerances specified in the relevant standard for cast, torch-cut and forged parts shall be applied.

Auxiliary dimensions shown in brackets are not required for the geometrical definition (manufacture) of the part.

General tolerances do not apply to
- auxiliary dimensions according to DIN 406-11 which are shown in brackets;
- non-indicated right angles between lines forming axes of coordinates.

3.1.2 Degree of accuracy

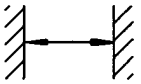
General tolerances are subject to the following degree of accuracy:

DIN ISO 2768-1:1991-06 – m

3.1.3 Linear dimensions

The limit deviations for the linear dimensions are shown in Table 7. The limit deviations indicated for sawing are SMS group specific values. The values in shaded areas correspond to DIN 7168:1991-04.

Table 7 – Linear dimensions

Degree of accuracy 	Limit deviations for nominal dimension ranges										
	0,5 [a] to 6	> 6 to 30	> 30 to 120	> 120 to 400	> 400 to 1000	> 1000 to 2000	> 2000 to 4000	> 4000 to 8000	> 8000 to 12000	> 12000 to 16000	> 16000 to 20000
m (medium)	± 0,1	± 0,2	± 0,3	± 0,5	± 0,8	± 1,2	± 2	± 3	± 4	± 5	± 6
Sawing	± 1				± 2			± 3	-		
[a] Permissible deviations for nominal dimensions smaller than 0,5 mm shall be shown at the nominal dimension itself.											

3.1.4 Radii of curvature and chamfer heights

The limit deviations for radii of curvature and chamfer heights (bevels) are shown in Table 8.
The values in shaded areas correspond to DIN 7168:1994-04.

Table 8 – Radii of curvature and chamfer heights

Degree of accuracy	Limit deviations for nominal dimension ranges				
	0,5 [a] to 3	> 3 to 6	> 6 to 30	> 30 to 120	> 120 to 400
m (medium)	± 0,2	± 0,5	± 1	± 2	± 4
[a] Permissible deviations for nominal dimensions smaller than 0,5 mm shall be shown at the nominal dimension itself.					

3.1.5 Angular dimensions

The limit deviations for angular dimensions and the pertaining tangent values are shown in Table 9.
The maximum permissible deviation in mm is calculated by multiplying the tangent value by the length of the shorter leg. Any smaller angular tolerance required shall be indicated on the drawing.

Table 9 – Angular dimensions

Degree of accuracy	Limit deviations in angle units for nominal dimension ranges of the shorter leg				
	Up to 10	> 10 to 50	> 50 to 120	> 120 to 400	> 400
m (medium)	± 1°	± 0° 30'	± 0° 20'	± 0° 10'	± 0° 5'
Tangent values	0,0175	0,0087	0,0058	0,0029	0,0015

3.1.6 Angular dimensions for lubrication holes

The limit deviations for angular dimensions of lubrication holes and the pertaining tangent values are shown in Table 10. The maximum permissible deviation in mm is calculated by multiplying the tangent value by the length of the shorter leg. Any smaller angular tolerance required shall be indicated on the drawing.
Lubrication holes can be identified by the metric thread and/or inch thread used at one end of the hole.

Table 10 – Angular dimensions for lubrication holes

Degree of accuracy	Limit deviations in angle units for nominal dimension ranges of the shorter leg				
	Up to 10	> 10 to 50	> 50 to 120	> 120 to 400	> 400
c (coarse)	± 1° 30'	± 1°	± 0° 30'	± 0° 15'	± 0° 10'
Tangent values	0,0262	0,0175	0,0087	0,0044	0,0029

3.2 General tolerances on form and location

3.2.1 Scope

General tolerances on form and location as in DIN ISO 2768-2:1991-04 are applicable to machined parts. They also apply to individual dimensions or dimensions toleranced according to the ISO tolerance system. According to DIN EN ISO 1101:2008-08 tolerances on form and location can be stated in addition to dimensional tolerances to ensure function and replaceability.

3.2.2 Degree of accuracy

Tolerances on form and location are subject to the following degree of accuracy:

DIN ISO 2768-2:1991-04 – H

3.2.3 Tolerances on form

Form tolerances limit the extent to which an individual element is allowed to deviate from its theoretically exact geometrical form.

3.2.3.1 Flatness and straightness

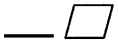
General tolerances on flatness and straightness  are given in Table 11.

Table 11 – Flatness and straightness

Tolerance class	General tolerances on flatness and straightness for nominal dimension ranges					
	Up to 10	> 10 to 30	> 30 to 100	> 100 to 300	> 300 to 1000	> 1000 to 3000
H	0,02	0,05	0,1	0,2	0,3	0,4

3.2.3.2 Roundness, cylindricity, profile line and profile surface

The form tolerances for roundness, cylindricity, profile line and profile surface  are limited by the dimensional tolerance areas defined by the dimensional tolerances including the general tolerances of the respective form elements of the workpiece.

3.2.4 Tolerances on location

Tolerances on location limit the extent of deviation of the relative locations of two or more elements one of which is, for functional reasons or for the purpose of clear definition, normally used as reference element for the tolerance indications. When necessary, more than one reference element can be specified. The reference element shall fulfil a sufficient degree of accuracy and a form tolerance shall be specified if necessary.

3.2.4.1 Parallelism

The permissible location tolerances for parallel is  are limited by the tolerance assigned to the distance between the parallel lines or surfaces.

3.2.4.2 Perpendicularity

The general tolerances for perpendicularity  are stated in Table 12.

Table 12 – Perpendicularity

Tolerance class	Perpendicularity tolerances for nominal dimension ranges for the shorter leg			
	Up to 100	> 100 to 300	> 300 to 1000	> 1000 to 3000
H	0,2	0,3	0,4	0,5

3.2.4.3 Symmetry

The general tolerances for non-rotation-symmetrical form elements  are stated in Table 13. The general tolerance also applies if one of the symmetrical form elements is rotation-symmetrical and the other is not (e. g. universal joint-shaft heads and sockets).

Table 13 – Symmetry

Tolerance class	Symmetry tolerances
H	0,5

3.2.4.4 Coaxiality

General tolerances for coaxiality  have not been specified. They shall not exceed the runout tolerance value given in Table 14.

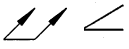
Table 14 – Radial and axial runout

Tolerance class	Runout tolerance
H	0,1

3.2.4.5 Run

The general tolerances for radial and axial runout  are limited by the permissible tolerance specified in Table 14.

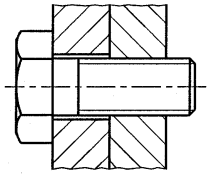
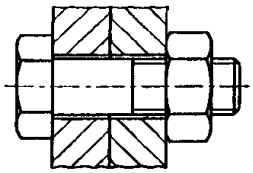
3.2.4.6 Total run and angularity

For total run and angularity  no general tolerances have been specified.

3.2.4.7 Position tolerances for hole-center distances and hole-circle diameters

The SMS group specific tolerances shown in Table 15 are to be understood as position tolerances according to DIN EN ISO 1101:2008-08 and apply to non-toleranced hole-center distances and hole-circle diameters.
The indication of the position tolerances prohibits the summation of the tolerances. This means that the distances between the holes are theoretically exact coordinate dimensions without deviations the intersections of which define tolerance cylinders corresponding to the tolerances shown in Table 15.

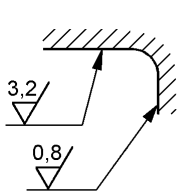
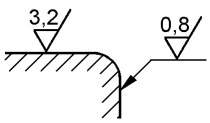
Table 15 – Position tolerances

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M72	M80	M90	M100
Through-hole for mechanical engineering	4,5	5,5	6,6	9	11	13,5	17,5	22	26	33	39	45	52	62	70	78	86	96	107
Through-hole for structural steel engineering	-	-	7	10	12	14,5	18,5	24	28	35	42	48	56	-	-	-	-	-	-
Location tolerance	Ø 0,25		Ø 0,3	Ø 0,5		Ø 0,75		Ø 1,0		Ø 1,5			Ø 2,0	Ø 3,0					Ø 3,5
	 For tap hole												 and through-hole						

3.3 Surface quality

Table 16 shows the standard surface qualities used by SMS group when no drawing indications are made. They are also valid when the summarising symbol is shown.

Table 16 – Surface quality

Symbol	Explanation
50	Linear dimensions in relation to surfaces without indication of roughness values. (e. g. surfaces produced by sawing)
25	Holes up to dia 40, oblong holes, keeper plate slots
25	Rough-machined parts, weld-in parts
3,2	Screw contact faces - on rolled plate
3,2	- on recesses for screws
3,2	Undercuts, chamfers, threads, thread undercuts, keyways, lubrication grooves, end faces
 Example 1  Example 2	The following applies to radii, curvatures and chamfers ≤ 50: - all inner curvatures, example 1, shall have the finer surface quality 0,8 of the adjoining surfaces, - all outer curvatures, example 2, shall have the coarser surface quality 3,2 of the adjoining surfaces, - all chamfers shall have the coarser surface quality of the adjoining surface.

3.4 Surface roughness values

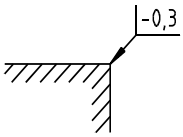
Table 17 shows an overview of the surface roughness values. The values in shaded spaces are SMS group standard values and shall be used with preference.

Table 17 – Surface roughness values

Selection series and comparison DIN ISO 1302:1993-12			
R_a µm	R_a µinch	Roughness class	R_z µm
50	2000	N 12	160
25	1000	N 11	100
12,5	500	N 10	63
6,3	250	N 9	40
3,2	125	N 8	25
1,6	63	N 7	12,5
0,8	32	N 6	6,3
0,4	16	N 5	2,5
0,2	8	N 4	1,6
0,1	4	N 3	1

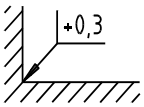
3.5 Workpiece edges

All workpiece edges produced by machining shall be deburred according to DIN ISO 13715:2000-12, see figures 14 and 15.



free of burrs up to 0,3

Fig. 14 – Outer edge



transition up to 0,3

Fig. 15 – Inner edge

3.6 Hole centerline tolerance in deep drilling

In drilling with single-lip drill or ejector drill with rotating workpiece, a hole centerline tolerance of 1 mm for 1000 mm of drilling depth shall not be exceeded.

When the drill rotates instead of the workpiece, twice the hole centerline tolerance is permitted.

3.7 Threads

3.7.1 Tolerances for metric ISO threads

Thread tolerance class according to DIN ISO 965-1:1999-11 medium (m)
Tolerance zone according to DIN ISO 965-1:1999-11 6g for the external thread (bolt);
Tolerance zone according to DIN ISO 965-1:1999-11 6H for the internal thread (nut).
For thread sizes of M64 and above, a drawing indication is required.

3.7.2 Thread runouts/thread undercuts

All thread runouts and undercuts shall be the normal design according to DIN 76-1 and DIN 76-2.

3.8 Roller-burnishing and deep-rolling

The difference between the two processes (Table 18) consists mainly in their purposes.
The purpose of roller-burnishing is the producing of the specified surface roughness.
Deep-rolling is a proven process for surface hardening by mechanical treatment. It makes use of the combination of three physical effects which take place at the same time.

- Residual compressive stress
- Strength increase by shaping;
- Smoothing through reduction of roughness.

Rough-machining: - preferably by turning, boring, inside turning or reaming with angular reamer,
- less suitable procedures are grinding, honing, reaming with multiple-edged reamers, and milling.

Deep-rolling requires permanent control of the working parameters during the process (rolling force, feed rate, speed and geometry).
It is recommended performing roller-burnishing or deep-rolling at the end of machining forming in one setup on the machine.

Table 18 – Roller-burnishing and deep rolling

Process	Drawing indication required
Roller-burnishing	Roller-burnish
Deep-rolling	Deep-roll

4 Inspection

4.1 Basic specifications

All features produced during the manufacturing processes (dimensions, surface roughness etc.) shall be examined by the manufacturer. Surface inspections specified on the drawings shall be carried out by the manufacturer of the surface after finish-machining.

4.2 Inspection of dimensions, requirements on measuring equipment

Every manufacturer shall make available sufficient measuring equipment for verification of the features he has produced. Measuring and inspection equipment shall be selected and used as appropriate for the respective measuring requirements and the measuring inaccuracies of the equipment shall be known.

When necessary, proof shall be furnished of the fulfilment of the requirements concerning the control of measuring and test equipment as in DIN EN ISO 9001:2008-12, item 7.6, "Control of monitoring and measuring devices", and in DIN EN ISO 10012.
Tolerances on form and location shall preferably be examined on calibrated 3-coordinate measuring machines. If the manufacturer has neither a three-coordinate measuring machine nor any other measuring and testing equipment, SMS group reserves the right to demand inspection of the workpiece by scanning on a machine tool in unclamped condition. This inspection shall be performed on a machine whose accuracy is known and which was not involved in the production of the workpiece. The accuracy of the machine shall be proved when required. Machine errors shall be eliminated; if this is not possible, they shall be taken into account. Deviations from these regulations require the previous approval by the department of quality inspection of SMS group.

4.3 Inspection documentation

When the criteria below apply, the manufacturer shall carry out an inspection and certify the results in an inspection document 3.1 according to DIN EN 10204:2005-01 stating the desired and the actual values.

- Dimensional tolerances with IT tolerance class ≤ IT9
- Dimensional tolerances without IT tolerance class as shown in the following:
  Dimensions below 180 mm with tolerance ranges ≤ 0,1 mm;
  Dimensions > 180 to 800 mm with tolerance ranges ≤ 0,2 mm;
  Dimensions > 800 to 2000 mm with tolerance ranges ≤ 0,4 mm;
  Dimensions > 2000 to 5000 mm with tolerance ranges ≤ 0,8 mm;
  Dimensions > 5000 mm with tolerance ranges ≤ 1,0 mm.
- Check dimensions according to DIN 406-10.
- Tolerances on form and location of small tolerance class H according to DIN ISO 2768-2:1991-04.
- Angles, curves and radii, small degree of accuracy m according to DIN ISO 2768-1:1991-06.
- Surface roughness values R_a ≤ 0,8 µm as in DIN ISO 1302:1993-12.
- Pressure tests for operating pressures > 25 bar stating type of test, test pressure, test time and pressure fluids.
- Threads, except for metrical (normal) vee threads and pipe threads, with indication of testing method/means.
- Toothings, stating base tangent lengths, tooth form, tooth alignment, pitch.
- Surface treatments and coats with indication of hardness and coat thickness.
- External condition, e. g. surface examination using penetrant testing or magnetic particle testing.
- Internal condition using ultrasonic testing.

4.4 Tolerances and limit deviations for linear dimensions from 1 to 10,000 mm

4.4.1 Scope

The following tolerances are specifications for all linear dimensions such as lengths, widths, heights, depths, diameters etc. For the purpose of tolerancing, the linear dimensions over 1 up to 10,000 mm nominal dimension are subdivided into 12 different tolerance classes, which shall be selected and agreed upon as required for the respective application. The standard tolerances stated in Table 19 are assigned to the respective tolerance series and classes. The values are based on the reference temperature of 20 °C according to DIN EN ISO 1:2002-10.

4.4.2 Designation of the tolerance series

The structure of the tolerance series designation is shown in figure 16.

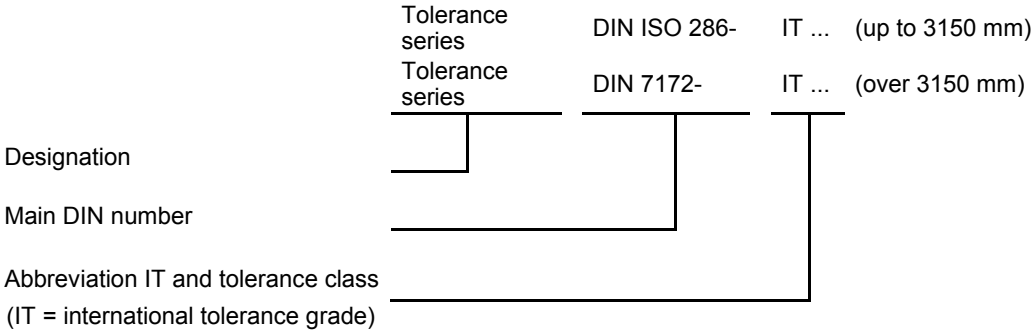


Figure 16 – Designation of the tolerance series

4.4.3 Standard tolerances

The values of the tolerance zones for the standard tolerances grades IT5 to IT16 are listed in Table 19.
It is pointed out that for dimensions over 500 mm special care is required in manufacture to ensure the fulfilment of tolerances of the tolerance classes finer than 8, in particular with respect to temperature variations and temperature gradients in the workpiece.

Table 19 – Standard tolerances

Nominal dimension range mm	IT µm											
	5	6	7	8	9	10	11	12	13	14	15	16
From 1 to 3	4	6	10	14	25	40	60	100	140	250	400	600
> 3 to 6	5	8	12	18	30	48	75	120	180	300	480	750
> 6 to 10	6	9	15	22	36	58	90	150	220	360	580	900
> 10 to 18	8	11	18	27	43	70	110	180	270	430	700	1100
> 18 to 30	9	13	21	33	52	84	130	210	330	520	840	1300
> 30 to 50	11	16	25	39	62	100	160	250	390	620	1000	1600
> 50 to 80	13	19	30	46	74	120	190	300	460	740	1200	1900
> 80 to 120	15	22	35	54	87	140	220	350	540	870	1400	2200
> 120 to 180	18	25	40	63	100	160	250	400	630	1000	1600	2500
> 180 to 250	20	29	46	72	115	185	290	460	720	1150	1850	2900
> 250 to 315	23	32	52	81	130	210	320	520	810	1300	2100	3200
> 315 to 400	25	36	57	89	140	230	360	570	890	1400	2300	3600
> 400 to 500	27	40	63	97	155	250	400	630	970	1550	2500	4000
> 500 to 630	32	44	70	110	175	280	440	700	1100	1750	2800	4400
> 630 to 800	36	50	80	125	200	320	500	800	1250	2000	3200	5000
> 800 to 1000	40	56	90	140	230	360	560	900	1400	2300	3600	5600
> 1000 to 1250	47	66	105	165	260	420	660	1050	1650	2600	4200	6600
> 1250 to 1600	55	78	125	195	310	500	780	1250	1950	3100	5000	7800
> 1600 to 2000	65	92	150	230	370	600	920	1500	2300	3700	6000	9200
> 2000 to 2500	78	110	175	280	440	700	1100	1750	2800	4400	7000	11000
> 2500 to 3150	96	135	210	330	540	860	1350	2100	3300	5400	8600	13500
> 3150 to 4000	105	165	260	410	660	1050	1650	2600	4100	6600	10500	16500
> 4000 to 5000	130	200	320	500	800	1300	2000	3200	5000	8000	13000	20000
> 5000 to 6300	160	250	400	620	980	1600	2500	4000	6200	9800	16000	25000
> 6300 to 8000	195	310	490	760	1200	1950	3100	4900	7600	12000	19500	31000
> 8000 to 10000	240	380	600	940	1500	2400	3800	6000	9400	15000	24000	38000

4.4.4 Limit deviations for external and internal dimensions in the nominal dimension range up to 3150 mm

The tolerance zones for the nominal dimension range up to 3150 mm according to DIN ISO 286-2:1990-11 are a selection of SMS group and are specified in Table 20 for external dimensions and in Table 21 for internal dimensions.

Table 20 – Tolerance zones for external dimensions up to 3150 mm

Nominal dimension range mm	Deviations (µm)														
	e7	e8	e9	f7	g6	h6	h9	h11	j6/js6 [a]	k6	m6	n6	p6	r6	s6
> 1 to 3	- 14 - 24	- 14 - 28	- 14 - 39	- 6 - 16	- 2 - 8	0 - 6	0 - 25	0 - 60	+ 4 - 2	+ 6 0	+ 8 + 2	+ 10 + 4	+ 12 + 6	+ 16 + 10	+ 20 + 14
> 3 to 6	- 20 - 32	- 20 - 38	- 20 - 50	- 10 - 22	- 4 - 12	0 - 8	0 - 30	0 - 75	+ 6 - 2	+ 9 + 1	+ 12 + 4	+ 16 + 8	+ 20 + 12	+ 23 + 15	+ 27 + 19
> 6 to 10	- 25 - 40	- 25 - 47	- 25 - 61	- 13 - 28	- 5 - 14	0 - 9	0 - 36	0 - 90	+ 7 - 2	+ 10 + 1	+ 15 + 6	+ 19 + 10	+ 24 + 15	+ 28 + 19	+ 32 + 23
> 10 to 18	- 32 - 50	- 32 - 59	- 32 - 75	- 16 - 34	- 6 - 17	0 - 11	0 - 43	0 - 110	+ 8 - 3	+ 12 + 1	+ 18 + 7	+ 23 + 12	+ 29 + 18	+ 34 + 23	+ 39 + 28
> 18 to 30	- 40 - 61	- 40 - 73	- 40 - 92	- 20 - 41	- 7 - 20	0 - 13	0 - 52	0 - 130	+ 9 - 4	+ 15 + 2	+ 21 + 8	+ 28 + 15	+ 35 + 22	+ 41 + 28	+ 48 + 35
> 30 to 50	- 50 - 75	- 50 - 89	- 50 - 112	- 25 - 50	- 9 - 25	0 - 16	0 - 62	0 - 160	+ 11 - 5	+ 18 + 2	+ 25 + 9	+ 33 + 17	+ 42 + 26	+ 50 + 34	+ 59 + 43
> 50 to 65	- 60 - 90	- 60 - 106	- 60 - 134	- 30 - 60	- 10 - 29	0 - 19	0 - 74	0 - 190	+ 12 - 7	+ 21 + 2	+ 30 + 11	+ 39 + 20	+ 51 + 32	+ 60 + 41	+ 72 + 53
> 65 to 80														+ 62 + 43	+ 78 + 59
> 80 to 100	- 72 - 107	- 72 - 126	- 72 - 159	- 36 - 71	- 12 - 34	0 - 22	0 - 87	0 - 220	+ 13 - 9	+ 25 + 3	+ 35 + 13	+ 45 + 23	+ 59 + 37	+ 73 + 51	+ 93 + 71
> 100 to 120														+ 76 + 54	+ 101 + 79
> 120 to 140	- 85 - 125	- 85 - 148	- 85 - 185	- 43 - 83	- 14 - 39	0 - 25	0 - 100	0 - 250	+ 14 - 11	+ 28 + 3	+ 40 + 15	+ 52 + 27	+ 68 + 43	+ 88 + 63	+ 117 + 92
> 140 to 160														+ 90 + 65	+ 125 + 100
> 160 to 180														+ 93 + 68	+ 133 + 108
> 180 to 200	- 100 - 146	- 100 - 172	- 100 - 215	- 50 - 96	- 15 - 44	0 - 29	0 - 115	0 - 290	+ 16 - 13	+ 33 + 4	+ 46 + 17	+ 60 + 31	+ 79 + 50	+ 106 + 77	+ 151 + 122
> 200 to 225														+ 109 + 80	+ 159 + 130
> 225 to 250														+ 113 + 84	+ 169 + 140
> 250 to 280	- 110 - 162	- 110 - 191	- 110 - 240	- 56 - 108	- 17 - 49	0 - 32	0 - 130	0 - 320	+ 16 - 16	+ 36 + 4	+ 52 + 20	+ 66 + 34	+ 88 + 56	+ 126 + 94	+ 190 + 158
> 280 to 315														+ 130 + 98	+ 202 + 170
> 315 to 355	- 125 - 182	- 125 - 214	- 125 - 265	- 62 - 119	- 18 - 54	0 - 36	0 - 140	0 - 360	+ 18 - 18	+ 40 + 4	+ 57 + 21	+ 73 + 37	+ 98 + 62	+ 144 + 108	+ 226 + 190
> 355 to 400														+ 150 + 114	+ 244 + 208
> 400 to 450	- 135 - 198	- 135 - 232	- 135 - 290	- 68 - 131	- 20 - 60	0 - 40	0 - 155	0 - 400	+ 20 - 20	+ 45 + 5	+ 63 + 23	+ 80 + 40	+ 108 + 68	+ 166 + 126	+ 272 + 232
> 450 to 500														+ 172 + 132	+ 292 + 252
> 500 to 560	- 145 - 215	- 145 - 255	- 145 - 320	- 76 - 146	- 22 - 66	0 - 44	0 - 175	0 - 440	+ 22 - 22	+ 44 0	+ 70 + 26	+ 88 + 44	+ 122 + 78	+ 194 + 150	+ 324 + 280
> 560 to 630														+ 199 + 155	+ 354 + 310
> 630 to 710	- 160 - 240	- 160 - 285	- 160 - 360	- 80 - 160	- 24 - 74	0 - 50	0 - 200	0 - 500	+ 25 - 25	+ 50 0	+ 80 + 30	+ 100 + 50	+ 138 + 88	+ 225 + 175	+ 390 + 340
> 710 to 800														+ 235 + 185	+ 430 + 380
> 800 to 900	- 170 - 260	- 170 - 310	- 170 - 400	- 86 - 176	- 26 - 82	0 - 56	0 - 230	0 - 560	+ 28 - 28	+ 56 0	+ 90 + 34	+ 112 + 56	+ 156 + 100	+ 266 + 210	+ 486 + 430
> 900 to 1000														+ 276 + 220	+ 526 + 470
> 1000 to 1120	- 195 - 300	- 195 - 360	- 195 - 455	- 98 - 203	- 28 - 94	0 - 66	0 - 260	0 - 660	+ 33 - 33	+ 66 0	+ 106 + 40	+ 132 + 66	+ 186 + 120	+ 316 + 250	+ 586 + 520
> 1120 to 1250														+ 326 + 260	+ 646 + 580
> 1250 to 1400	- 220 - 345	- 220 - 415	- 220 - 530	- 110 - 235	- 30 - 108	0 - 78	0 - 310	0 - 780	+ 39 - 39	+ 78 0	+ 126 + 48	+ 156 + 78	+ 218 + 140	+ 378 + 300	+ 718 + 640
> 1400 to 1600														+ 408 + 330	+ 798 + 720
> 1600 to 1800	- 240 - 390	- 240 - 470	- 240 - 610	- 120 - 270	- 32 - 124	0 - 92	0 - 370	0 - 920	+ 46 - 46	+ 92 0	+ 150 + 58	+ 184 + 92	+ 262 + 170	+ 462 + 370	+ 912 + 820
> 1800 to 2000														+ 492 + 400	+1012 + 920
> 2000 to 2240	- 260 - 435	- 260 - 540	- 260 - 700	- 130 - 305	- 34 - 144	0 - 110	0 - 440	0 -1100	+ 55 - 55	+ 110 0	+ 178 + 68	+ 220 + 110	+ 305 + 195	+ 550 + 440	+1110 +1000
> 2240 to 2500														+ 570 + 460	+1210 +1100
> 2500 to 2800	- 290 - 500	- 290 - 620	- 290 - 830	- 145 - 355	- 38 - 173	0 - 135	0 - 540	0 -1350	+ 67 - 67	+ 135 0	+ 211 + 76	+ 270 + 135	+ 375 + 240	+ 685 + 550	+1385 +1250
> 2800 to 3150														+ 715 + 580	+1535 +1400

[a] js6 applies to nominal dimension ranges over 500.

Table 21 – Tolerance zones for internal dimensions up to 3150 mm

Nominal dimension range mm	Deviations (µm)														
	D7	D10	E9	F7	F8	G7	G8	H7	H8	H9	H12	H13	J7/JS7[a)]	K7	M7	P9
> 1 to 3	+ 30 + 20	+ 60 + 20	+ 39 + 14	+ 16 + 6	+ 20 + 6	+ 12 + 2	+ 16 + 2	+ 10 0	+ 14 0	+ 25 0	+ 100 0	+ 140 0	+ 4 - 6	0 - 10	- 2 - 12	- 6 - 31
> 3 to 6	+ 42 + 30	+ 78 + 30	+ 50 + 20	+ 22 + 10	+ 28 + 10	+ 16 + 4	+ 22 + 4	+ 12 0	+ 18 0	+ 30 0	+ 120 0	+ 180 0	+ 6 - 6	+ 3 - 9	0 - 12	- 12 - 42
> 6 to 10	+ 55 + 40	+ 98 + 40	+ 61 + 25	+ 28 + 13	+ 35 + 13	+ 20 + 5	+ 27 + 5	+ 15 0	+ 22 0	+ 36 0	+ 150 0	+ 220 0	+ 8 - 7	+ 5 - 10	0 - 15	- 15 - 51
> 10 to 18	+ 68 + 50	+ 120 + 50	+ 75 + 32	+ 34 + 16	+ 43 + 16	+ 24 + 6	+ 33 + 6	+ 18 0	+ 27 0	+ 43 0	+ 180 0	+ 270 0	+ 10 - 8	+ 6 - 12	0 - 18	- 18 - 61
> 18 to 30	+ 86 + 65	+ 149 + 65	+ 92 + 40	+ 41 + 20	+ 53 + 20	+ 28 + 7	+ 40 + 7	+ 21 0	+ 33 0	+ 52 0	+ 210 0	+ 330 0	+ 12 - 9	+ 6 - 15	0 - 21	- 22 - 74
> 30 to 50	+ 105 + 80	+ 180 + 80	+ 112 + 50	+ 50 + 25	+ 64 + 25	+ 34 + 9	+ 48 + 9	+ 25 0	+ 39 0	+ 62 0	+ 250 0	+ 390 0	+ 14 - 11	+ 7 - 18	0 - 25	- 26 - 88
> 50 to 65	+ 130	+ 220	+ 134	+ 60	+ 76	+ 40	+ 56	+ 30	+ 46	+ 74	+ 300	+ 460	+ 18	+ 9	0	- 32
> 65 to 80	+ 100	+ 100	+ 60	+ 30	+ 30	+ 10	+ 10	0	0	0	0	0	- 12	- 21	- 30	- 106
> 80 to 100	+ 155	+ 260	+ 159	+ 71	+ 90	+ 47	+ 66	+ 35	+ 54	+ 87	+ 350	+ 540	+ 22	+ 10	0	- 37
> 100 to 120	+ 120	+ 120	+ 72	+ 36	+ 36	+ 12	+ 12	0	0	0	0	0	- 13	- 25	- 35	- 124
> 120 to 140																
> 140 to 160	+ 185	+ 305	+ 185	+ 83	+ 106	+ 54	+ 77	+ 40	+ 63	+ 100	+ 400	+ 630	+ 26	+ 12	0	- 43
> 160 to 180	+ 145	+ 145	+ 85	+ 43	+ 43	+ 14	+ 14	0	0	0	0	0	- 14	- 28	- 40	- 143
> 180 to 200																
> 200 to 225	+ 216	+ 355	+ 215	+ 96	+ 122	+ 61	+ 87	+ 46	+ 72	+ 115	+ 460	+ 720	+ 30	+ 13	0	- 50
> 225 to 250	+ 170	+ 170	+ 100	+ 50	+ 50	+ 15	+ 15	0	0	0	0	0	- 16	- 33	- 46	- 165
> 250 to 280	+ 242	+ 400	+ 240	+ 108	+ 137	+ 69	+ 98	+ 52	+ 81	+ 130	+ 520	+ 810	+ 36	+ 16	0	- 56
> 280 to 315	+ 190	+ 190	+ 110	+ 56	+ 56	+ 17	+ 17	0	0	0	0	0	- 16	- 36	- 52	- 186
> 315 to 355	+ 267	+ 440	+ 265	+ 119	+ 151	+ 75	+ 107	+ 57	+ 89	+ 140	+ 570	+ 890	+ 39	+ 17	0	- 62
> 355 to 400	+ 210	+ 210	+ 125	+ 62	+ 62	+ 18	+ 18	0	0	0	0	0	- 18	- 40	- 57	- 202
> 400 to 450	+ 293	+ 480	+ 290	+ 131	+ 165	+ 83	+ 117	+ 63	+ 97	+ 155	+ 630	+ 970	+ 43	+ 18	0	- 68
> 450 to 500	+ 230	+ 230	+ 135	+ 68	+ 68	+ 20	+ 20	0	0	0	0	0	- 20	- 45	- 63	- 223
> 500 to 560	+ 330	+ 540	+ 320	+ 146	+ 186	+ 92	+ 132	+ 70	+ 110	+ 175	+ 700	+1100	+ 35	0	- 26	- 78
> 560 to 630	+ 260	+ 260	+ 145	+ 76	+ 76	+ 22	+ 22	0	0	0	0	0	- 35	- 70	- 96	- 253
> 630 to 710	+ 370	+ 610	+ 360	+ 160	+ 205	+ 104	+ 149	+ 80	+ 125	+ 200	+ 800	+1250	+ 40	0	- 30	- 88
> 710 to 800	+ 290	+ 290	+ 160	+ 80	+ 80	+ 24	+ 24	0	0	0	0	0	- 40	- 80	- 110	- 288
> 800 to 900	+ 410	+ 680	+ 400	+ 176	+ 226	+ 116	+ 166	+ 90	+ 140	+ 230	+ 900	+1400	+ 45	0	- 34	- 100
> 900 to 1000	+ 320	+ 320	+ 170	+ 86	+ 86	+ 26	+ 26	0	0	0	0	0	- 45	- 90	- 124	- 330
> 1000 to 1120	+ 455	+ 770	+ 455	+ 203	+ 263	+ 133	+ 193	+ 105	+ 165	+ 260	+1050	+1650	+ 52	0	- 40	- 120
> 1120 to 1250	+ 350	+ 350	+ 195	+ 98	+ 98	+ 28	+ 28	0	0	0	0	0	- 52	- 105	- 145	- 380
> 1250 to 1400	+ 515	+ 890	+ 530	+ 235	+ 305	+ 155	+ 225	+ 125	+ 195	+ 310	+1250	+1950	+ 62	0	- 48	- 140
> 1400 to 1600	+ 390	+ 390	+ 220	+ 110	+ 110	+ 30	+ 30	0	0	0	0	0	- 62	- 125	- 173	- 450
> 1600 to 1800	+ 580	+ 1030	+ 610	+ 270	+ 350	+ 182	+ 262	+ 150	+ 230	+ 370	+1500	+2300	+ 75	0	- 58	- 170
> 1800 to 2000	+ 430	+ 430	+ 240	+ 120	+ 120	+ 32	+ 32	0	0	0	0	0	- 75	- 150	- 208	- 540
> 2000 to 2240	+ 655	+ 1180	+ 700	+ 305	+ 410	+ 209	+ 314	+ 175	+ 280	+ 440	+1750	+2800	+ 87	0	- 68	- 195
> 2240 to 2500	+ 480	+ 480	+ 260	+ 130	+ 130	+ 34	+ 34	0	0	0	0	0	- 87	- 175	- 243	- 635
> 2500 to 2800	+ 730	+ 1380	+ 830	+ 355	+ 475	+ 248	+ 368	+ 210	+ 330	+ 540	+2100	+3300	+ 105	0	- 76	- 240
> 2800 to 3150	+ 520	+ 520	+ 290	+ 145	+ 145	+ 38	+ 38	0	0	0	0	0	- 105	- 210	- 286	- 780

[a)] JS7 applies to nominal dimension ranges over 500.

4.5.5 Limit deviations for external and internal dimensions in the nominal dimension range from 3150 mm to 10,000 mm

The tolerance zones for the nominal dimension range from 3150 mm to 10,000 mm according to DIN 7172:1991-04 are a selection of SMS group and are specified in Table 22 for external dimensions and in Table 23 for internal dimensions.

Table 22 – Tolerance zones for external dimensions from 3150 mm to 10,000 mm

Nominal dimension range mm	Deviations (µm)												
	e7	e8	e9	f7	g6	h6	h9	h11	js6	k6	m6	n6	p6
> 3150 to 4000	- 320 - 580	- 320 - 730	- 320 - 980	- 160 - 420	- 40 - 205	0 - 165	0 - 660	0 - 1650	+ 83 - 83	+ 165 0	+ 263 + 98	+ 330 + 165	+ 455 + 290
> 4000 to 5000	- 350 - 670	- 350 - 850	- 350 - 1150	- 175 - 495	- 43 - 243	0 - 200	0 - 800	0 - 2000	+ 100 - 100	+ 200 0	+ 320 + 120	+ 400 + 200	+ 560 + 360
> 5000 to 6300	- 380 - 780	- 380 - 1000	- 380 - 1360	- 190 - 590	- 47 - 297	0 - 250	0 - 980	0 - 2500	+ 125 - 125	+ 250 0	+ 395 + 145	+ 500 + 250	+ 690 + 440
> 6300 to 8000	- 420 - 910	- 420 - 1180	- 420 - 1620	- 210 - 700	- 51 - 361	0 - 310	0 - 1200	0 - 3100	+ 155 - 155	+ 310 0	+ 495 + 185	+ 610 + 300	+ 850 + 540
> 8000 to 10,000	- 460 - 1060	- 460 - 1400	- 460 - 1960	- 230 - 830	- 55 - 435	0 - 380	0 - 1500	0 - 3800	+ 190 - 190	+ 380 0	+ 610 + 230	+ 760 + 380	+ 1060 + 680

Table 23 – Tolerance zones for internal dimensions from 3150 mm to 10,000 mm

Nominal dimension range mm	Deviations (µm)												
	D7	D10	E9	F7	F8	G7	H7	H8	H9	H12	H13	JS7	K7	M7
> 3150 to 4000	+ 840 + 580	+ 1630 + 580	+ 980 + 320	+ 420 + 160	+ 570 + 160	+ 300 + 40	+ 260 0	+ 410 0	+ 660 0	+ 2600 0	+ 4100 0	+ 130 - 130	0 - 260	- 98 - 358
> 4000 to 5000	+ 960 + 640	+ 1940 + 640	+ 1150 + 350	+ 495 + 175	+ 675 + 175	+ 363 + 43	+ 320 0	+ 500 0	+ 800 0	+ 3200 0	+ 5000 0	+ 160 - 160	0 - 320	- 120 - 440
> 5000 to 6300	+ 1120 + 720	+ 2320 + 720	+ 1360 + 380	+ 590 + 190	+ 810 + 190	+ 447 + 47	+ 400 0	+ 620 0	+ 980 0	+ 4000 0	+ 6200 0	+ 200 - 200	0 - 400	- 145 - 545
> 6300 to 8000	+ 1290 + 800	+ 2750 + 800	+ 1620 + 420	+ 700 + 210	+ 970 + 210	+ 541 + 51	+ 490 0	+ 760 0	+ 1200 0	+ 4900 0	+ 7600 0	+ 245 - 245	0 - 490	- 185 - 675
> 8000 to 10,000	+ 1480 + 880	+ 3280 + 880	+ 1960 + 460	+ 830 + 230	+ 1170 + 230	+ 655 + 55	+ 600 0	+ 940 0	+ 1500 0	+ 6000 0	+ 9400 0	+ 300 - 300	0 - 600	- 230 - 830

Referenced technical standards, codes and regulations

DIN 76-1	Thread run-outs and thread undercuts; Part 1: For ISO metric threads in accordance with DIN 13-1
DIN 76-2	Runout and undercut for pipe thread according to DIN ISO 228 Part 1
DIN 406-10	Technical drawings; Dimensioning; Definitions, general principles
DIN 406-11	Technical drawings; Dimensioning; Rules for the application
DIN 7168:1991-04	General tolerances of linear and angular dimensions and general geometrical tolerances
DIN 7172:1991-04	Tolerances and limit deviations for sizes above 3150 up to 10,000 mm; principles, standard tolerances, limit deviations
DIN EN 10204:2005-01	Metallic products – Types of inspection documents
DIN EN ISO 1:2002-10	Geometrical product specifications (GPS) – Standard reference temperature for geometrical product specifications and verification
DIN EN ISO 1101:2008-08	Geometrical product specifications (GPS); Geometrical tolerancing; tolerances of form, orientation, location and run-out
DIN EN ISO 9001:2008-12	Quality management systems; Requirements
DIN EN ISO 10012	Measurement management systems – Requirements for measurement processes and measuring equipment
DIN EN ISO 14660-1:1999-11	Geometrical product specifications (GPS) – Geometrical features – Part 1: General terms and definitions
DIN ISO 286-2:1990-11	ISO system of limits and fits; Tables of standard tolerance grades and limit deviations for holes and shafts
DIN ISO 965-1:1999-11	ISO general purpose metric screw threads – Tolerances – Part 1: Principles and basic data
DIN ISO 1302:1993-12	Geometrical Product Specifications (GPS); Indication of surface texture in technical product documentation
DIN ISO 2768-1:1991-06	General tolerances; Tolerances for linear and angular dimensions without individual tolerance indications
DIN ISO 2768-2:1991-04	General tolerances; Geometrical tolerances for features without individual tolerance indications
DIN ISO 13715:2000-12	Technical drawings; edges of undefined shape; vocabulary and indications

Revision of September 2010

Layout adapted to SN 104.
New logo: SMS group.
Standards indicated with year and month.
2.2.2 New instruction: "The use of summarising symbols shall be avoided".
2.4.2 Definition of tolerance zone and explanation on drawing indication adapted to DIN EN ISO 1302:2002-06.
Indication of level condition incorporated in Part 6, Table 5.
Indication of reference surface moved to Part 1 "Principles".
Editorial revision.

SMS group

Manufacturing Instructions

Assembling

SN 200-6

ICS 25.020

Dimensions in mm

Supersedes
SN 200-6: 2007-02

Table of contents

1 Scope

The requirements specified below apply to the pre-assembling in manufacturing shops, disassembling for shipment, and final assembling of products and materials of SMS group unless other requirements are specified in design, ordering or manufacturing documents.

Assembling is the permanent joining or other way of fitting together two or more workpieces of defined geometrical shape; it includes all handling and auxiliary procedures including measuring and inspection.

2 Safety instructions

For details on hazardous materials and environmental protection, refer to SN 200-1:2010, section 4.

Country-specific safety regulations shall be complied with.
For components coming into contact with oxygen, it is essential to ensure that they are absolutely clean from any oil and grease.
Couplings requiring the introduction of heat (flame) for disconnecting shall not be used on pipe lines which carry flammable fluids.

Edited by:
SMS Siemag
Standards Office

3 Preparation

All parts shall be deburred (free of burrs according to DIN ISO 13715: 2000-12) and cleaned, all surfaces shall be properly dressed before assembling.
Holes used for feeding fluids shall be illuminated, residues removed (e. g. with compressed air), and the holes then checked for correct passage of the fluid.
The parts shall be assembled on a base surface which corresponds to the future supporting surface and complies with the accuracy required for the inspections to be made. The static and dynamic loads shall be taken into account.
Assembling of the components shall be made only after the inspection of the individual parts, complete inspection records of all individual parts shall be made available, see SN 200-10:2010.

4 Assembling and disassembling

4.1 Machines

4.1.1 Basic specifications

For assembling (e. g. of wear plates, couplings, bushings etc.), the bonding, lubricating and sealing instructions of the makers shall be followed.
On assembled parts and machined surfaces, the maximum surface contact percentages shall be achieved.
The specified fitting clearances and contact patterns shall be taken into account, applied and documented.
The geometrical tolerances for the assembling of machine components shall be complied with according to item 5.2.

4.1.2 Screws and bolts

For screwed/bolted joints which are not marked on drawings, the usual tightening procedures for assembling shall be applied. The basic data are given in Table 2 (extract from Normenheft NH/Book of Standards Part 4:2008).
The pretensioning forces and tightening torques specified in Table 2 do not apply to bolts with fine pitch threads, expansion bolts, T-head bolts according to SN 425:2009-09, and masonry and foundation bolts according to SN 559:2009-07.
When screws/bolts with property classes other than 8.8 are used, the pretensioning forces and tightening torques can be calculated using the conversion factors in Table 1 below.

Table 1 – Conversion factors for different property classes

Property class	3.6	4.6	5.6	10.9	12.9	A2-70	A2-80
Conversion factor	0,28	0,375	0,47	1,41	1,69	0,71	0,94

Tightening torques indicated on the drawings shall also be applied for partial assembling for the purpose of finish machining.
When no torques or pretensioning values are indicated on the drawing and no other details on securing are given, the screwed joints shall be secured with Loctite 243 according to SN 507:2003-08.

Table 2 – Permissible loads on bolts of property class 8.8 (extract from NH/Book of Standards, Part 4:2008)

Bolt size		**Stressed cross-section**	**Tightening method**		
			Turning [a]		**Stretching**
d	**P (Pitch)**	**A_s mm²**	**Pretensioning force F_V (kN)**	**Tightening torque M_A (Nm)**	**Pretensioning force F_V (kN)**
M 8	1	20,1	7	7	-
M 8	1,25	36,6	13	18	-
M 10	1,5	58	20	35	-
M 12	1,75	84,3	29	61	-
M 16	2	157	55	149	-
M 20	2,5	245	86	290	-
M 24	3	353	124	500	158
M 30	3,5	561	199	1004	251
M 36	4	817	291	1749	366
M 42	4,5	1121	401	2806	502
M 48	5	1473	529	4236	660
M 56	5,5	2030	732	6791	909
M 64	6	2676	969	10147	1199
M 72 x 6		3463	1265	14689	1551
M 80 x 6		4344	1597	20368	1946
M 90 x 6		5590	2069	29492	2504
M 100 x 6		7000	2605	41122	3136
M 110 x 6		8560	3198	54799	3835
M 125 x 6		11800	4205	80284	5018
M 140 x 6		14200	5352	113326	6362
M 160 x 6		18700	7073	171027	8378

[a] Basis for calculation: slightly oiled, μ = 0,125

4.1.3 Shrink fitting

For the shrink fitting or shrinking off of bearings, couplings and other parts, the makers' installation instructions and the maximum permissible heating and undercooling temperatures shall be observed. This applies in particular to quenched and tempered and to hardened components.

4.1.4 Lubrication

Grease bearing points and grease lines shall be delivered with initial fill.
All components which need lubrication shall be properly provided with sufficient quantities of one of the lubricants recommended in SN 180-1:2009-07.

4.1.5 Hydraulic systems

When hydraulic power packages are used to effect movements, the necessary purity of the hydraulic fluid shall be ensured, at least degree of purity 15/14/11 acc. to ISO 4406:1999-12.
As a minimum requirement, the hydraulic fluid shall fulfil the properties of an HLPD according to DIN 51524-2:2006-04 (e. g. Renolin MRX 46 as in SN 200-7, Table 6).

4.1.6 Coating

Areas which are no longer accessible after assembling shall be provided with prime and top coats according to SN 200-7:2010 before assembling.
All exposed worked contact faces, with the exception of shrink joints, shall be provided with anti-corrosion compound Tectyl 511-M or equivalent products before assembling.

4.1.7 Disassembling

Disassembling shall be made only to the necessary extent. Screws/bolts and shims shall be left on the components provided that this does not cause problems for shipment.
Prior to disassembling, parts likely to be mixed up (e. g. pipe supports, split covers, split housings etc.) shall be provided with permanent and well visible marking using steel stamping letters or figures.

4.2 Fluid-carrying components

4.2.1 Basic specifications

The locations of pipe lines, line components and pipe supports are shown on drawings. Deviations are allowed only upon agreement with the design department.
For pipework which is not fully dimensioned and has to be fitted during assembling, the following shall be taken into account:

- Function-adapted laying of the pipework according to the general arrangement drawing, the pipework or the P & I diagram (pipework and instrument flow diagram);
- function-adapted installation of valves and fittings with due regard to accessibility;
- well-ordered arrangement of the pipework and routing for easy assembling and disassembling;
- laying of the pipe lines without straining according to DIN EN 13480-4:2002-08.
- The space required for the use of hydraulic pretensioning units (e. g. for anchor bolts, gear bearing screws) shall be taken into account.

The general tolerances for the installation of pipe lines are specified in section 5.3.

4.2.2 Couplings and flanges

In the assembling of pipe couplings, cleanliness and lubrication of the thread shall be ensured and the suppliers' assembling instructions shall be followed.
When pipe couplings in stainless steel are assembled, the thread and the surface of the union nut which is in contact with the welding cone shall be provided with a sufficient quantity of lubricant (e. g. "Fett-Micro-Gleit GP 350" by Micro Gleit Company or any other lubricant approved by SMS group) to avoid seizing of the couplings.

When flanges made of two different materials are used, the parts remaining at the pipe (flanges and welding collar) shall always be made of equivalent pipe material for reasons of pickling. For all piping components which can be removed before pickling (split SAE flanges/split flanges etc.), the use of surface-treated (galvanized, chromalised or nickel-plated) steel is allowed.

As shown in figure 1, the screw holes in pipe lines and valves/fittings shall be arranged in such a way that they are symmetrical to the two main axes and that no holes are located on the axes themselves, refer to DIN 1092-1:2008-09.
Every flange shall be provided with a number of bolt holes that can be divided by four.

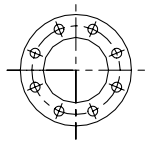


Fig. 1 – Flange

4.2.3 Sealing of pipe couplings and threaded fittings

When male stud couplings with front-side elastic seal are used, no sealing agents shall be applied in addition.

For the sealing of male stud couplings, no copper seals shall be used.
In exceptional cases, couplings and threaded fittings without front-side elastic seals shall be sealed in the low-pressure range ≤1,6 MPa with Omnifit 50H (by Henkel), in the high-pressure range >1,6 MPa with AVX No. 586 (by Loctite) or with equivalent sealing compounds.
Couplings sealed with AVX can be disconnected only by the introduction of heat (flame); for this reason AVX shall not be used for pipe lines which carry flammable fluids.
Couplings of grease pipe lines shall never be provided with additional sealing compound.

4.2.4 Connecting holes

To avoid contamination of the control elements, all connecting holes (of valves, measuring instruments, cylinder ports, valve block connections etc.) shall be kept closed with appropriate means like disks, caps, adhesive tape etc. until final assembly. Connecting holes opened for reasons of installation shall be closed again immediately after installation.

4.2.5 Arrangement of fastening elements

Unless otherwise specified on drawings, pipework shall be installed in such a way that the distance between two fasteners does not exceed the values in Table 3.
Fastenings shall always be used immediately near detachable connections and near bends.
Weld-on pipe fasteners shall be welded on using a fillet weld of a = 0,3 x smallest plate thickness.
Grease pipe lines of outside diameters up to and including 10 mm shall be fastened to the machine without clearance using appropriate pipe clamps.

Table 3 – Distances

Pipe outside diameter		Max. distance in m
	≤ 10	0,6
> 10	≤ 38	1,5
> 38	≤ 88,9	2,5
> 88,9		3,0

4.2.6 Cleanliness of pipelines and fluid-carrying components

Prior to final assembling, pipework and fluid-carrying components shall be cleaned so that all impurities (dirt, chips, welding spatter, paint, etc.) are removed from the inside surface. After cleaning, the pipe lines and fluid-carrying components shall be closed in such a way (e. g. using a steel plate plus soft seal for flanges) that new contamination is safely avoided.

5 Inspection

5.1 Basic specifications

The scope of inspection for assembled units shall be agreed upon with our department of quality inspection, see SN 200-10:2010.
The manufacturer shall draw up records of all checks/inspections made by him.
As far as applicable and feasible, the minimum requirement is the examination of
- the tolerances of form and location for assembled units,
- the general tolerances for pipe lines,
- the supporting and seating surfaces, the connecting and takeover points,
- clearances and contact patterns to be adjusted,
- surface contact percentages (with 0,05 mm feeler gauge),
- movements and travelling distances (with auxiliary drives if necessary),
- cylinder strokes (using suitable hydraulic power units),
- corrosion protection and coat of paint, see SN 200-7:2010.

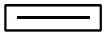
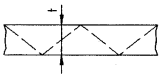
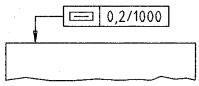
5.2 Form and location tolerances for assembled equipment components

The tolerances in Table 4 are related to the indicated reference length or relevant overall length of the components. The SMS group standard is tolerance class medium (m). The SMS group-specific indication of the level condition is shown in Table 5.

Table 4 – Form and location tolerances

Feature	Tolerance class			
	Very fine (sf)	Fine (f)	Medium	Coarse (g)
Straightness	0,05	0,1	0,2	0,5
Flatness	0,05	0,1	0,2	0,5
Parallelism	0,03	0,1	0,2	0,5
Perpendicularity	0,05	0,1	0,2	0,5
Inclination	0,03	0,1	0,2	0,5
Level condition	0,05	0,1	0,2	0,5
Vertical	0,05	0,1	0,2	0,5
Axial alignment	0,03	0,1	0,2	0,5

Table 5 – Level condition

Symbol	Tolerance zone definition	Drawing indication	Explanation
			The toleranced horizontal line shall lie between two horizontal lines which are t = 0,2 mm apart. When a reference length is not indicated, reference is always made to the relevant overall length.

5.3 General tolerances for pipe lines

For pipework which is not fully dimensioned and freely laid, the priority is on the guaranteeing of its function. All untoleranced dimensions are subject to accuracy classes C and F according to Tables 6 to 8, extract from DIN EN ISO 13920:1996-11.

For fully dimensioned pipework (e. g. pipe detail drawings, isometric drawings), accuracy classes B and F according to Tables 6 to 8, extract from DIN EN ISO 13920:1996-11, apply to all untoleranced dimensions.

Table 6 – Tolerances on linear dimensions (outside, inside and stepped dimensions)

Tolerance class	Nominal dimension range										
	2 to 30	> 30 to 120	> 120 to 400	> 400 to 1000	> 1000 to 2000	> 2000 to 4000	> 4000 to 8000	> 8000 to 12,000	> 12,000 to 16,000	> 16,000 to 20,000	> 20,000
B	± 1	± 2	± 2	± 3	± 4	± 6	± 8	± 10	± 12	± 14	± 16
C	± 1	± 3	± 4	± 6	± 8	± 11	± 14	± 18	± 21	± 24	± 27

Table 7 – Tolerances on angular dimensions

Tolerance class	Nominal dimension range (length of the shorter leg, see SN 200-4, item 8.2.3)					
	Up to 400	> 400 to 1000	> 1000	to 400	> 400 to 1000	> 1000
	Permissible deviations in degrees and minutes			Permissible deviations in tangent values		
B	± 45'	± 30'	± 20'	0,013	0,009	0,006
C	± 1°	± 45'	± 30'	0,018	0,013	0,009

Table 8 - Straightness, flatness and parallelism tolerances

Tolerance class	Nominal dimension range (longer lateral length of the surface)									
	> 30 to 120	> 120 to 400	> 400 to 1000	> 1000 to 2000	> 2000 to 4000	> 4000 to 8000	> 8000 to 12,000	> 12,000 to 16,000	> 16,000 to 20,000	> 20,000
F	1	1,5	3	4,5	6	8	10	12	14	16

Referenced technical standards, codes and regulations

DIN 51524-2:2006-04	Pressure fluids – Hydraulic oils – Part 2: HLP hydraulic oils; Minimum requirements
DIN EN 1092-1:2008-09	Flanges and their joints; Circular flanges for pipes, valves, fittings and accessories, PN designated; Part 1: Steel flanges
DIN EN 13480-4:2002-08	Metallic industrial piping; Part 4: Fabrication and installation
DIN EN ISO13920:1996-11	General tolerances for welded constructions; Tolerances for lengths, angles, shape and position
DIN ISO 13715:2000-12	Technical drawings; Edges of undefined shape; Vocabulary and indications
ISO 4406:1999-12	Hydraulic fluid power; Fluids; Method for coding the level of contamination by solid particles
Book Of Standards (NH) Part 4: 2008	Permissible bolt loads for bolts of strength category 8.8 - Operating loads, pretensioning forces, tightening torques, pretensioning units
SN 180-1:2009-07	Operating materials; Lubricant: Grease - Selection
SN 200-1:2010	Manufacturing Instructions – Principles
SN 200-7:2010	Manufacturing Instructions – Coating and preserving
SN 200-10:2010	Manufacturing Instructions – Inspection
SN 425:2009-09	T-head bolts of property classes 5.6 and 8.8 with metric threads
SN 507:2003-08	Metal bonding
SN 559:2009-07	Masonry and foundation bolts; Types and installation

Revision of September 2010

Layout adapted to SN 104.
Validity for SMS group.
Standards indicated with year and month.
Section 2: Addition of "Country-specific safety regulations shall be complied with".
Table 5 taken from Part 5.
Section 4.1.2: Non-applicability of forces and torques in Table 2 extended to "masonry and foundation bolts".
Table 2: Addition of "Basis for calculation: slightly oiled".
Table 1: Addition of conversion factor for property class 3.6.
Editorial revision.

SMS group

Manufacturing Instructions

Coating and preserving

SN 200-7

ICS 25.220

Dimensions in mm

Supersedes
SN 200-7: 2007-02

Table of contents

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Number of pages: 10

Edited by:
SMS Siemag
Standards Office

1 Scope

The requirements specified below apply to the coating and preserving of products and materials of SMS group unless other requirements are specified in design, ordering or manufacturing documents.

2 Basic requirements

2.1 Hazardous materials

Compliance with the specifications and regulations concerning hazardous materials made in Part 1, section 4, shall be ensured.

2.2 Steel surfaces

All surfaces in steel, with the exception of stainless or acid-resistant steels, shall be provided with paint coats. Machined surfaces whose surface hardness is ≤ Ra 6,3 and which are to be provided with a paint coat can additionally be primed with a base coat. This does not apply to contact surfaces and functional surfaces, these surface shall be preserved.

2.3 Colours

All colours shall be the glossy type.

2.4 Specifications in manufacturing documents

Specifications in the manufacturing documents shall be made when the standard specifications do not apply. This refers only to the specification of a cover coat. When no coat is to be applied, the specification "Only preservation" is required.

3 Coating and preserving of machine and steel components

3.1 Basic specifications

Parts which have to remain uncoated shall be preserved with Tectyl 502-C or equivalent products after shot-blasting/pickling. Drawing indication is required.

Exceptions:
Anchor plates according to SN 227-1 to 4 which are cast in concrete shall be blasted to remove rolling skin and annealing scale from the surface. To achieve better adhesion to the foundation, these parts shall be neither coated nor preserved. Indoor storage of these parts is necessary to avoid new formation of rust; refer to SN 200-9:2010 for approved storage classes.

3.2 Surface preparation

3.2.1 Basic specifications

Before the prime coat is applied, all surfaces to be provided with a coat or with preserving compound shall be cleaned to remove annealing colours, rust, slag, rolling skin, mill scale, dirt, dust, oil, grease, old paint, cooling lubricants etc.

3.2.2 Standard preparation grade

Table 1 shows the standard preparation grades as in DIN EN ISO 12944-4:1998-07.

Table 1 – Standard preparation grades

Standard preparation grade	Description
Sa 2½	Scale, rust and coats have been removed to such an extent that remainders on the steel surface are visible only as spots of slight shading due to the discolouring of pores.
Sa 3	Scale, rust and coats have been completely removed (when viewed without magnification).
St 3	Loose coats or scale have been removed; rust has been removed to such an extent that, after subsequent cleaning, the steel surface shows a clear lustre given by the metal.
Be	Remainders of coats, scale and rust have been completely removed; preparation grade Be corresponds to preparation grade Sa 3.

3.2.3 Derusting by blasting

For blasting, the following metallic chill-cast cleaning abrasive with sharp-edged grain is used:

Blast cleaning abrasive M/CI/G70 as in ISO 11124-2:1997-06

When this blast cleaning abrasive is used, the specified average roughness of R_a 12,5 µm shall not be exceeded.
When the parts are exposed to normal corrosion attack, the required preparation grade is Sa 2½ according to Table 1. When the parts are exposed to very heavy corrosion attack and when they are important for the functioning of the machine, the required preparation grade is Sa 3 according to Table 1.

3.2.4 Derusting by pickling

For small parts, pickling (e. g. in a phosphoric acid bath) can be used instead of blasting to remove rust and to prepare the surface. In this case the required preparation grade is Be according to Table 1.

3.2.5 Manual derusting

Preparation grade St 3 according to Table 1 is required for machine components which cannot be blasted due to their sizes or weights, e. g. mill housings.

3.3 Coating

3.3.1 Prime coat

After the preparation of the steel surface, the prime coat shall be applied within 6 hours to avoid new formation of rust.

When the surface is prepared by pickling in a phosphoric acid bath, the prime coat shall be applied not earlier than after 48 hours to avoid chemical changes of the prime coat.

The weld area shall be thoroughly cleaned to remove the alkaline or acid constituents of the filler metals and to avoid their destructive effects.

The prime coat shall always be applied before the components are machined.

Prime coats and their properties are stated in Table 2. The standard colours for the prime coats are listed in Table 5. This prime coat prevents the penetration of cooling lubricants during machining.

Depending on the degree of damage to the prime coat caused by finish-machining or welding, the prime coat shall either be repaired or newly applied.
Areas which are not accessible after assembling shall be provided with prime and top coats prior to final assembling.

Table 2 – Prime coats

Type of prime coat	Standard preparation grade	Layer thickness (µm)	Temperature-resistant up to max. (°C)	Max. durability [a] (in months)		Note	Specification in manufacturing documents
				Indoor storage	Outdoor storage		
SMS group standard [d] Water-soluble low-solvent universal coat on alkyd-hybrid system basis with zinc phosphate, free of lead and chromate.	Sa 2 ½ or Be	40 to 50	120	21	9	All machine and structural steel components, pipe lines and tanks in steel. Follow-up and Morgoil spare parts.	No
Heat-resistant Silicate zinc dust paint, moisture hardening	Sa 2 ½ or Be	70 to 75	400	24	12	Machines or machine parts exposed to elevated temperatures.	Yes
Chemical-resistant [b] Two-component epoxy resin primer with zinc phosphate	Sa 2 ½ or Be	40 to 50	150 [c]	21	9	Machines or machine parts which are exposed to fumes or splashes of chemicals	Yes
	It is recommended using stainless and acid-resistant steel for tanks.						
Oil-resistan **External coat** Same as SMS group standard prime coat.	Sa 2 ½ or Be	40 to 50	120	21	9	All machines.	No
Internal coat Two-component epoxy-resin primer	Sa 3 or Be	40 to 50	150 [c]	21	9	E. g. gear housings and gear internals such as welded gear wheels and oil flingers.	Yes

[a] Indoor storage = closed building without temperature control
Outdoor storage = open-air storage under tarpaulin or roof
} refer to SN 200-9:2010 Approved storage classes

[b] The exact composition of the chemical shall be indicated on the drawing.

[c] No permanent exposure.

[d] Manufacturers who are not bound by Directive 1999/13/EC can also use coats which contain solvents. All other instructions/regulations concerning inadmissible hazardous materials given in Part 1 are fully valid and shall be complied with.

3.3.2 Delivery and intermediate coats

The delivery coat is required only if the cover coat is to be applied after site installation. The intermediate coat is needed only on machines or machine parts which are exposed to fumes and splashes of chemicals.
The intermediate coat shall be applied after completion of workshop assembly or functional or acceptance inspection, immediately before the application of the cover coat.
Delivery coats, intermediate coats and their properties are listed in Table 3, standard colours, in Table 5.

Table 3 – Delivery and intermediate coats

Types of delivery and intermediate coats	Layer thickness (µm)	Temperature-resistant up to max. (°C)	Max. durability [a] (in months)		Note	Specification in manufacturing documents
			Indoor storage	Outdoor storage		
Delivery coat Same as SMS group standard prime coat.	40 to 50	120	36	18	Cover coat after site installation. To be specified through shop order or interoffice letter.	No
Intermediate coat Two-component epoxy-resin with zinc phosphate and iron mica.	40 to 50	150 [b]	36	18	Machines or machine parts which are exposed to fumes or splashes of chemicals	Yes

[a] Indoor storage = closed building without temperature control
Outdoor storage = open-air storage under tarpaulin or roof
} refer to SN 200-9:2010 Approved storage classes

[b] No permanent exposure.

3.3.3 Cover coat

Cover coats and their properties are listed in Table 4, the standard colours for the cover coats, in Table 5.
As a rule, the cover coat shall be applied only after proper application of the coats stated in Tables 2 and 3 and after completion of assembling or functional or acceptance testing of the machine. Areas which are not accessible after assembling shall be provided with prime and top coats prior to the final assembling.

Table 4 – Cover coats

Type of cover coat	Layer thickness (µm)	Temperature-resistant up to max. (°C)	Max. durability [a] (in months)			Note	Specification in manufacturing documents
			Indoor storage	Outdoor storage	Outdoor installation		
SMS group standard [d] Water-soluble low-solvent universal cover coat on alkyd-hybrid system basis, free of lead and chromate.	40 to 50	120	36	18	18	All machines and structural steel components, pipe lines and tanks in steel.	No
Heat-resistant Silicone bronze paint	15 to 20	400	36	18	18	Machines or machine parts exposed to elevated temperatures.	Yes
Chemical-resistant [b] Two-component epoxy-resin coating compound	40 to 50	150 [c]	29	24	-	Machines or machine parts which are exposed to fumes or splashes of chemicals.	Yes
Oil-resistant							
External coat Same as SMS group standard cover coat.	40 to 50	120	36	18	-	All machines.	No
Internal coat Two-component epoxy-resin cover coat	40 to 50	150 [c]	36	18	-	E. g. gear housings and gear internals such as welded gear wheels and oil flingers, etc.	Yes

[a] Indoor storage = closed building without temperature control
Outdoor storage = open-air storage under tarpaulin or roof
} refer to SN 200-9:2010 Approved storage classes
Outdoor installation = installation of equipment components in outside areas without protection

[b] The exact composition of the chemical shall be indicated on the drawing.

[c] No permanent exposure.

[d] Manufacturers who are not bound by Directive 1999/13/EC can also use coats which contain solvents. All other instructions/regulations concerning inadmissible hazardous materials given in Part 1 are fully valid and shall be complied with.

3.3.4 Standard colours for coats

The SMS group standard colours for coats are listed in Table 5. Other colours are available and will be indicated in the manufacturing documents.

Table 5 – Standard colours

Application	Colour	Specification in manufacturing documents
SMS group standard prime coat	Grey, similar to RAL 7005	No
Heat-resistant prime coat	Grey, similar to RAL 7037	Yes
Chemical-resistant prime coat	Reddish brown, similar to RAL 3009	Yes
Oil-resistant external prime coat	Grey, similar to RAL 7005	No
Oil-resistant internal prime coat	Reddish brown, similar to RAL 3011	Yes
Delivery coat	Olive grey, similar to RAL 7002	No
Intermediate coat	Reddish brown, similar to RAL 3009	Yes
SMS group standard cover coat	Green, similar to RAL 6011	No
Heat-resistant cover coat	White aluminium, similar to RAL 9006	Yes
Chemical-resistant cover coat	Green, similar to RAL 6011	Yes
Oil-resistant external cover coat	Green, similar to RAL 6011	No
Oil-resistant internal cover coat	Ivory, RAL 1014	Yes
Rotating parts in the danger zone	Yellow/black marking DIN 4844-1:2005-05 RAL 1004 / RAL 9005	Yes
Cover plates (bulb or checker plate)	Jet black RAL 9005	No
Cover plates (antislip coated) Anti-slip coat for smooth plates, e. g. 3M Safety-Walk Extra Stark (extra strong), anti-slip coat for bulb plates, e. g. 3M Safety-Walk Verformbar (deformable), slip blocking grade: R13, standard preparation grade Sa 2 ½.	Jet black RAL 9005	Yes
SMS Siemag company nameplate **Base plate** **Company name** **Bar**	Traffic white RAL 9016 Jet black RAL 9005 Traffic red RAL 3020	No
SMS Meer company nameplate **Base plate** **Company name** **Bar**	Signal white RAL 9003 Jet black RAL 9005 Sky blue RAL 5015	No
Guard rail	Yellow RAL 1004	No
Purchased parts	Maker's standard colour	No
Hydraulic cabinets, servo boxes or other hydraulic units with internal coat	Cream RAL 9001	No

3.3.5 Coating of follow-up and Morgoil spare parts

Follow-up spare parts are spare parts which are not part of the original equipment delivery. Unless otherwise specified in the manufacturing documents, follow-up and Morgoil spare parts are provided only with the SMS group standard prime coat according to Table 2. Machined functional surfaces shall be preserved as specified in item 3.4.

3.3.6 Emulsion-resistant coat

Data on prime and cover coats and their properties with regard to emulsion resistance depend on the respective emulsion. Generally valid specifications cannot be given here. Checks and specifications shall be made for every individual case. A drawing indication is required.

3.4 Preservation

Preserving compounds and their properties are specified in Table 6.

Surfaces without prime, delivery or cover coat shall be provided with preservative compound only after assembling or functional/acceptance testing of the machine has been completed.
To avoid formation of rust under the coat, the surfaces shall be dry before the preserving compound is applied.

Table 6 – Preserving compounds

Type of preservation	Standard preparation grade [b]	Layer thickness (µm)	Max. durability [a] (in months)		Note	Specification in manufacturing documents
			Indoor storage	Outdoor storage		
Preservation of external surfaces **Tectyl 846**	Sa 3	50	36	12	For metallically bright surfaces; can be removed with solvent.	No
Preservation of internal surfaces **Tectyl 502 – C**	Sa 3	40	24	3	For metallically bright surfaces, gear internals; dissolves during the test run.	No
Tectyl 511 – M	Sa 3	15	18	-	For intermediate storage and transports of short duration.	
Renolin MRX 46	Sa 3	-	24	-	For hydraulic units. Oil/preserving oil for functional testing.	No
Preservation of Morgoil bearings **95 % Tectyl 502 - C** **5 % Tectyl 511 - M**	Sa 3	70	36	6	Morgoil bearings (dip preservation)	No

[a] Indoor storage = closed building without temperature control
Outdoor storage = open-air storage under tarpaulin or roof
} refer to SN 200-9:2010 Approved storage classes

[b] The indication of Sa 3 with regard to preservation refers to the features of the preparation grades as in DIN EN ISO 12944-4:1998-07 and not to the rust removal method Sa (blast cleaning).

4 Coating and preserving of fluid-carrying components

4.1 Basic specifications

4.1.1 Pipes

Pipes are semi-finished products which have not undergone machining and are delivered to the site by the meter for further preparation for use as connecting lines.

4.1.2 Pipe lines

Pipe lines are prefabricated lines fastened to machines and consisting of pipes and pipe line components. This includes pipe lines delivered to the site in prefabricated condition. They are used to convey a fluid (cooling water, air, oil, etc.) from the point of provision (e. g. tank) to the point of consumption (e. g. cylinder).

4.1.3 Tank

A tank is a component for the provision of fluids in which pressure exists or may build up due to the manner of operation. Tanks are classified into unpressurised or vacuum tanks, and pressure tanks.

4.1.4 Protection during storage and transport

All pipes shall be clean and closed with caps as protection during transport. All pipe lines and all tank openings shall be cleaned after every work step and suitably closed for transport (e. g. flange connections with steel plate and soft packing, pipe caps, pipe plugs etc.) so that ingress of dirt is avoided.

4.2 Surface preparation

4.2.1 Steel pipes

Pipes up to and including an outside diameter of 273 mm shall be pickled, flushed and passivated. The required preparation grade is Be according to Table 1.
Pipes with outside diameters exceeding 273 mm shall be

- pickled, flushed, and passivated,
- sandblasted inside and outside,
- sandblasted only outside provided that the interior is free of scale, rust and other dirt.

Precision steel tubes according to DIN EN 10305-1 to 3:2010-05, DIN EN 10305-4:2003-10, DIN EN 10305-5:2010-05 and DIN EN 10305-6:2005-08 shall be left in the supplier's as-treated, delivery condition (bright annealed and oiled).

4.2.2 Pipes in stainless and acid-resistant steel

These pipes shall be delivered to the place of use in metallically bright pickled or descaled condition and without further treatment.

4.2.3 Pipe lines in steel

These pipe lines shall be pickled, flushed and passivated.
Pickling residues shall be removed by blowing off with compressed air. The required preparation grade is Be according to Table 1.
Pipe lines prepared with cutting ring fittings or similar methods, e. g. WALFORM (see SN 888), and which have not been welded or heat-treated, shall neither be pickled nor passivated.

4.2.4 Pipe lines in stainless and acid-resistant steel

These pipe lines shall be pickled, blasted or brushed to remove scale layers or annealing colours which may have formed and to ensure the formation of a passivation layer.
Scale and slag shall be completely removed, annealing colours are acceptable up to colour scale brown; refer to DIN 25410:2001-04, Annex A, annealing colours 1 and 2.

4.2.5 Pipe fasteners in steel

Depending on their quantity and condition, prefabricated fasteners and semi-finished products shall be pickled or steel shot blasted to preparation grade Sa 2½ according to Table 1.

4.2.6 Pipe fasteners in stainless and acid-resistant steel

Prefabricated fasteners which have neither been welded or heat treated, shall be pickled or brushed to remove scale layers or annealing colours which may have formed and to ensure the formation of a passivation layer.
Scale and slag shall be completely removed, annealing colours are acceptable up to colour scale brown; refer to DIN 25410:2001-04, Annex A, annealing colours 1 and 2.

4.2.7 Tanks in steel

Tanks shall be steel-shot blasted; the required preparation grades are Sa 3 for hydraulic tanks and Sa 2½ according to Table 1 for tanks of centralised and Morgoil lubrication systems, water, and compressed-air systems.

Tanks without manhole (small inspection opening) shall be pickled inside, flushed and passivated; the required preparation grade is Be according to Table 1.

4.2.8 Tanks in stainless and acid-resistant steel

These tanks shall be pickled or brushed to remove scale layers or annealing colours which may have formed and to ensure the formation of a passivation layer.

Scale and slag shall be completely removed, annealing colours are acceptable up to colour scale brown; refer to DIN 25410:2001-04, Annex A, annealing colours 1 and 2.

4.3 Coating and preserving

4.3.1 Steel pipes

After surface preparation, these pipes shall be provided with an SMS group standard prime coat according to Table 2, an internal coat shall not be applied. The standard colours for the prime coats are listed in Table 5.

4.3.2 Pipes in stainless and acid-resistant steel

These pipes shall be neither coated nor preserved.

4.3.3 Pipe lines in steel

These pipes shall be externally coated with the SMS group standard primer according to Table 2, an internal coat shall not be applied. The max. durability period is 18 months in case of indoor storage.
The standard colours for the prime coats are listed in Table 5.
When internal preservation is required, it shall be made with Tectyl 511-M according to Table 6 or equivalent products. Specification in the manufacturing documents is required. With internal preservation, the max. durability period is 36 months in case of indoor storage.

4.3.4 Pipe lines in stainless and acid-resistant steel

These pipes shall be neither coated nor preserved.

4.3.5 Pipe fasteners in steel

Pipe fasteners in steel shall be provided with an SMS group standard prime coat according to Table 2.
The standard colours for the prime coats are listed in Table 5.

4.3.6 Pipe fasteners in stainless and acid-resistant steel

These pipes shall be neither coated nor preserved.

4.3.7 Tanks in steel

They shall be externally coated with the SMS group standard primer according to Table 2.
The standard colours for the prime coats are listed in Table 5.
For internal coating, the products stated in Table 8 shall be used as appropriate for the intended use. Parts screw-fastened to or reaching into the tank shall not be coated but preserved with Tectyl 502-C according to Table 8 or equivalent products.
Tanks without manhole shall be rinsed with Inertol Poxitar. The max. durability period is 24 months in case of indoor storage.
After surface treatment, all openings shall be safely closed for transport.

Table 8 – Coating and preserving of tanks in steel

Internal coating and preserving compounds	Layer thickness (µm)	Note	Specification in manufacturing documents
Tarponal® (zinc-rich paint)	40 to 50 ca. 250 g/m^2	To be used for hydraulic systems.	Yes
Copaphen Aluminium	2 x 30 ca. 350 g/m^2	To be used for centralised oil and Morgoil lubrication systems.	Yes
Inertol Poxitar	3 x 80 ca. 1000 g/m^2	To be used for water and compressed-air systems.	Yes
Tectyl 502-C	40	To be used for all other tanks.	Yes

4.3.8 Tanks in stainless and acid-resistant steel

They shall be neither coated nor preserved.

5 Inspection

All suppliers are bound to present the prime coat on machines or machine components to SMS group before the cover coat is applied.

SMS group reserves the right to check compliance with the specified number of paint coats and layer thicknesses as well as their proper application.

The coating and preserving compounds, adhesives and sealing materials used shall be certified by presenting safety data sheets and technical specifications.

Referenced technical standards, codes and regulations

DIN 4844-1:2005-05	Graphical symbols; safety colours and safety signs; Part 1: Design principles for safety signs in workplaces and public areas
DIN 25410:2001-04	Nuclear facilities, surface cleanliness of components
DIN EN 10305-1:2010-05	Steel tubes for precision applications – Technical delivery conditions – Part 1: Seamless cold drawn tubes
DIN EN 10305-2:2010-05	Steel tubes for precision applications – Technical delivery conditions – Part 2: Welded cold drawn tubes
DIN EN 10305-3:2010-05	Steel tubes for precision applications – Technical delivery conditions – Part 3: Welded cold sized tubes
DIN EN 10305-4:2003-10	Steel tubes for precision applications – Technical delivery conditions - Part 4: Seamless cold drawn tubes for hydraulic and pneumatic power systems
DIN EN 10305-5: 2010-05	Steel tubes for precision applications – Technical delivery conditions – Part 5: Welded cold sized square and rectangular tubes
DIN EN 10305-6: 2005-08	Steel tubes for precision applications – Technical delivery conditions – Part 6: Welded cold drawn tubes for hydraulic and pneumatic power systems
DIN EN ISO 12944-4:1998-07	Paints and varnishes; Corrosion protection of steel structures by protective paint systems; Part 4: Types of surface and surface preparation
ISO 11124-2:1997-06	Preparation of steel substrates before application of paints and related products; Specifications for metallic blast-cleaning abrasives; Part 2: Chilled-iron grit
SN 200-9:2010	Manufacturing Instructions; Packaging
SN 227-1	Single anchor plates for T-head bolts of property class 5.6
SN 227-2	Double anchor plates for T-head bolts of property class 5.6
SN 227-3	Single anchor plates for T-head bolts of property class 8.8
SN 227-4	Double anchor plates for T-head bolts of property class 8.8
SN 888	WALFORM guideline for design and manufacture
Directive 1999/13/EC	Limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations

Revision of September 2010

Adaptation to SN 104.
Validity for SMS group.
Standards indicated with year and month.
2.2 Use of primer newly added.
3.3.1 Prime coat to be applied before machining.
Table 2: changed into low-solvent and water-soluble coats.
Acid-resistant replaced with chemical-resistant.
Table 3: changed into low-solvent and water-soluble coats.
Acid-resistant replaced with chemical-resistant.
Table 4: changed into low-solvent and water-soluble coats.
Acid-resistant replaced with chemical-resistant.
Table 5: Standard colours extended/added.
4.1.4 Adding of instruction that pipelines shall be suitably closed for transport.
Editorial revision.

SMS group

Manufacturing Instructions

Labeling and shipping

SN 200-8

ICS 55.020

Supersedes
SN 200-8:2007-02

Table of contents

1 Scope

The instructions given in this part are SMS Siemag-specific and describe the labeling of components and assemblies in the course of manufacture and shipment. The instructions apply to parts which are handled in SAP and/or in the STOR system and when no other specifications are made on drawings or in other manufacturing documents. In other companies of the SMS group different instructions may be applicable.

Edited by:
SMS Siemag
Standards Office

2 Definitions of terms

2.1 Handling in SAP

The following terms are used for handling in the SAP system.

2.1.1 WBS element, WBS number

The WBS element (work breakdown structure element) in SAP defines a supply or service which has to be effected or rendered within the scope of a project. Figure 1 shows the composition of the WBS number at SMS Siemag as an example.

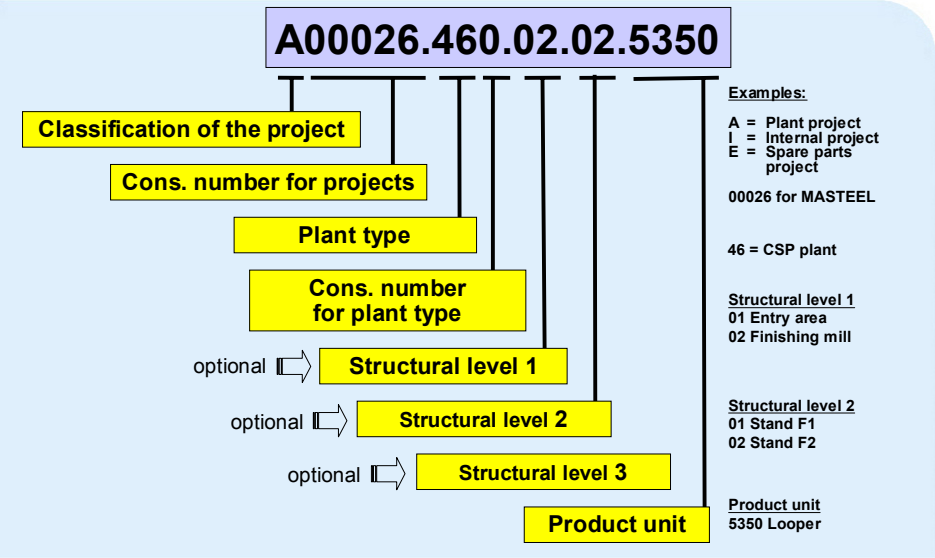

Fig. 1 – Example of a WBS number of the Hot/Cold Mill division

2.1.2 Material, material number

In SAP, material is used as generic term with the following meanings:
- Material number;
- material master;
- raw material, semi-finished products, finished goods;
- Synonym for drawing item, standardised item, catalogue item;
- component part, assembly, products.

The material number has eight (8) digits.
EXAMPLE: 10024213 socket head screw

2.1.3 Ident. No.

Ident. No. is an indication used for the identification of parts (e. g. document number, material number etc.).

2.1.4 Designation

Designation is the name of the shipping unit.

2.1.5 Quantity

Quantity is the numerical indication of the number of parts contained in the shipping unit.
Piece(s) as unit of quantity need not be indicated, for other units of quantity (e. g. set, meter, kg etc.), the indication is required.

2.1.6 Final package

Final package is a package which is ready for shipment **direct to the customer**.

2.1.7 Shipping unit

In SAP, a shipping unit (VE) is given a number which is the consecutive number of a unit in the scope of supply of loose parts or of an assembled unit. In a shipping unit (VE) only loose parts of a WBS (work breakdown structure) element can be combined.

2.1.8 Preliminary package

A preliminary package (VP) is a transport unit ready for shipment to the packaging company. The preliminary package (VP) consists of one or more shipping units (VE).

2.2 Handling in STOR

The following terms are used for handling in the STOR system.

2.2.1 Order number, project number

This number is used to split up the equipment on the basis of functional aspects from the equipment unit level (machine) to the sub-item level, see figure 2.

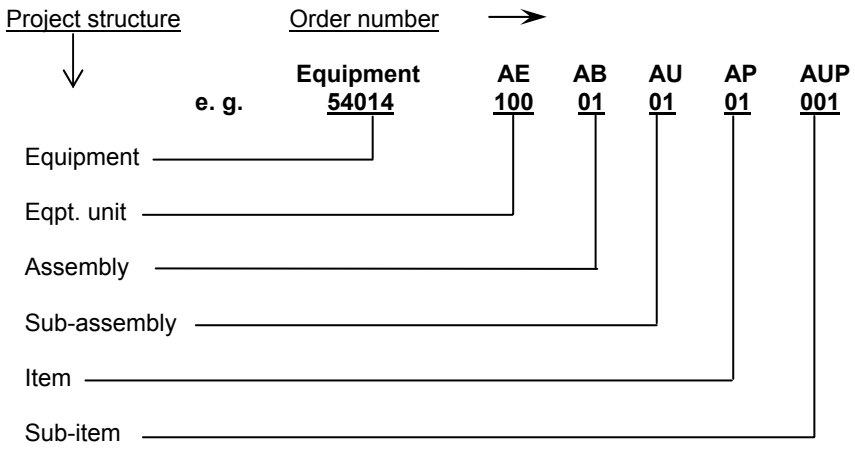

Fig. 2 – Project structure for handling in STOR

2.2.2 Ident. No.

Ident. No. is an indication used for the identification of parts (e. g. drawing number, material number etc.).

2.2.3 Designation

Designation is the name of the shipping unit.

2.2.4 Quantity

Quantity is the numerical indication of the number of parts contained in the shipping unit.
Piece(s) as unit of quantity need not be indicated, for other units of quantity (e. g. set, meter, kg etc.), the indication is required.

2.2.5 Final package

Final package is a package which is ready for shipment direct to the customer.

2.2.6 Shipping unit

In STOR, a shipping unit (VE) is given a number which is the consecutive number of a unit in the scope of supply of loose parts or of an assembled unit. In a shipping unit (VE) only loose parts of an order item (VP) can be combined.

2.2.7 Preliminary package

A preliminary package (VP) is a transport unit ready for shipment to the packaging company. The preliminary package (VP) consists of one or more shipping units.

3 Reporting of shipping units and packages by the supplier

3.1 Handling in SAP

The following instructions concerning the reporting of shipping units (VE) and packages by the supplier shall be observed for handling in SAP.

3.1.1 Items of SMS Siemag design

Shipping units and packages containing items of SMS Siemag design shall be reported by suppliers only with the table made available by SMS Siemag as this table can be read by our data processing systems. The shipment labels provided shall be attached to the respective shipping units (VE).

3.1.1.1 Reporting of the shipping units

The report of the shipping units shows the assignment of the project items to the shipping units (VE), see example in Annex A (normative).

3.1.1.2 Reporting of the package data

The report of the package data shows the assignment of the shipping units (VE) to the packages. These data are used as basis for the SMS Siemag delivery note, see example in Annex B (normative) with bill of materials, and in Annex C (normative) without bill of materials.

3.1.2 Items of foreign design

Shipping units (VE) and packages containing items of foreign design shall be reported by the suppliers only with the MS-Excel table made available by SMS Siemag as this table can be read by our data processing systems.
Further proceeding is like that described in 3.1 but here only blank forms can be made available as the supplier is responsible for compiling the bill of materials For this reason the supplier shall report only the contents of his packages; component parts to be supplied by him shall be specified in detail.

3.1.3 Shipment labels

Shipment labels are stickers which contain specific data of the shipping unit (VE). Figure 3 shows the data on a shipment label as an example. For shipment the labels shall be sticked on punched plastic supports and attached to the shipping units (VE) with non-rotting pack threads or zinc-coated tying wires. The labels shall never be sticked on the shipping units (VE).

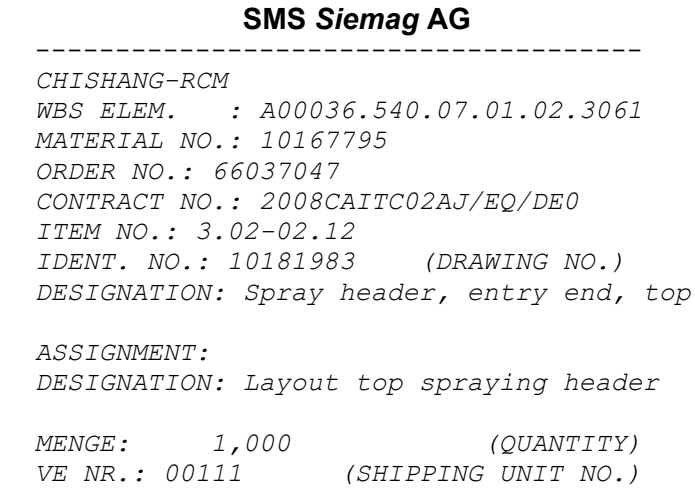

Fig. 3 – Example of a shipment label used for handling in SAP

3.2 Handling in STOR

The following instructions concerning the reporting of shipping units (VE) and packages by the supplier shall be observed for handling in STOR.

3.2.1 Items of SMS Siemag design

Shipping units (VE) and packages containing items of SMS Siemag design shall be reported by suppliers only with the table made available by SMS Siemag as this table can be read by our data processing systems. The shipment labels provided shall be attached to the respective shipping units (VE).

3.2.1.1 Reporting of the shipping units

The report of the shipping units (VE) shows the assignment of the project items to the shipping units (VE), see example in Annex D (normative).

3.2.1.2 Reporting of the package data

The report of the package data shows the assignment of the shipping units (VE) to the packages. These data are used as basis for the SMS Siemag delivery note, see example in Annex E (normative).

3.2.2 Items of foreign design

Shipping units (VE) and packages containing items of foreign design shall be reported by the suppliers only with the MS-Excel table made available by SMS Siemag as this table can be read by our data processing systems.
Further proceeding is like that described in 3.2 but here only blank forms can be made available as the supplier is responsible for compiling the bill of materials For this reason the supplier shall report only the contents of his packages; component parts to be supplied by him shall be specified in detail.

3.2.3 Shipment labels

Shipment labels are stickers which contain specific data of the shipping unit (VE). Figure 4 shows the data on a shipment label as an example. For shipment the labels shall be sticked on punched plastic supports and attached to the shipping units (VE) with non-rotting pack threads or zinc-coated tying wires. The labels shall never be sticked on the shipping units (VE).

SMS *Siemag AG*

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AUFTRAGS-NR.: 37017635 10 10 01
ORDER NO.:
CONTRACT NO.:
ITEM NO.:  2.30.07.05
CONSIGNEE:
IDENT. NO.: 21163752     (DRAWING NO.)

BENENNUNG:   Motorgrundrahmen

DESIGNATION: MOTOR BASE - TOP PINCH ROLL

MENGE:     1,000            (QUANTITY)
VE NR.: 00230      (SHIPPING UNIT NO.)
```

Fig. 4 – Example of a shipment label used for handling in STOR

4 Marking of components during the manufacturing process

4.1 Basic specifications

Components of in-house and external manufacture shall be marked by the manufacturing shops/departments as specified in passages 4.2 and 4.3. The marking is required to ensure that materials can be found and traced back, and assigned to working papers and quality documents.

4.2 WBS number or order number

Parts passed to the manufacturing shop via the incoming goods or material provision department shall be marked with the full WBS number or order number using a wiping-proof white or yellow tube colour marker. When the marking is removed because of further processing, the responsible employee is obliged to apply the marking in another accessible place before the existing marking is removed.

4.3 Serial number

Parts which require marking are given a 6-digit serial number by the SMS Siemag department of quality assurance. In in-house manufacture, this number is passed on in the working papers, in external manufacture, it is indicated in the ordering documents.
For parts which require marking, the necessity of marking is indicated on the drawings and in ordering documents and working papers. A serial number assigned to every component one time ensures that this part can be traced back through all manufacturing processes. The serial number shall be stated in all quality documents.

4.3.1 Stamping of the serial number

The supplier of the raw material shall stamp the serial number on the material in the place indicated on the drawing using stamping figures of at least 8 mm in height. Stamping shall be applied in such a way that the number is not removed by subsequent processes like annealing or sandblasting and remains fully legible. The stamped serial number shall be marked by drawing a coloured frame around it using a tube colour marker.

4.3.2 Re-stamping of the serial number

If the serial number is removed or becomes illegible because of processing steps during production (machining, welding, assembling etc.), the employee charged with the processing step shall ensure maintenance of the serial number by re-stamping it in the same or in a different place.

4.3.3 Finish-stamping of the serial number

When manufacture of the component requiring marking has been completed, the serial number shall be finish-stamped in the place specified on the drawing using stamping figures of at least 8 mm in height. The stamped serial number shall be marked by drawing a coloured frame around it using a tube colour marker.
In in-house manufacture, finish-stamping shall be carried out by the assembly workshop, in external manufacture, by the supplier.

Revision of September 2010

Layout adapted to SN 104.
Validity for SMS group.
Instructions for SAP added.
Section 4: Chapter on "Marking of components during the manufacturing process" added,
Editorial revision.

Annex A (normative) **Example of a report of the shipping units for handling in SAP with SMS Siemag bill of materials**

Company				**1000**			**SMS Siemag AG**															
WBS element				**A00011.580.10.02.30.3001**			**Utility system, pup coil handling**															
BOM header material				**10106295**			**Manifold-type valve stand**															
Procedure No.				**0000000083**																		
Language 1				**DE**																		
Language 2				**EN**																		
Order number				**4500000021**																		
Order confirmation No.																						
Supplier				**0005960190**			**G. Wurth GmbH**															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
SMS Siemag material No.	**Quantity/unit**	**Total quantity**	**QU**	**Weight/unit**	**Total weight**	**Designation**	**Level**	**Assembly**	**Item**	**Addit. information 1st language**	**Addit. information 2nd language**	**S (Status)**	**Bill of materials**	**Nodes**	**Counter**	**StlNr FS (BOM No. FS)**	**VE No.(loose)**	**Quantity VE(loose)**	**Assembled shipping units**	**Qty VE (assembl.)**	**Qty VE (assembl.)**	**Qty VE (assembl.)**
																			VE No. (assembled) ->	1		
10106295	1	1	ST	957,204	957,204	Manifold-type valve stand	0	X	0000			P	00011815	00000000	00000000	00011815						
10095662	1	1	ST	144,200	144,200	Valve block V cpl.	.1	X	0001			P	00011815	00000001	00000002	00011816				1		
10095615	1	1	ST	134,300	134,300	Valve block 118	..2		0001			P	00011816	00000001	00000002					1,000		
10001453	3	3	ST	0,075	0,225	Threaded coupling	..2		0003			P	00011816	00000002	00000004		2-3	1,000		1		
10004422	1	1	ST	0,045	0,045	Plug screw	..2		0004			P	00011816	00000003	00000006					1		
10004418	2	2	ST	0,018	0,036	Plug screw	..2		0005			P	00011816	00000004	00000008					2		
10004424	1	1	ST	0,078	0,078	Plug screw	..2		0006			P	00011816	00000005	00000010					1		

Columns

1 - 10 Already completed in form sheet

11, 12 For additional information on the shipping units (VE); optional

13 - 17 Already completed in form sheet

18 For consecutive numbering of the loose (unassembled) parts. Indication of shipping unit (VE) numbers possible in the input field in the form 1;2 or 1-3.

19 States the number of unassembled and assembled shipping units (VE).

20 Separates data on unassembled and assembled shipping units

21 ff Here the numbers of the assembled shipping units (VE) shall be entered as "column headings" in line 12 and the quantities of the parts assembled in the respective VE shall be stated in the columns. Indication of shipping unit (VE) numbers in the form 1;2 or 1-3 is possible in the input field (line 12).

Shipping unit unassembled/assembled Permissible characters 0-9; in series or enumerations the operators " - ", " ; " are allowed, spaces are ignored.

Quantity VE (shipping units) Permissible characters 0-9; for the QU "piece(s)" only whole numbers shall be indicated, other QU, with 3 decimal places.

Annex B (normative) **Example of a report of the packages for handling in SAP with SMS Siemag bill of materials**

Plant	**1000**	**SMS Siemag AG**					
WBS element	**A00011.580.10.02.30.3001**			**Utility system, pup coil handling**			
BOM header material	**10106295**			**Manifold-type valve stand**			
Procedure No.	**0000000083**						
Language 1	**DE**						
Language 2	**EN**						
Purchase order number	**4500000021**						
Order confirmation No.							
Supplier	**0005960190**			**G. Wurth GmbH**			
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Shipping unit (supplier)	**SMS Siemag material**	**Designation in 1st language**	**Package No.**	**Kind of package**	**Dimensions (LxWxH), in cm:**	**Net weight (kg)**	**Gross weight (kg)**
1		Info (optional)	1	KI	100,5x 100x 100	100,000	111,000
2		Info (optional)	2	KA	10,25x 11,25x 12,25	20,000	25,000
3		Info (optional)	2				

Columns

1 Please indicate here the shipping unit number you have assigned to the item in the Reporting of the shipping units.
2 This column is not relevant for suppliers.
3 Additional information on the package (optional)
4 Please indicate a consecutive package number in this column.
5 Please indicate here the type of package (abbreviation).
Permissible abbreviations of the kinds of packages: BD = bottom; BDEG = bottom structure, welded in; BR = letter, BU = bundle; HOB = hobbock; KA = cardbox, KHK = squared timber structure; KI = case; KO = chest; KUB = bucket; PA = pallet; PAK = pallet-type cardbox; RO = roll, SA = sack; SCHL = sledge; TR = drum; UV = unpacked; VE = crate.

6 } Please enter here the sizes (in cm) and weights (in kg) of your packages.
7 } Permissible characters 0-9; x --> serves as separator between length, width and height, spaces are ignored.
8 } Permissible characters 0-9; the basic unit of quantity for lengths is always centimeter (cm).

Annex C (normative) **Example of a report of the packages for handling in SAP without SMS Siemag bill of materials**

Plant	**1000**				**SMS Siemag AG**							
WBS element			**A00010.332.01.23.01.0100**			**Segment 1**						
BOM header material			**10081309**			**Roller bridge, loose side**						
Procedure No.			**0000000078**									
Language 1			**DE**									
Language 2			**EN**									
Purchase order number			**4500000018**									
Order confirmation No.												
Supplier			**0005960190**			**G. Wurth GmbH**						
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Shipping unit (supplier)	**Shipping unit (SMS Siemag)**	**Qty.**	**QU**	**Designation in 1st language**	**Additional information in 1st language**	**Designation in 2nd language**	**Addit. inform. in 2nd language**	**Package No.**	**Kind of package**	**Dimensions (LxWxH) in cm**	**Net weight (kg)**	**Gross weight (kg)**
1		1,000	ST	Material 01	Additional data 01	Part 01	Add. data 01	1	KI	100x300x100	200,000	250,000
2		5,000	M	Material 02	Additional data 02	Part 02	Add. data 02	1				
4		4,000	M	Material 04	Additional data 04	Part 04	Add. data 04	2	KA	50x50x50	100,000	110,000

Columns

1 Please indicate here the shipping unit number you have assigned to the item in the Reporting of the shipping units.
2 This column is not relevant for suppliers.
3 Indicate the quantity contained in the shipping unit (VE).
4 Indicate the basic unit of quantity. Permissible units of quantity: ST = piece; M = meter; M2 = square meter; L = liter; KG = kilogram.
Please note that only whole numbers shall be indicated for the basic unit of quantity in column 3 (Qty.).
5 Please enter the designation of the shipping unit (VE) in this column.
6, 7,8 For additional information on the shipping unit; optional.
9 Please indicate a consecutive package number in this column.
10 Please indicate here the type of package (abbreviation).
Permissible abbreviations of the kinds of packages: BF = bottom; BDEG = bottom structure, welded in; BR = letter, BU = bundle; CO = container; EP = euro-pallet; FA = barrel; GB = skeleton container; HOB = hobbock; KA = cardbox; KHK = squared timber structure; KI = case; KO = chest; KUB = bucket; PA = pallet; PAK = pallet-type cardbox; RO = roll; SA = sack; SCHL = sledge; TR = drum; UV = unpacked; VE = crate.

11
12
13 } Please enter here the sizes (in cm) and weights (in kg) of your packages.

Annex D (normative) **Example of the reporting of the shipping units for handling in STOR**

Purchase order No. 1928888.001 K **Reporting of the shipping units**

1	2	3	4	5	6	7	7a	8	9	11	12	13	14	15	16	17	18
Project No.	AB	AU	AP	AUP	Ident. No.	Qty.	Unit of quantity	Weight in kg	Designation (German)	Unassembled shipping units		Assembled shipping units					
										No.	Quantity	4					
46015239	71	9	4		20405338	1	Piece	208	Ladder with safety cage			1					
46015239	71	9	4	1	M9052547	2	Meter	72	Tube DIN 2448 - 48,3 x 3,6 mm			2					
46015239	71	9	4	2	M9722894	31	Meter	38	Square DIN 1014 20			31					
46015239	71	9	4	3	M9021028	5	Meter	17	Flat steel bar DIN 1017 50 x 5			5					
46015239	71	9	4	4	M9021028	7	Meter	79	Flat steel bar DIN 1017 50 x 5			7					
46015239	71	9	4	5	M9040109	2	m²	0	Plate EN 10029 5			2					
46015239	71	9	5		M9030026	10	Meter	27	Angle bar 50 x 50 x 5	1	10						
46015239	71	9	6		20405337	2	Piece	3	Ladder base	2	2						
46015239	71	9	7		46015239710907	4	Stück	0	Upat-UKA3 anchor bolt M16	3	4						

Columns

1
2
3
4
5
6
7
7a
8
9
} These columns are already completed in our form.

11 In this column the unassembled (loose) parts shall be indicated with consecutive numbers; assembled units shall be indicated in columns 13 to 18.

12 This column shows the parts which are shipped unassembled.

13
14
15
16
17
18
} Here the numbers of the assembled shipping units (VE) shall be entered as "column headings" and the quantities of the parts assembled in the respective VE shall be stated in the columns.

Annex E (normative) **Example of the reporting of the packages for handling in STOR**

Purchase order No. 1928888.001 K **Reporting of the package data**

1	2	3	4	5	6	7	8	9	9a	10	13	14	15	16	17
Supplier VE No.	**SMS Siemag VE No.**	**Project No.**	**AB**	**AU**	**AP**	**AUP**	**Ident. No.**	**Qty.**	**Unit of quantity**	**Designation (German)**	**Package No.**	**Kind of package**	**Dimensions (LxWxH) in cm**	**Weight in kg NET**	**Weight in kg GROSS**
1		46015239	71	9	5		M9030026	10	Meter	Angle bar	1	U	5x220x600	27	27
2		46015239	71	9	6		20405337	2	Piece	Ladder base	2	KA	20x20x2	4	6
3		46015239	71	9	7		M9030025	4	Piece	Upat-UKA3 anchor bolt M16	2				
4		46015239	71	9	4		20405338	1	Piece	Ladder with safety cage	3	U	913x71x68	208	208

Columns

1 Please indicate here the shipping unit number you have assigned to the item in the Reporting of the shipping units.

2 This column is not relevant for suppliers.

3, 4, 5, 6, 7, 8, 9, 9a: These columns need not be filled in, the data can be taken from the Reporting of the shipping units (VE).

10 Please enter the designation of the shipping unit (VE) in this column. This is of particular importance for assembled shipping units (VE) as their designations may differ from those in our bill of materials.

13 Please indicate a consecutive package number in this column.

11 Please indicate here the type of package. (e. g. B = bundle; CO = container; EP = euro-pallet; EW = disposable pallet; FA = barrel; GB = skeleton container; KA = cardbox; KH = squared timber structure; KI = case; U = unpacked; VS = crate)

15, 16, 17: Please enter here the sizes (in cm) and weights (in kg) of your packages.

SMS group

Manufacturing Instructions

Packing

SN 200-9

ICS 55.020

Supersedes
SN 200-9:2007-02

Table of contents

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SMS Siemag
Standards Office

1 Scope

The requirements specified below apply to packing and transport of products and materials of SMS group unless other requirements are specified in design, ordering or manufacturing documents.

2 Packaging categories

2.1 Category 1 - Case packaging

Case made of solid wood, plywood and OSB3 boards (Oriented Strand Boards), goods heat-sealed in aluminium sandwich film (acc. to BWB TL 8135-0003:2000-07 or equivalent film) with addition of appropriate desiccant.

Goods: Corrosion-sensitive machine-building and electric materials, prefabricated pipe lines.
Guaranteed durability: 24 months.

* BWB means Bundesamt für Wehrtechnik und Beschaffung (Federal Office for Defence Technology and Procurement)

2.2 Category 2 - Case packaging

Case as in 2.1 but with the use of padding elements as appropriate for the sensitivity of the goods, case-in-case packaging. The g values shall be specified.

Goods: Highly sensitive electrical and control components.
Guaranteed durability: 24 months.

2.3 Category 3 – Case packaging

Case as in 2.1 but goods sealed in 0,2 mm PE film (BWB TL 8135-0019:2009-06 or equivalent film).

Goods: As in 2.1.
Guaranteed durability: 12 months.

2.4 Category 4 – Case packaging

Case as in 2.1 without sealing of goods but with gilled plates when the top section of the case is provided with plywood and OSB3 board cladding.

Goods: Shock and corrosion resistant units (simple machine components, pins, parts for pipe lines such as welding fittings, threaded fittings).
Guaranteed durability: 24 months.

2.5 Category 5 - Crate

Goods: Components insensitive to corrosion and to the usual mechanical effects occurring during transport; all types of vessels.

2.6 Category 6 - Bundle

Goods > 100 mm for pipes sold by the meter, structures/racks which do not need protection against the usual mechanical effects and have been combined only for the purpose of forming a loading unit.
< 100 mm in crates of category 5 but with closed end side.

2.7 Category 7 - Sledge

Goods: Robust corrosion-resistant components whose dimensions exceed the usual loading gauges.

2.8 Category 8 - Cladding, including cable drums

Goods: Parts whose dimensions and weights exceed the usual loading gauges. For components which are insensitive to corrosion and mechanical effects of transport, only the machined surfaces are protected by cladding.

2.9 Category 9 - Dangerous goods packaging

Goods:	Dangerous goods as in	Dangerous Goods Ordinance Sea	for transport by sea
		Dangerous Goods Ordinance Road and Rail	for road and rail transport
		IATA-DGR	transport by air

2.10 Category 10 - Unpacked goods

Goods: Components which do not need particular protection during transport.

2.11 Category 11 - Transport packaging

The transport packaging gives no durability guarantee for storage.

Goods: Parts for intermediate shipment (to subsuppliers, machining workshops, central packers).
These parts shall be protected against climatic and mechanical influences during transport.

2.12 Category 12 - Container packaging, packing on load-bearing transport bottoms

Goods heat-sealed in aluminium sandwich film (BWB TL 8135-0003:2000-07 or equivalent film) with addition of appropriate desiccant.

Goods As in 2.1.

Guaranteed durability: 6 months.

2.13 Category 13 - Add-on packaging

Goods: Components which are loaded with the loading gear attached to the goods.

2.14 Category 14 - Tarpaulin packaging

Goods: Machine components without electrical components

2.15 Category 15 - Special packaging

Goods: Heavy goods (package which requires a special bottom structure with steel girders).

3 Quality and strength of the packaging materials

3.1 Basic specifications

Specific requirements of the buyer's country concerning type and nature of the materials are defined in the applicable version of the Consular and Standard Regulations of the Hamburg Chamber of Commerce (K und M).

3.2 Packages of categories 1 to 8 and 11 to 13

For load-bearing structural parts, coniferous timber as in DIN 4074-1:2008-12 - S 10 - TA/FI (pine/fir) – dry – shall be used.
For non-load-bearing structural elements inside the barrier enclosures of cases, the use of timber as in DIN 4074-1:2008-12 - S 7 -TA/FI (pine/fir) - dry is allowed in due consideration of Table 1.

Table 1 – Supplements to DIN 4074-1:2008-12

	Grading class S 10	**Grading class S 7**
Max. size of resin galls	l = 5,0 cm b = 0,5 cm	l = 10 cm b = 1 cm
Min. specific gravity	0,45 to 0,50 kg/dm^3	0,45 to 0,50 kg/dm^3

The following material is allowed for surface cladding according to Annex B (normative):
- wood according to DIN 4074-1:2008-12:2008-12-S7-TA/FI - semi-dry;
- plywood according to DIN 68705-3:1981-12 -BFU 100, min. thickness 12 mm;
- plywood of the type APA RATED SHEATHING and type APA RATED STURD-I FLOOR, bonding method EXTERIOR; minimum thickness 12 mm, vertical fibre orientation, for all case type classes.
  For case type 1 (see Annex D.1), a minimum thickness of 9 mm is also permitted.
- OSB3 boards according to DIN EN 300:2006-09, minimum thickness 12 mm, only for case types 1 to 3.

3.3 Packages of category 9

Only type-tested cases and containers as in RM 001:1985-06 shall be used.

4 Design of packages

4.1 Basic specifications

For packages exceeding one of the following values:

Length = 1190 cm, width = 240 cm, height = 240 cm, weight = 20,000 kg,

the packer shall, upon request, draw up transport/packing sketches and hand them over to SMS group before packing starts.

For air freight, the maximum package dimensions shall be agreed upon with SMS group in each individual case.

4.1.1 Strength values

For strength values and design features according to DIN 1052:2008-12, see Annex A, Tables A.1 and A.2.

4.1.2 Stress assumptions

For stress assumptions like drop heights and acceleration during transport, as in strength calculations for wooden packages used in the shipping of heavy-goods (RGV), see section 5, Fixation of goods, Table 4.

4.1.3 Diagonal bracing

For diagonal bracing of the batten frames, see Annex D, figure D.7.

4.1.4 Case type

The case type specifies the construction of a case. The following types of cases shall be used:

Case type 1 - OSB3 boards/plywood, see Annex D, figures D.1 to D.3 and D.8.

Case type 2 - Sawn timber cladding, see Annex D, figures D.4 to D.7 and D.8.

Case type 3 - Cases with circumferential battens, see Annex D, figure D.12.

4.1.5 Case type class

Cases are assigned to type classes according to the weights to be packed, see Table 2.
Details are specified in Annex B, Tables B.1 to B.7 and Annex C, Table C.1.

Table 2 – Case type classes

Net weight in kg	Case type class
500 to 1500	1
1 500 to 5000	2
> 5000 to 10 000	3
> 10 000 to 25 000	4
>25 000 to 50 000	5
> 50 000	6

4.1.6 Nailing

Nailing shall be made as specified in DIN 1052:2008-12.
For the nailing of wooden battens, refer to Annex D, figure D.11.

4.1.7 Classes of wood

Use shall be made of wood of the wood classes according to item 3.2.

4.1.8 Nailing of end-grained wood

Nailing of end-grained wood shall be applied only for fixing the components of a case.

4.2 Cases of packaging categories 1 to 4 and 13

The cases shall be designed in such a way that

- they have at least two entry openings for the forklift;
- the cases and crates can be stacked in conventional loading up to a stacking impact pressure of 10 kN/m^2;
- cases of 5 t and more are provided with heavy-lift corners at the rope sling points and with edge guards at the lids, see Table 3;
- the packages withstand the tying-up forces occurring in transhipment;
- handling with hoisting gears and/or industrial trucks is possible.

The above design specifications do not apply when cases with circumference battens are used for the packing of goods up to 500 kg. In this case a single entry opening for the forklift is allowed, secondary runner thickness min. 100 mm.

Table 3 – Heavy lift corners and edge guards

Gross weight of case (in tonnes)	Heavy lift corners/edge guards Plate thickness (in mm)
Up to 5	--
5 to 10	min. 1,5
10 to 15	min. 3
15 to 20	min. 6
20 to 30	min. 8
From 30	min. 10

All square end wall joists shall be bolted up with the longitudinal runners. The mushroom head bolts are specified in Annex C, Table C.1. For case type class 6, double bolting is required. When vertical supports are used, these supports shall be fixed. The side and end faces shall be provided with vertical planking.
Case lids shall be sealed against ingress of moisture with appropriate sealing elements arranged at the bottom side of the lid. The sealing element shall be placed between the planking and the batten frame. Vertical openings of the goods with diameters $\geq$ 500 mm shall be covered with 5 to 6 mm thick plywood panels. The plywood panels shall be fixed in their positions.

4.3 Crates of packaging category 5

The specifications given for the cases in 4.2 above also apply to crates. The bottom of the crate is the load-carrying element and shall always remain closed. Two thirds of the end, side and lid faces shall be provided with planking.

4.4 Bundles of packaging category 6

A bundle shall be made up in such a way that

- it has at least two entry openings for the forklift,
- it withstands the tying-up forces occurring in transhipment,
- handling with hoisting gears and/or industrial trucks is possible.

Bundling shall be carried out as follows:

- with square-timber clamps and clamping screws (threaded rods). The clamps are also allowed in the form of channel sections.
- with intermediate layers in wood, plywood or plastic material, dimensioned as required for the weight of the goods and secured with clamping screws to avoid slipping,
- with suitable screws/bolts whose projecting lengths shall be covered with strips provided with appropriate recesses. The cover strips shall be fastened with nails.
- The screw connection shall be properly secured.

4.5 Sledges of packaging category 7

The sledge shall be designed in such a way that

- it has at least two entry openings for the forklift,
- the rope sling points are provided with heavy-lift corners when the weight exceeds 5 t,
- it withstands the tying-up forces occurring in transhipment,
- handling with hoisting gear and/or industrial trucks is possible.

The sledge structure is allowed in timber or in steel.
If direct bolting is not possible, the goods shall be fastened on the sledge with appropriate bands.
Length and width of the sledge structure shall not be smaller than the respective dimensions of the goods.
The ends of longitudinal bottom ledges shall be bevelled at 45° leaving at least 30 % of the ledge thickness.
If necessary, appropriate padding shall be provided between the goods and the supporting structure and between the goods and the fastening elements.

4.6 Cladding of packaging category 8

The cladding shall be designed in such a way that

- it has at least two entry openings for the forklift,
- the rope sling points are provided with heavy-lift corners when the weight exceeds 5 t,
- it withstands the tying-up forces occurring in transhipment,
- handling with hoisting gear and/or industrial trucks is possible.

Preservation shall be made by applying contact preservative and adhesive aluminium film.
The cladding of machined surfaces shall cover the entire surface. Fittings and projecting parts shall be fully clad and padded if necessary.

4.7 Dangerous goods packaging of packaging category 9

When packing units are prepared, special attention shall be paid to the regulations on the maximum quantities allowed for the packing together of dangerous goods.

4.8 Transport packaging of packaging category 11

The transport packaging shall be designed in such a way that

- it has at least two entry openings for the forklift,
- it withstands the tying-up forces occurring in transhipment,
- handling with hoisting gear and/or industrial trucks is possible,
- the parts are protected against climatic influences and mechanical influences during transport.

4.9 Container packaging of packaging category 12

In container packaging the inside dimensions of the containers shall be observed.

5 Fixation of goods

5.1 Stress assumptions

The forces of gravity which are relevant for the securing of the goods result from the actually occurring acceleration and deceleration values.
Table 4 states the acceleration factors for the different types of transport.
The g-values shown in the table are the maximum acceleration forces occurring in normal operation. In combined transport, the type of transport causing the highest acceleration values shall be taken into account.

Table 4 – Stress assumptions according to CTU directive on combined transport

Acceleration forces (according to HPE Guidelines 2006)			
Type of transport	**Forward acceleration**	**Backward acceleration**	**Lateral acceleration**
Road transport	1,0 g	0,5 g	0,5 g
Railway transport Shunting traffic	4,0 g	4,0 g	0,5 g (a)
Combined transport*	1,0 g	1,0 g	0,5 g (a)
Maritime transport Baltic Sea North Sea Worldwide maritime transport	 0,3 g (b) 0,3 g (c) 0,4 g (d)	 0,3 g (b) 0,3 g (c) 0,4 g (d)	 0,5 g 0,7 g 0,8 g
Air transport	1,5 g	1,5 g	vertical ± 3,0 g

The above values shall be combined with vertical gravitational forces of 1 g and dynamic fluctuations (vertical) as follows:

(a) = ± 0,3g (b) = ± 0,5g (c) = ± 0,7g (d) = ± 0,8g

* Railway wagons with containers, swaps, semi-trailers, trucks, and complete trains type UIC (International Union of Railways) and type RIV (Regolamento Internazionale Veicoli, Agreement governing the exchange and use of coaches in international traffic).

The forces resulting from the accelerations can be calculated by multiplying mass (packaged goods or unit) with acceleration:

$F = m \times g$

Other types of acceleration forces may occur.

5.2 Fixation of goods

The goods shall be bolted to the case bottom structure using load-distributing transverse wooden members. The number and the dimensioning of the bolts shall be calculated according to Annex C, Table C.2. The minimum bolt spacing and the minimum bolt distance from the loaded edge in grain direction shall be 7 d, but at least 10 cm.
Securing in place of movable parts of the goods shall be made in the same quality as the fixation of the goods on the bottom of the case.
If screw-fastening/bolting of the merchandise to the case bottom structure is impossible or possible only to a limited extent, appropriate intermediate layers, padding elements, supports or blocking elements shall be used to avoid slipping of the goods in the case.
The following measures are appropriate:

- jamming of the goods using wooden thrust blocks and threaded rods (for min. bolt diameter, see Annex C, Table C.1),
- lashing of the goods using prestretched wire and turnbuckle (proof of sufficient wire cross-section is required),
- textile straps and textile belts with pertaining locking devices with due consideration of the suppliers specifications and qualities,
- old fixation devices shall be used with appropriate edge guards.
- sensitive parts or surfaces shall be protected with suitable materials.

6 Packaging

6.1 Basic specifications

Within the scope of the incoming and outgoing-goods inspection, the preservative applied to the goods by the supplier shall be checked by the packer for damage on the outer surfaces and if damaged shall be properly repaired using a preserving agent according to SN 200-7:2010.

6.2 Goods heat-sealed in plastic film

Depending on the durations of transport and storage, the goods shall be protected against corrosion by adding desiccants and heat-sealing the goods in plastic film.
The following materials are used as barrier films:

- polyethylene film according to BWB TL 8135-0019:2009-06 or equivalent film,
- aluminium sandwich film according to BWB TL 8135-0003:2000-07 or equivalent film.

6.3 VCI method

Preservation using the VCI method with at least one appropriate carrier material (paper, film, foam pack, etc.) is an alternative possibility, but requires previous consultation with SMS group with regard to compatibility.
Barrier enclosures shall be designed to allow the proper opening and re-closing of the enclosure for two times. After every opening, the desiccant shall be completely replaced.
Projecting parts and sharp edges shall be properly padded to prevent wearing through or piercing of the film. The air inside the barrier enclosure shall be exhausted.
Openings in the barrier enclosure such as areas pierced by fastening elements shall be sealed vapour-tight with seals and sealing compound applied to both sides of the barrier film, see Annex D, figure D.10.

6.4 Desiccant

The necessary desiccant quantity shall be calculated according to DIN 55474:1997-07 for a maximum permissible ultimate humidity of 40%. The water vapour permeability shall be established using the procedures specified in DIN EN ISO 15106-3:2005-05; the films shall be checked both in as-delivered and in aged condition. When hygroscopic material has to be enclosed for reasons of packaging, the necessary quantity of desiccant units shall be calculated using the calculation formula below. The factors and calculation values are stated in Table 5.
The desiccant bags of the low-dust type shall be placed in the upper section of the film enclosure and properly secured against falling. The fastening of the desiccant bags shall be made in such a way that it permanently withstands loads resulting from transport, handling, and from weight increase due to the absorption of moisture. Direct contact between desiccant and packed goods is not allowed.

Formula:

$$n = \frac{1}{a} (V \times b + m \times c + A \times e \times WDD \times t)$$

Table 5 – Desiccant units

Factor	Meaning	Calculation value		
n	Number of desiccant units	-		
a	Water volume to be absorbed by each desiccant unit to comply with the permissible max. air humidity in the enclosure	Permissible ultimate humidity	20%	40%
	Permiss. ultimate humidity in per cent	Factor a	3	6
e	Correction factor related to the permissible ultimate humidity	Factor e	0,9	0,7
V	Inside volume of the package in m³	-		
b	Humidity content of the entrapped air in g/m³	e.g. at 20 °C and 85% relat. humidity b = 15 g/m³		
m	Mass of the hygroscopic packaging aids (in kg)	-		
C	Factor for the humidity content of the hygroscopic packaging aids in g/kg (‰)	C = 80 for wood, air dry = 18 % water content		
		C = 80 for wood and cardboard 80 for padding elements on organic basis		
A	Surface area of barrier enclosure in m²	-		
-	-	Exemplary values of suitable films		
WDD	Water vapour permeability of the barrier enclosure for the climate to be expected, in g/m² x d, measured according to DIN 53122 -1: 2001-08 or DIN 53122 -2: 1982-07		Testing climate	
		Type of film	20/85	38/90
		LD–PE * 0,2 mm thick	0,4	2,0
		Aluminium sandwich film	< 0,1	0,1
t	Total duration of transport and storage in days	-		

* Low-density polyethylene film

7 Case marking

The marking of cases is shown in Annex D, figure D.13.

7.1 Elements of the marking

The marking consists of lettering, handling marking, IPPC (International Plant Protection Convention) marking and the company logo.

7.1.1 Lettering

The lettering is project-related and is part of the shipping instructions.
SMS group will make the shipping instructions available to the contractor in due time.

7.1.2 Handling marking

In addition to the lettering, the packages shall be provided with the relevant internationally used handling symbols according to DIN EN ISO 780:1999-04.
All packages whose unit weights exceed 5 t shall be provided with the marking of the center of gravity and of the point of lifting gear application.
Storage-class marking shall be made using the symbols shown in item 7.5.

7.1.3 IPPC marking

Wooden cases shall be marked with the IPPC stamp. This stamp gives information on treatment methods, country of origin, and the competent phytosanitary authority, and contains the registration number of the company which has carried out treatment and packaging.

7.1.4 Company logo

All cases shall be provided with the logo of the SMS group company, e. g. SMS Siemag or SMS Meer, using a stencil.
The stencil and letter size shall be chosen as appropriate for the size of the case. The company logo shall be applied to all sides and on each side in central position at the top edge.

7.2 Execution of the marking

If there are no regulations to the contrary, all letterings shall be in Arabic numerals and Latin capital letters.
The size of the lettering shall be adapted to the size of the case and the space remaining near the handling symbol.
The handling marking shall be made according to DIN EN ISO 780:1999-04 in the usual letter sizes specified in the standard.
The lettering shall be applied so as to ensure that the handling marking is not covered, in particular when signs are used.

7.3 Application of the marking

The packages shall be provided with light-fast and sea-water resistant contrast colour (preferably black RAL 9005) using a stencil or with lettering signs. The materials used for the signs shall be resistant to heat, cold, UV radiation and sea water.
When parts are not packed or when sledge structures are used, the marking may be applied to the goods themselves.
The handling marking shall be applied as specified in DIN EN ISO 780:1999-04.

7.4 Arrangement of the marking

The lettering shall be applied to at least two sides of the package, if lettering on 4 sides is required, this will be communicated to the packer in due time.
Packages of cylindrical shape shall be provided with marking on two opposite faces. The IPPC stamp shall be applied to at least 2 sides.

7.5 Approved storage classes

The storage class shall be chosen as appropriate for the most sensitive of the goods. If no specifications are given by SMS group, the storage class shall be determined by the maker or supplier of the goods. The selected storage class shall be documented in plain text in an appropriate place of the documentation accompanying the goods (e. g. advice of delivery, delivery note, packing list). Symbols to be used are specified in DIN EN ISO 780:1999-04.

7.5.1 Storage class 1

Outdoor storage under tarpaulin or roof. The package shall be stored in a dry place. The pertaining symbol is shown in Fig. 1.

Fig. 1 – Outdoor storage under tarpaulin or roof

7.5.2 Storage class 2

Closed building without temperature control (indoor storage).
The pertaining symbol is shown in Fig. 2.

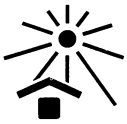

Fig. 2 – Indoor storage

7.5.3 Storage class 3

Bay protected from frost, temperature range from 5 °C to 50 °C.
The pertaining symbol is shown in Fig. 3.

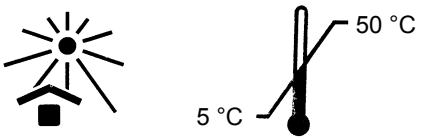

Fig. 3 – Bay protected from frost

7.5.4 Storage class 4

Air-conditioned bay, temperature range from 15 °C to 25 °C.
Air humidity 40 % to 60 %.
The pertaining symbol is shown in Fig. 4.

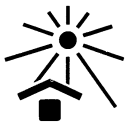

Fig. 4 – Air-conditioned bay

7.5.5 Storage class 5

Special storage area for dangerous goods.
Dangerous goods within the meaning of the Dangerous Goods Ordinance for the respective type of transport (GGVSee = Dangerous Goods Ordinance for sea transport, GGVSE = DGO for road and rail transport, IATA-DGR = DGO for air transport) shall be provided at least with the following additional marking:

- Lettering: UN No. (expert committee of the United Nations) and technical designation of the goods.
- Marking of the storage class with class symbol and class figure; in case of more than one dangerous property, the class symbols for the dangerous goods shall be shown in addition. The size of the marking shall be at least 100 x 100 mm, on containers, 250 x 250 mm.
- When packages are combined to form loading units, markings and identifiers of the individual packages shall be fully and clearly visible, otherwise the loading unit shall be provided with new markings/identifiers.

8 Inspection

8.1 Basic specifications

The packer shall inform SMS group in due time (i. e. at least two days) before packaging starts. SMS group has the right to be present during packaging. SMS group reserves the right to check the packaging.

The packer shall complete an inspection report (form No. 1325 of SMS Siemag) for every package. In addition, the calculation documents and a list of the materials used stating quantities, cross-sections etc. shall be drawn up for each package. The documents shall be made available to SMS group for countersigning. Works-specific records of identical contents will be accepted by SMS group.

If, on the basis of the records or during inspection of the packages, there is reasonable doubt concerning proper preservation, marking or packaging, the authorized representative of SMS group will decide as to whether opening of the packages and possibly opening of the barrier enclosures is required.

If the opened packages are found to be unacceptable, the representative of SMS group will decide whether additional opening of twice the number of packages opened for the previous inspection shall take place.

Such additional inspection will be repeated till all packages of an additional inspection have been found to be fully acceptable.

The packer is responsible for correct execution of packaging in accordance with these minimum requirements, and for the perfect quality of the packing material. Any deviation from these conditions requires the previous written approval by SMS group.

The packaging inspection does not relieve the packer from its warranty obligations and liability.

8.2 Testing atmospheres

The testing atmospheres to be used shall be chosen as appropriate for the country of destination. If no climate data are available, atmosphere B according to DIN 53122-1:2001-08 shall be used. If no particular proof of water vapour permeability has been furnished, the max. permissible water vapour permeability factor (mean value of as-delivered and aged condition) stated in the relevant technical term of delivery shall be used.
The test results shall be proven in an inspection certificate type 3.1 or 3.2 according to DIN EN 10204:2005-01.

Referenced technical standards, codes and regulations

DIN 603:1981-10	Mushroom head square neck bolts
DIN 1052:2008-12	Timber structures, design and construction
DIN 4074-1:2008-12	Strength grading of wood, coniferous sawn timber
DIN 53122-1:2001-08	Determination of water vapour transmission
DIN 53122-2:1982-07	Determination of water vapour transmission of plastic films, elastomer films, paper, board and other sheet materials – Electrolysis method
DIN 55474:1997-07	Auxiliary means of packaging - Desiccants in bag
DIN 68705-3:1981-12	Plywood; Building-veneer plywood
DIN EN 300:2006-09	Oriented strand boards (OSB) – Definitions, classification and specifications
DIN EN 10204:2005-01	Inspection documents for metallic products
DIN EN ISO 780:1999-04	Packaging – Pictorial marking for handling of goods
DIN EN ISO 15106-3:2005-05	Plastics; Film and sheeting – Determination of water vapour transmission rate – Part 3: Electrolytic detection sensor method
SN 200-7: 2010	Manufacturing Instructions – Coating and preserving
CTU-Richtlinie	CTU Directive: Cargo transport unit, packaging directives
BWB TL 8135-0003:2000-07	Federal Office for Defence Technology and Procurement
BWB TL 8135-0019:2009-06	Federal Office for Defence Technology and Procurement
HPE-Richtlinien 2006	HPE Packaging Guidelines (HPE: The Registered Federal Association for Wooden Packages, Pallets and Export Packaging)
RGV	Technical sheets for overseas shipments
GGVSE	Regulation on carriage of dangerous goods by road and rail (Dangerous Goods Ordinance Road and Rail)
GGVSee	Ordinance on the transportation of dangerous goods with sea-going vessels (Dangerous Goods Ordinance Sea)
IATA-DGR	Dangerous goods ordinance for air transport
RM 001: 1985-06	Guidelines associated with the Dangerous Materials Handling Provisions - Refers to all Carriers of Goods
K und M	Consular and Standard Regulations of the Hamburg Chamber of Commerce

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Annex A (normative) **Permissible stresses**

The permissible (perm.) stresses for wood when used as packing material are specified in Table A.1.
The permissible compressive stress in N/cm² for angular application of force on wood of grading class S10 for load case H (main forces) is calculated using the data of Table A.2.
Calculation formula: $\sigma_{dperm} \leq \sigma_{dperm} \,||\, - (\sigma_{dperm} \,||\, - \sigma_{dperm}) \sin \alpha$

For load case HZ (main and additional forces) - shunting impact, transport by crane or industrial truck - the permissible stresses shall be multiplied by the factor 1,15.

Table A.1 – Strength data for wood used as packing material

Permissible stresses σ_{perm} and τ_{perm} in N/cm² for load case H				
Type of stress	**Grading class S7**		**Grading class S10**	
	Coniferous wood	**Hard-wood**	**Coniferous wood**	**Hard-wood**
Bending $\sigma_{b\ perm}$	900	950	1250	1400
Bending of through beams without joints $\sigma_{b\ perm}$	950	1000	1250	1500
Tension in direction of grain $\sigma_{z\ perm}$	0	0	1100	1250
Pressure in direction of grain $\sigma_{d\ perm}$ $\parallel$	750	900	1100	1250
Pressure perpendicular to direction of grain $\sigma_{d\ perm}$ $\perp$	250	400	250	400
Pressure perpendicular to direction of grain in components in which minor indentations are harmless $\sigma_{d\ perm}$	300	500	300	500
Shearing off in direction of grain and glued joint τ_{perm}	120	130	120	130

Table A.2 – Permissible compressive stress for angular application of force

Permissible compressive stress in N/cm² for angular application of force on wood of grading class S10 for load case H (main forces)				
Angle α or β between connecting load and direction of grain	**Coniferous wood**		**Oak and beech wood**	
	—	**For components for which minor indentations are harmless**	—	**For components for which minor indentations are harmless**
0°	1100	1100	1250	1250
10°	950	1100	1100	1130
20°	800	900	950	1000
30°	650	700	820	900
40°	550	600	700	770
50°	450	500	600	680
60°	400	450	500	600
70°	300	370	430	550
80°	270	330	400	530
90°	250	320	390	500

Annex B (normative) **Surface cladding**

B.1 Construction of bottom

The data for the construction of the bottom are specified in Tables B.1 and B.2.

Table B.1 – Construction of bottom

Case type class	Net weight in kg	Min. board/panel thickness in mm			Longitudinal runner W x H in cm	Secondary runner W x H in cm	Square end wall joist W x H in cm
		Wood	OSB3	Plywood [a)]			
1	From 500 to 1 500	24	12	12	8 x 10	10 x 10	8 x 8
2	1 500 to 5 000	24	12	12	10 x 12	10 x 10	8 x 10
3	> 5 000 to 10 000	24	12	12	12 x 14	10 x 10	10 x 12
4	> 10 000 to 25 000	24	12	12	14 x 16	12 x 12	12 x 14
5	>25 000 to 50 000	24	12	12	≥ 14 x 16	≥ 12 x 12	≥ 14 x 16
6	> 50 000	24	12	12	≥ 18 x 20	≥ 14 x 14	≥ 18 x 20

[a)] For case type 1 (see Annex D.1) a minimum thickness of 9 mm is allowed when plywood of the type APA RATED SHEATHING and type APA RATED STURD-IFLOOR is used with bonding method EXTERIOR.

Table B.2 – Number of squared timbers (longitudinal runners)

Bottom width (cm)	**≤ 100**	**101 to 180**	**181 to 240**	**241 to 300**	**301 to 350**
Min. number of squared timbers	2	3	4	5	6

B.2 Construction of side part, end part and lid

The data for the construction of side part, end part and lid are given in Tables B.3 to B.7.

Table B.3 – Construction of side part, end part and lid

Case type class	Net weight in kg	Min. board/panel thickness in mm			Batten frame, diagonal, horizontal in cm
		Wood	OSB3	Plywood [a)]	
1	From 500 to 1 500	24	12	12	10 x 2,4
2	1 500 to 5 000	24	12	12	10 x 2,4
3	> 5 000 to 10 000	24	12	12	10 x 2,4
4	> 10 000 to 25 000	24	12	12	10 x 2,4
5	25 000 to 50 000	24	12	12	≥ 10 x 2,4
6	> 50 000	24	12	12	≥ 10 x 2,4

[a)] For case type 1 (see Annex D.1) a minimum thickness of 9 mm is allowed when plywood of the type APA RATED SHEATHING and type APA RATED STURD-IFLOOR is used with bonding method EXTERIOR.

Table B.4 – Number of side-part sections

Length of case (cm)	≤ 300	301 to 500	501 to 700	701 to 900	> 900
Number of sections	1	2	3	4	5

Table B.5 - Number of end-part sections

Length of case (cm)	≤ 200	> 200
Number of sections	1	2

Table B.6 - Number of longitudinal lid battens

Lid width (cm)	≤ 100	101 to 200	201 to 250	251 to 300	301 to 350	351 to 400
Number of battens	3	4	5	6	7	8

Table B.7 – Dimensioning and quantities of lid joists

Lid width (cm)	≤ 100	101 to 150	151 to 200	201 to 250	251 to 300	301 to 350	351 to 400
Square timber W x H (cm) [a)]	6 x 8	8 x 10	10 x 12	12 x 14	14 x 16	14 x 18	≥ 14 x 18

[a)] Center distance from square timber to square timber max. 70 cm

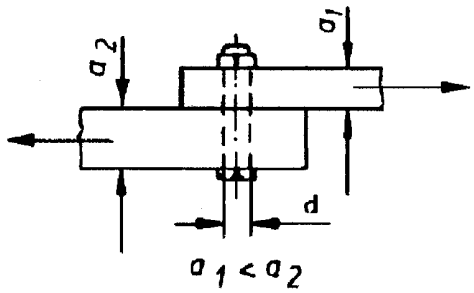
Annex C (normative) **Dimensioning of mushroom head bolts**

Use shall be made of mushroom head bolts according to DIN 603:1981-10. The relevant data are given in C.1 and C.2.

Table C.1 – Dimensioning of mushroom head bolts, fixation of goods

Case type class	Net weight in kg	Mushroom-head bolt dia. in mm	Max. hole dia. in mm
1	From 500 to 1 500	12	13
2	1 500 to 5 000	12	13
3	> 5 000 to 10 000	16	17
4	> 10 000 to 25 000	16	17
5	> 25 000 to 50 000	20	21
6	> 50 000	30	31

Table C.2 – Permissible loads on mushroom-head bolt joints for application of force in direction of grain, in N

	Coniferous wood incl. larch	Oak and beech wood
single-lap joint 	550 N/mm² × a_1 × d, but not more than 2 400 N/mm² × d^2	700 N/mm² × a_1 × d, but not more than 2 800 N/mm² × d^2

d = bolt diameter in mm

Annex D (normative) **Construction examples**

The examples shown have been taken from HPE Guidelines 2006.

D.1 Case type 1 - OSB/plywood

Figures D.1 to D.3 show construction examples of case type 1 (OSB/plywood).
Tables D.1 to D.3 state the designations of the item numbers in the figures.

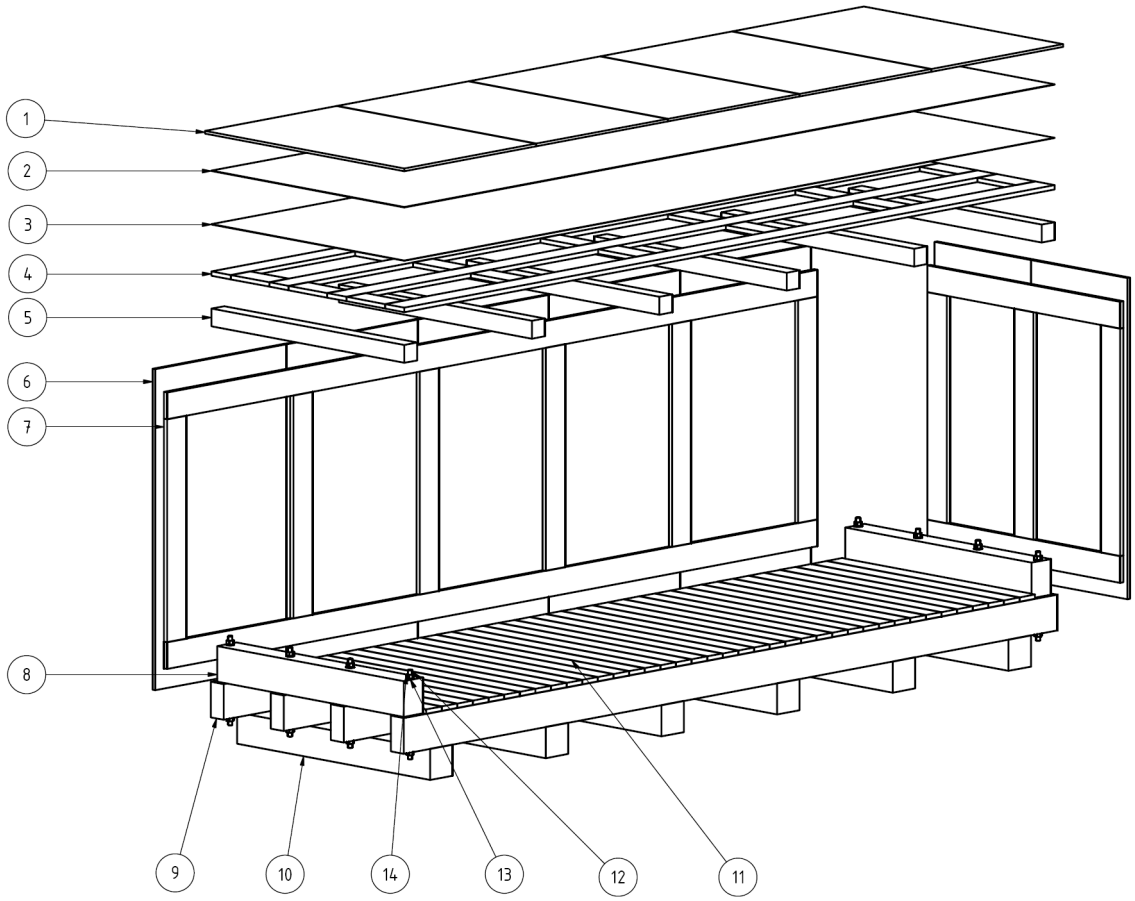


Fig. D.1 – Example of a case (case type 1)

Table D.1 – Item numbers and their designations (case type 1)

Item	Designation	Item	Designation
1	OSB board/plywood	8	Square end wall joist
2	Film	9	Longitudinal runner
3	Barrier layer	10	Transversal runner
4	Support battens (horizontal, for lid)	11	Bottom boards
5	Squared battens (lid)	12	Bolt
6	OSB/plywood (side)	13	Washer
7	Support battens	14	Nut

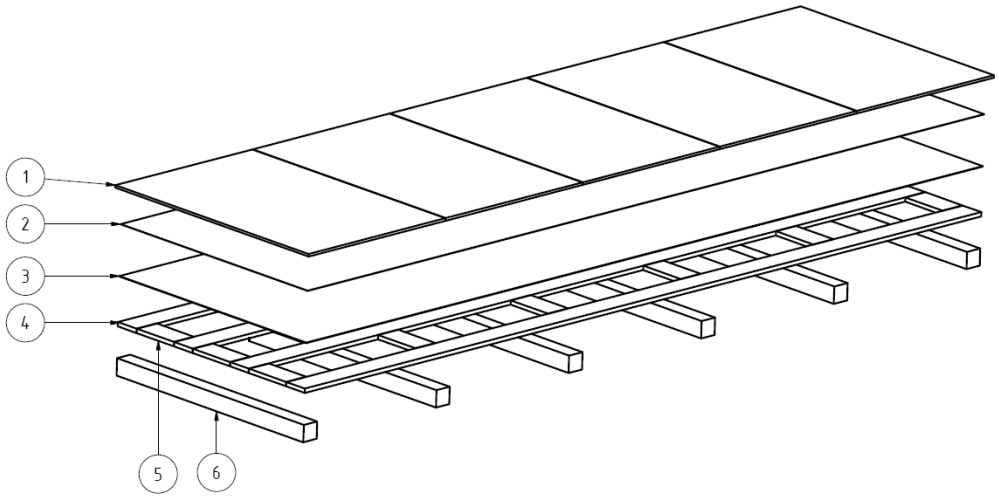


Fig. D.2 – Example of a lid assembly (case type 1)

Table D.2 – Items of lid assembly (case type 1)

Item	Designation
1	OSB/plywood
2	Film
3	Barrier layer
4	Batten
5	Lining
6	Lid support bar

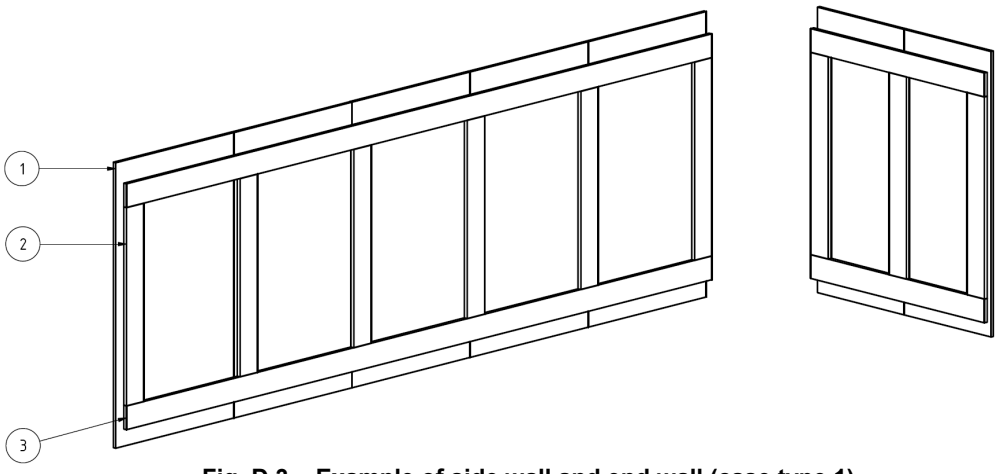


Fig. D.3 – Example of side wall and end wall (case type 1)

Table D.3 – Items of side wall and end wall (case type 1)

Item	Designation
1	OSB/plywood
2	Batten (vertical)
3	Batten (horizontal)

D.2 Case type 2 - Sawn timber cladding

The figures D.4 to D.7 show construction examples of case type 2 (sawn timber cladding). The designations of the item numbers in the figures are explained in Tables D.4 to D.6.

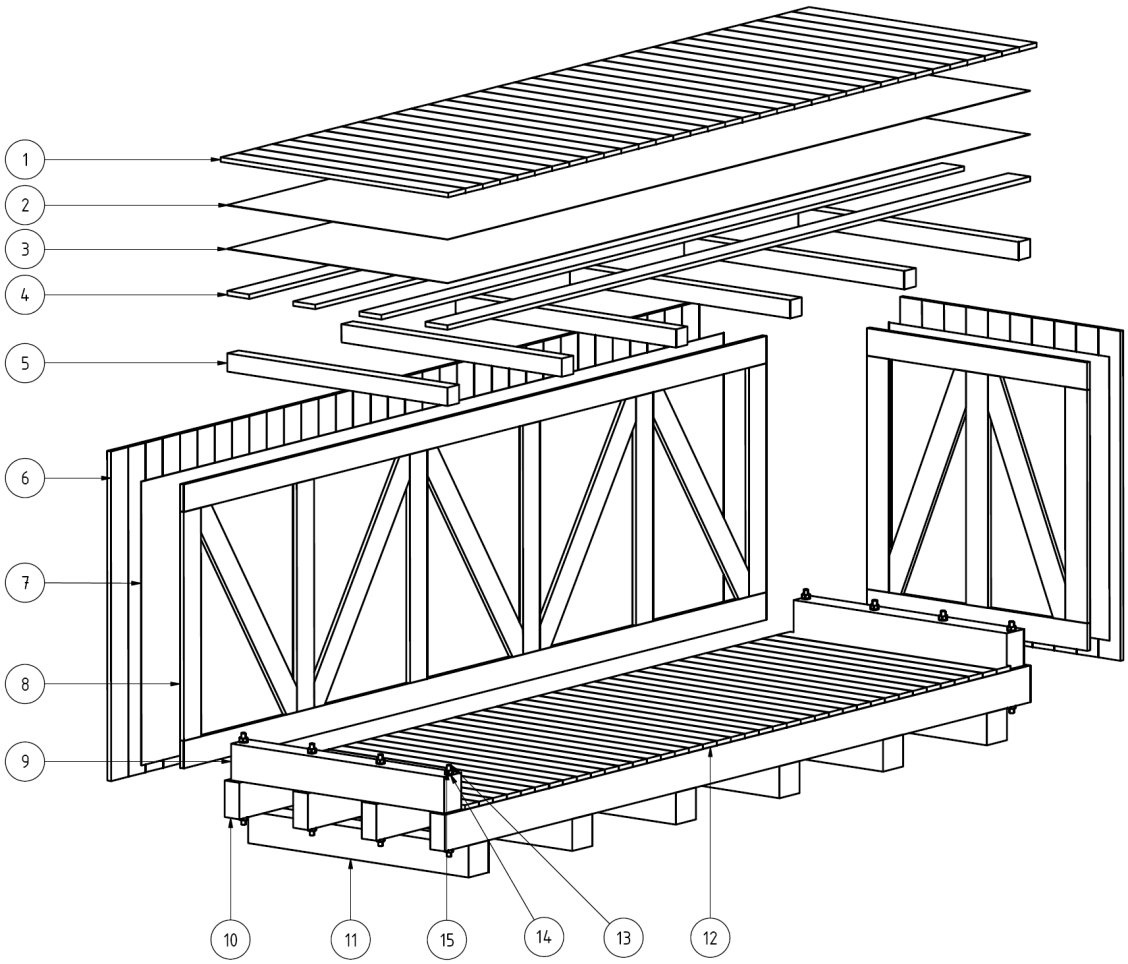


Fig. D.4 – Example of a case (case type 2)

Table D.4 – Item numbers and their designations (case type 2)

Item	Designation	Item	Designation
1	Sawn timber (lid)	9	Square end wall joist
2	Film	10	Longitudinal runners
3	Barrier layer	11	Transversal runners
4	Cross battens (lid)	12	Bottom boards
5	Squared battens (lid)	13	Bolt
6	Sawn timber (side)	14	Washer
7	Jute-pitch paper	15	Nut
8	Support battens (with diagonals)		

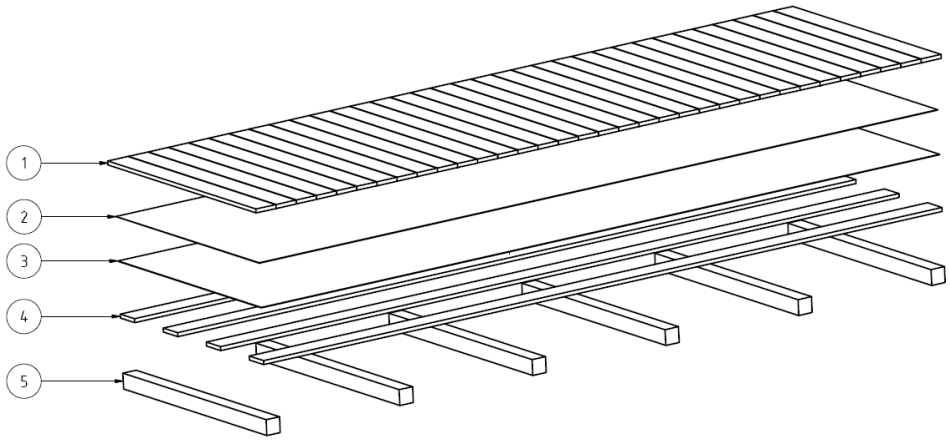


Fig. D.5 – Example of a lid assembly (case type 2)

Table D.5 – Lid assembly (case type 2)

Item	Designation
1	Sawn timber
2	Film
3	Plastic or hardboard cover
4	Batten
5	Lid support bar

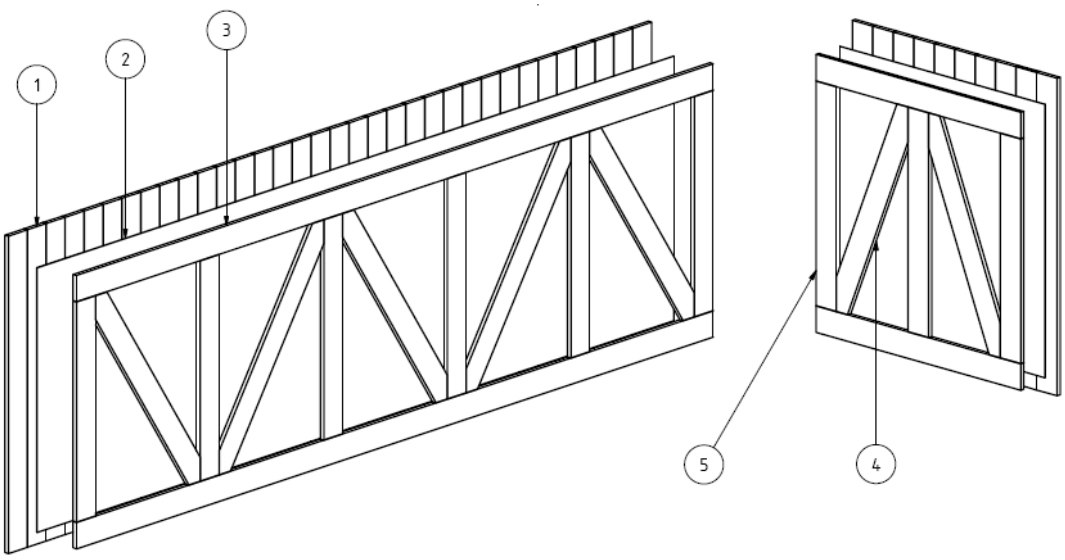


Fig. D.6 – Example of side wall and end wall (case type 2)

Table D.6 – Side wall and end wall (case type 2)

Item	Designation
1	Sawn timber cladding
2	Jute-pitch paper
3	Batten (horizontal)
4	Batten (diagonal)
5	Batten (vertical)

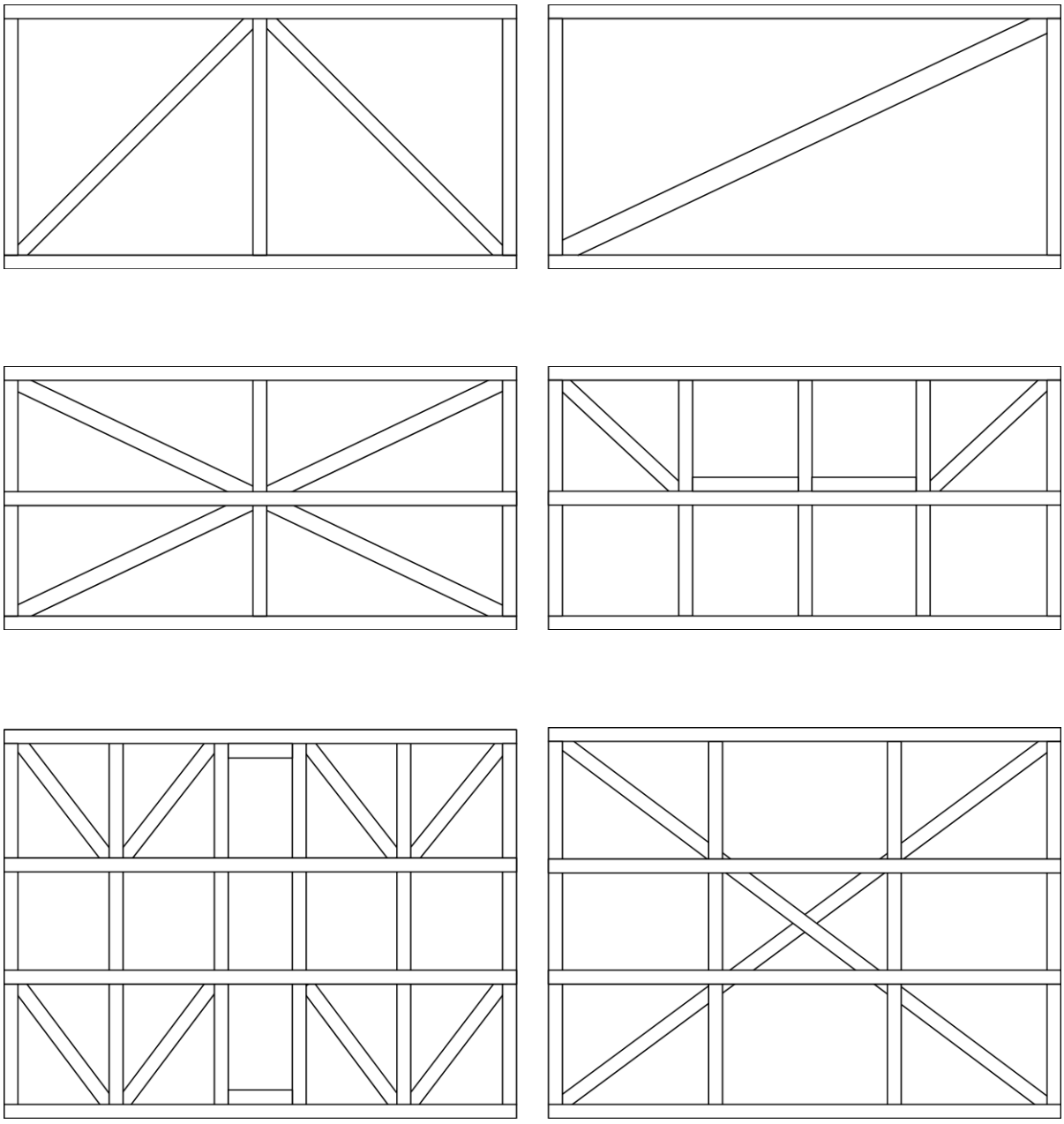


Fig. D.7 – Sections with diagonal bracing (case type 2)

D.3 Case types 1 and 2

Figure D.8 shows an example of the bottom assembly of case types 1 and 2. Table D.7 gives the designations of the item numbers in the figure.

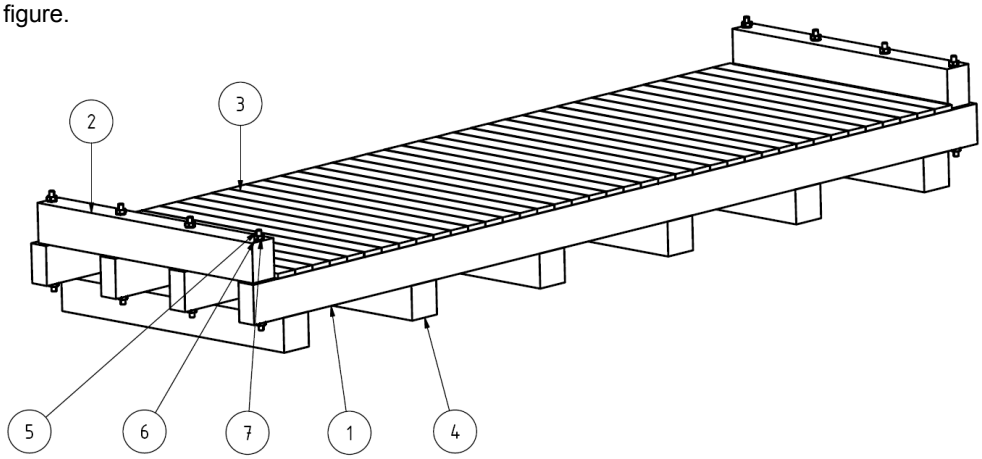


Fig. D.8 – Example of a bottom assembly

Table D.7 – Bottom assembly

Item	Designation
1	Longitudinal runners
2	Square end wall joist
3	Bottom boards
4	Transversal runners
5	Bolt
6	Washer
7	Nut

D.4 Distribution of battens

The distribution of the battens is shown in figure D.9.

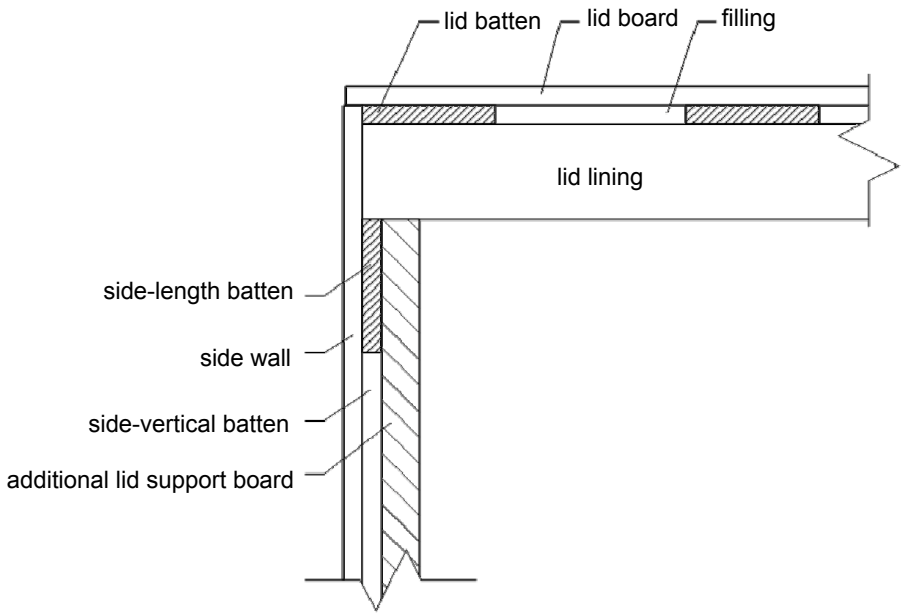


Fig. D.9 – Distribution of battens

D.5 Barrier film

Fig. D.10 shows the piercing of the barrier film.

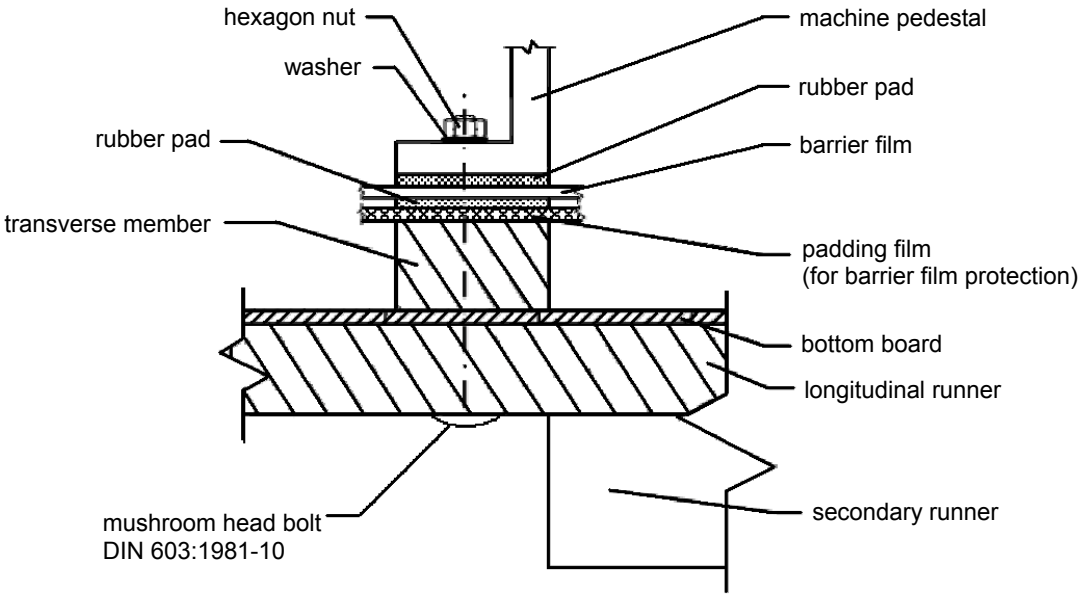


Fig. D.10 – Piercing of the barrier film

D.6 Nailing of wooden battens

Figure D.11 shows a sample sketch for the nailing of wooden battens.
The battens shall be fixed with at least 2 nails in every board.

Shortest applicable nail distances:
- 5 d from unloaded edge,
- 10 d from loaded edge.

d = nail diameter

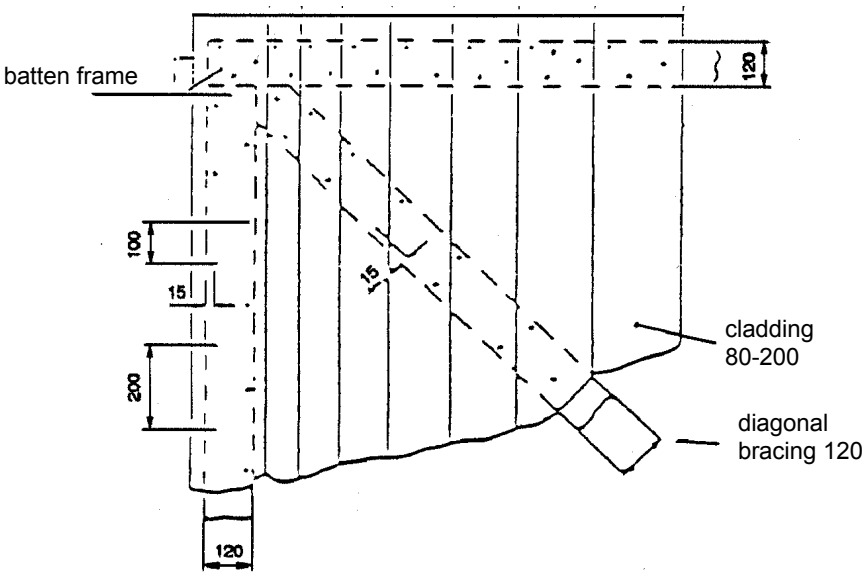


Fig. D.11 – Nailing of wooden battens - sample sketch -

D.7 Case type 3 - Case with circumferential battens up to 500 kg

Fig. D.12 shows a case with circumferential battens up to 500 kg with external butt strap. The case can optionally be provided with internal butt strap.

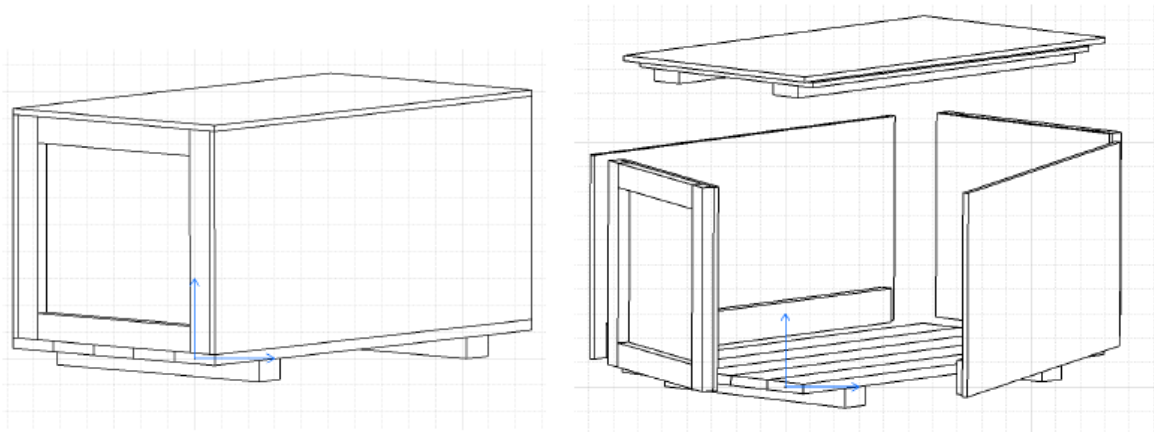


Fig. D.12 – Case with circumferential battens and external butt strap

D.8 Case marking

Fig. D.13 shows a typical example of case marking

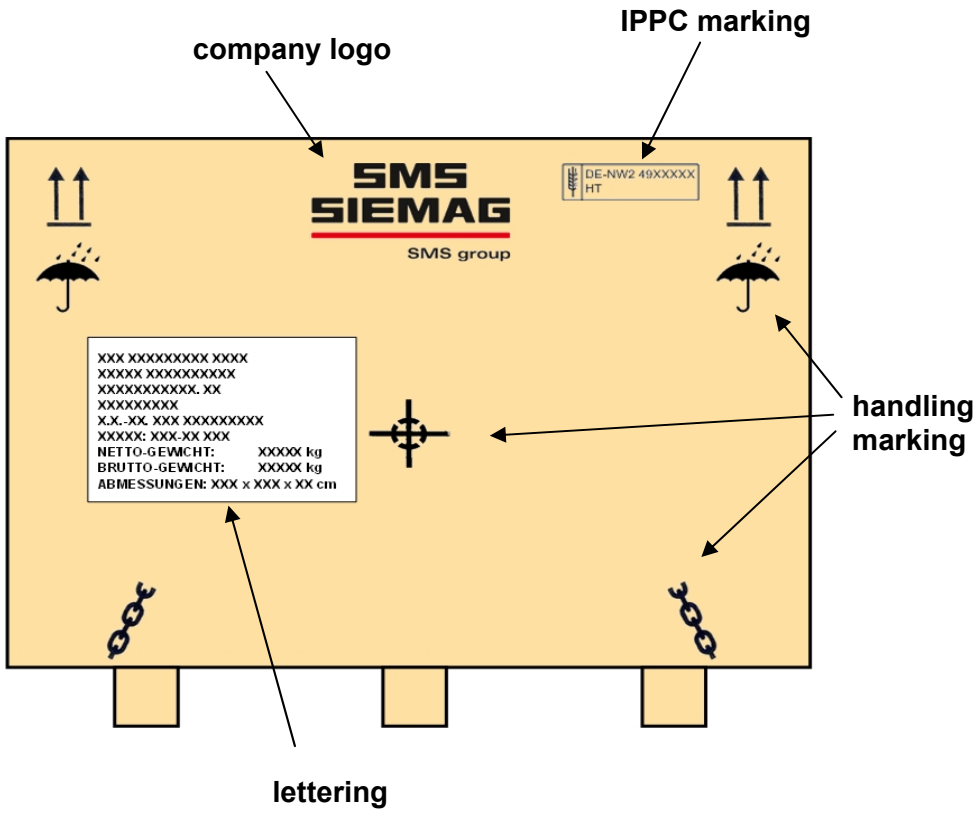


Fig. D.13 – Typical example of case marking

SMS group

Manufacturing Instructions

Inspection

SN 200-10

ICS 19.020

Supersedes
SN 200-10:2007-02

Table of contents

1 Scope

The requirements specified below apply to the inspections of products and materials of SMS group unless other requirements are specified in design, ordering or manufacturing documents.

2 Warranty

The manufacturer/supplier shall warrant the proper execution of all his supplies and services.
He is responsible for the fulfilment of the requirements concerning hazardous materials and environmental protection given in SN 200-1:2010 and for compliance with material quality, execution of welding, dimensional accuracy, surface finish, treatment procedures etc. SMS group reserves the right to carry out examinations. The examination by the SMS group quality assurance department does not relieve the manufacturer/supplier of his warranty obligations.

3 Inspection instructions

3.1 Basic specifications

All features produced by the manufacturer shall be examined by the manufacturer/supplier himself and the results shall be recorded. Recording of the examination results shall be made in accordance with the instructions on the drawings and in the purchase orders, and with the criteria stated in the preceding parts of this SN. Inspection records and certificates shall be drawn up in German and/or English. For the purpose of clear identification, the purchase order number, WBS number, material number, document number and the designation of the part of SMS group shall be indicated on all documents.

Every manufacturer is responsible for ensuring that the finished product is free of all processing and machining residues such as welding slag, loose burrs, chips, drilling emulsion etc. The clean condition shall be checked by visual examination according to DIN EN 13018 and shall be guaranteed.

Independently of the manufacturer's obligation to draw up records, the SMS group quality inspectors shall have the right to check the fulfilment of all features or to demand proof of fulfilment to be furnished by the manufacturer. If inevitable, destructive testing shall be permitted for this purpose and the manufacturer shall carry out such testing if so requested by the SMS group quality inspector.

All features tested/examined within the scope of intermediate or final inspection shall be recorded by the SMS group quality inspector or documented by him on the record drawn up by the manufacturer.

Edited by:
SMS Siemag
Standards Office

3.2 Component parts

Inspection instructions for component parts are stated on the relevant drawings, in the purchase orders and in the parts of this SN; the scope of inspection depends on the scope of supplies and services of the respective manufacturer.
For special component parts, delivery and inspection instructions are available as component-specific SN standards which are binding when indicated on the pertaining drawing. In exceptional cases, additional inspection schedules for component parts are drawn up by the SMS group quality inspection department and made available to the manufacturers together with the drawings and ordering documents.

3.3 Assembled units

Given the wide range of products of SMS group, it is not possible to specify standard inspection instructions for assembled units (assemblies) within the scope of this SN.

Manufacturers of assembled units are therefore bound to contact the SMS group quality inspection department to agree on the relevant inspection procedures. For the most part, the scopes of assembly and inspection are shown in specific schedules, which are made available to the manufacturers and are constituent parts of this SN.

Within the scope of these inspections, the minimum requirements for inspection are functional and movement tests of oscillating and rotating parts.

3.4 Particular inspection instructions

Equipment like lifting appliances, pressure vessels etc. shall be inspected on the basis of the scopes of acceptance inspections specified in the legal regulations or regulations having legal character. Country-specific regulations shall be complied with.

4 Inspections made by the final customer

Inspections which have been contractually agreed between SMS group and the customer will be notified to the manufacturer in the respective manufacturing documents.

5 Inspection results

5.1 Basic specifications

All inspections made on the basis of the inspection instructions given in the individual parts of this SN shall be documented and the desired and the actual values stated in the records. The appropriate forms of records and certificates for the documentation of inspection results are available at SMS group and will be made available upon request. If the supplier draws up his own works-specific records with identical contents within the scope of his quality assurance system, these will be accepted by SMS group. It shall be ensured that the records can be assigned to the manufacturing documents of SMS group.

The original records shall be handed over complete, in size A4, to the SMS group quality inspector at his visit to the manufacturer's works. If SMS group does not carry out an inspection at the manufacturer's works, the original records shall be sent to the SMS group department of quality inspection. All records whose presentation is specified in this SN 200 are constituent parts of the scope of order and supply. If inspection records are missing or not complete, payments will be withheld by SMS group.

5.2 Component parts

If the drawing stipulates identification marking of every single component part (e. g. by stamping figures or engraving), the actual values of every single component part shall be documented (one record for every part).
For parts manufactured in quantities greater than 1 (one) and for which no identification marking is required, it is sufficient to record the actual values of the respective upper and lower limits (i. e. one record per lot stating values ranging from ... to ...).

5.3 Assembled units

The inspection records of assembled units shall state the desired and the actual values.

6 Inspection documents

6.1 Basic specifications

In general, inspection documents shall be drawn up in conformity with DIN EN 10204:2005-01 on the basis of the requirements made in the manufacturing documents.

The fulfilment of the regulations specified in Part 1 for inadmissible hazardous materials shall be proved at least for every order in an inspection document type 2.1 "Declaration of compliance with the order" according to DIN EN 10204:2005-01.

If payments by SMS group or its customers depend on the handover of inspection documents, an inspection certificate type 3.2 according to DIN EN 10204:2005-01 shall be drawn up by the manufacturer in cooperation and mutual agreement with the SMS group quality inspector instead of an inspection certificate type 3.1 according to the same standard.

6.2 Component parts

If no special requirements are made in the manufacturing documents, the presentation of the test records stated in the individual parts of this SN is the minimum requirement for component parts.

For specific inspections, an inspection certificate 3.1 DIN EN 10204:2005-01 shall be drawn up and the test records of the component parts shall be annexed to this certificate.

6.3 Assembled units

For assembled units for which no special requirements are made in the manufacturing documents, the minimum requirement is an inspection document 2.1 "Declaration of compliance with the order" as specified in DIN EN 10204:2005-01.

For specific inspections, an inspection certificate 3.1 DIN EN 10204:2005-01 shall be drawn up and the test records of the assembled units shall be annexed to this certificate.

7 Types of inspection documents

Table 1 shows the types of inspection documents according to DIN EN 10204:2005-01 and their designations in German, English and French.

Table 1 – Types of inspection documents

Designations of the document types according to EN 10204				Contents of the document	Validation of the document by
Type	German	English	French		
2.1	Werksbescheinigung	Declaration of compliance with the order	Attestation de conformité à la commande	Confirmation of compliance with the order	Manufacturer
2.2	Werkszeugnis	Test report	Relevé de contrôle	Confirmation of compliance with the order with indication of results of non-specific inspection	Manufacturer
3.1	Abnahmeprüfzeugnis 3.1	Inspection certificate 3.1	Certificat de réception 3.1	Confirmation of compliance with the order with indication of results of specific inspection	Manufacturer's authorized inspector who is independent of the manufacturing department
3.2	Abnahmeprüfzeugnis 3.2	Inspection certificate 3.2	Certificat de réception 3.2	Confirmation of compliance with the order with indication of results of specific inspection	Manufacturer's authorized inspector who is independent of the manufacturing department, and either the purchaser's authorized inspector or the inspector designated by the official regulations

Referenced technical standards, codes and regulations

DIN EN 10204:2005-01	Metallic products; Types of inspection documents
DIN EN 13018	Non-destructive testing; Visual testing; General principles
SN 200-1:2010	Manufacturing Instructions; Principles

Revision of September 2010

Adaptation to SN 104.
Validity for SMS group.
Standards indicated with year and month.
Editorial revision.