

Technical Specification:

Pipe Class for pipelines PN 84
with H₂ (hydrogen) requirements




| | | | | |
|--|---|---|---|------------|
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| Replaces the following document(s): | | | | |
| - | | | | |


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1 Scope and purpose

This technical specification has been drawn up in accordance with the technical regulations and standards in force. This Pipe Class applies to the pipelines of Gasunie Germany (GUD), which are installed and operated in accordance with the DVGW (German Association of the Gas and Water Sector) regulations.

In case of modifications or extensions of existing installations, which are operating in the range of pressure and temperature specified below, the present Pipe Class has to be applied.

Deviations

Deviations from this Pipe Class, (e.g. deviating dimensions) resulting from a strength calculation, must be approved in advance in writing by the client GUD. Adjustments to the dimensions (e.g. overall lengths) are not permitted without the express consent of GUD.

All dimensions are given in “mm” unless otherwise indicated.

The following operating parameter are covered by this Pipe Class.

| Medium | Pressure (bar) | | Temperature °C | |
|--|----------------|------|----------------|------|
| | Min. | Max. | Min. | Max. |
| Natural gas / Hydrogen (H ₂) up to 100% | | 84 | -20 | +50 |

Table 1 Medium

2 Design standards

The Pipe Class is based on the following design standards:

| | |
|----------------|---|
| GasHDLtgV | Regulation on High-Pressure Gas Lines |
| DVGW G 463 (A) | High Pressure Gas Steel Pipelines for a Design Pressure of more than 16 bar; Design and Construction |
| DVGW G 492 (A) | Gas Measuring Systems for Operating Pressures up to and including 100 bar; |
| DIN EN 1594 | Gas Infrastructure - Pipelines for Maximum Operating Pressure over 16 bar - Functional Requirements |
| AD-2000 | Technical Regulation for Pressure Vessels and Pressure Pipes developed by TÜV Germany |
| DIN 30690-1 | Construction Elements in the Gas Supply System - Part 1: Requirements for Construction Elements in Gas Supply Systems |
| VdTÜV-MB1062 | Guideline for the Manufacture and Testing of Pipelines |

Specific and particular requirements for each component of this Pipe Class are given in the corresponding standard to be applied.

The drawings shown herein have only the scope of indicating the dimensions related to the adjacent table. They are to be considered as guide information only.

3 Basic Parameters

3.1 Pressure- Temperature Rating

| Allowable Operating Pressure [bar] at Operating Temperature [°C] | |
|---|-----------|
| Bar | °C |
| 84 | -20 / +50 |

Table 2: Operating Pressure / Operating Temperature

3.2 Base materials

| Component | Base Material |
|------------------------------------|--|
| Pipes | L360NE, L485ME / QE, DIN EN ISO 3183 |
| Elbows / Bends | L360NE, L485ME / QE, DIN EN ISO 3183 P355NH / NL1, P460NH / NL1, DIN EN 10028-3 |
| T-Pieces | L360NE, L485ME / QE, DIN EN ISO 3183 P355NH / NL1, P460NH / NL1, DIN EN 10028-3 |
| Reducers | L360NE, L485ME / QE, DIN EN ISO 3183 P355NH / NL1, P460NH / NL1, DIN EN 10028-3 |
| Flanges | P355QH1, P460QH, DIN EN 10222-4 |
| Welded Nipples and Sockets | P355NH, P460QH, DIN EN 10273, DIN EN 10222-4 |
| Pipe Caps | P355NH / NL1, P460NH / NL1, DIN EN 10028-3 |
| Spacers / Blanks | P355NH, DIN EN 10028-3 |
| Bolting | 42CrMo4, DIN EN 10269 40NiCrMo84, VdTÜV-WB 380 |
| RJ-Gaskets | Soft iron |
| Flat Gasket / Spiral Wound Gaskets | 1.4571 / graphite |
| Plugs, Double Nipples | 1.4571, DIN EN 10272 |

Table 3: Characteristic base materials


3.3 Design Basis

The dimensioning of piping components is carried out for predominantly static loading induced by internal pressure. In case of dynamic loads, (e.g. pressure surges or additional external loads), corresponding additional calculations must be carried out.

3.4 Safety Factor

| | Underground and above ground | | HDD / Pressings | | Crossing of railway lines | |
|----------------------|------------------------------|---------------|-----------------|---------------|---------------------------|---------------|
| | Safety factor | Design factor | Safety factor | Design factor | Safety factor | Design factor |
| Pipes | 1,6 | 0,625 | 1,8 | 0,555 | 2,0 | 0,5 |
| Elbows / Bends | 1,6 | 0,625 | 1,8 | 0,555 | 2,0 | 0,5 |
| Branches / T-Pieces* | 1,8 | 0,555 | --- | --- | --- | --- |
| Reducers | 1,6 | 0,625 | --- | --- | --- | --- |
| Pipe Caps | 1,8 | 0,555 | --- | --- | --- | --- |
| Flanges | 1,6 | 0,625 | --- | --- | --- | --- |
| Bolting | 1,8 | 0,555 | --- | --- | --- | --- |
| Spacers / Blanks | 1,8 | 0,555 | --- | --- | --- | --- |

* For T-Pieces \geq DN400, a minimum value of utilization against internal pressure \leq 80%, based on the calculation according to AD2000, B9, must be observed.

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3.5 Manufacturing Tolerance

If not otherwise specified in the individual technical texts, the manufacturing tolerance (c1 value) has been considered in accordance with the specific component design standards.

3.6 Corrosion Allowance

c2 = 0 mm

3.7 Mechanical Properties

The specific yield / tensile strength values for the calculation of the pipes and pipe fittings were taken from the standards listed in Table 4 in conjunction with AD 2000 W series, considering the wall thickness or the diameter of the finished part (after heat treatment). (1 N/mm² = 1 MPa).

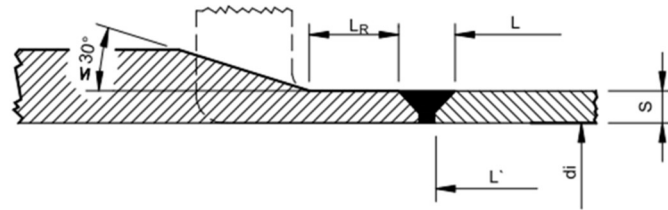
| Material | Standard | Room temperature | At 50°C |
|----------------|-----------------|------------------|---------------|
| L360NE | DIN EN ISO 3183 | Table A2 | Table A2 |
| L485ME/QE | DIN EN ISO 3183 | Table A2 | Table A2 |
| P355QH1 | DIN EN 10222-4 | Table 4 | Table 6 |
| P460QH | DIN EN 10222-4 | Table 4 | Table 6 |
| P355NH / NL1 | DIN EN 10028-3 | Table 4 | Table 5 |
| P460NH / NL1 | DIN EN 10028-3 | Table 4 | Table 5 |
| P355NH | DIN EN 10273 | Table 5 | Table 7 |
| 42CrMo4 | DIN EN 10269 | Table 4 | Table 6 |
| 40NiCrMo84/III | VdTÜV-WN 380 | Section 9.1.1 | Section 9.1.1 |

Table 4: Strength parameter according to standard

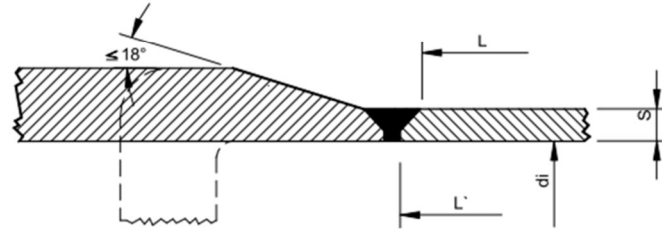
If the yield / tensile strength values, determined under the conditions specified in the table above, have to be reduced due to manufacturing reasons (product form of the primary material or the manufacturing process), the manufacturer/supplier must submit a design calculation approved by a responsible independent Notified Body for the corresponding piping component.

3.8 Wall thickness transition - constant inside diameter

Form 1



Form 2



$$L = L_R = L' \geq 30 \text{ mm}$$

L = Normal test length (external)

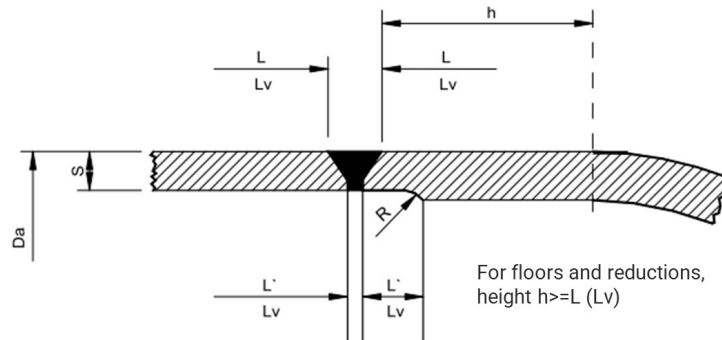
L' = Normal test length (internal)

S = Wall thickness

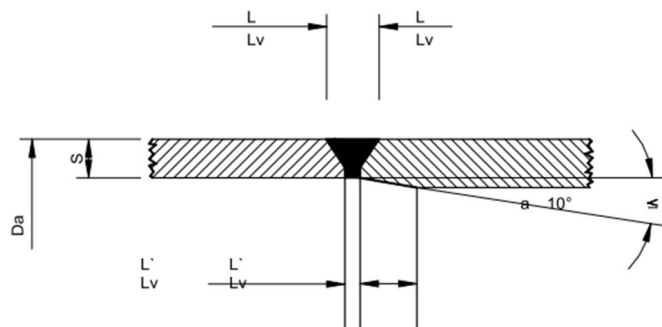
Pipes for the transportation sector must be processed in accordance with VdTÜV-Mb 1055

3.9 Wall thickness transition - constant outside diameter

Form A (preferred)



Form B



$$L = L' = L_v = L'_v \geq 50 \text{ mm}$$

L = Normal test length (external)

L' = Normal test length (internal)

L_v = Shortened test length


S = Wall thickness

3.10 Welding Joints: Preparation of welding ends for aboveground and underground pipelines

The welding joints shall be performed in accordance with DIN EN ISO 9692-1 / VdTÜV- MB 1055 as follows:

$s < 5 \text{ mm}$, Code 1.3 (V-groove with angle $30^\circ +5^\circ/0^\circ$)

$s \geq 5 \text{ mm}$, Code 1.5 (Y-groove with angle $30^\circ +5^\circ/0^\circ$ and root $1.6 \text{ mm} \pm 0.8 \text{ mm}$)

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4 Pipes

- 4.1 Steel Pipe, piggable, for pipeline**
- 4.2 Steel Pipe for HDD`S / Pressings, piggable, for pipeline**
- 4.3 Steel Pipe for crossing of railways, piggable, for pipeline**
- 4.4 Steel Pipe, not piggable, for station piping**
- 4.5 Steel Pipe Adapter for fittings and flanges, piggable**

5 Elbows / Pipe Bends

- 5.1 Elbow 3D-Type, non-piggable, for station piping**
- 5.2 Elbow 5D-Type, non-piggable, for station piping**
- 5.3 Pipe Bend 10D-Type, piggable, with tangent lengths, for pipeline**
- 5.4 Pipe Bend 20D-Type, piggable, with tangent lengths, for pipeline**
- 5.5 Pipe Bend 14D-Type, welded, piggable, with tangent lengths, for pipeline**
- 5.6 Miter Bend 10D-Type, piggable, for pipeline**
- 5.7 Miter Bend 20D-Type, welded, piggable, for pipeline**

6 Branches / Tees

- 6.1 Tee Equal, piggable, with baffle plates**
- 6.2 Tee Reduced, piggable, with baffle plates**
- 6.3 Tee Equal, non-piggable, for station piping**
- 6.4 Tee Reduced, not piggable, for station piping**

7 Pipe Caps

- 7.1 Pipe Caps**

8 Reducers

- 8.1 Reducer Concentric, welded / seamless**
- 8.2 Reducer Eccentric**

9 Flanges

9.1 Flange WN, ASME B16.5, Class 600, RJ

Legend

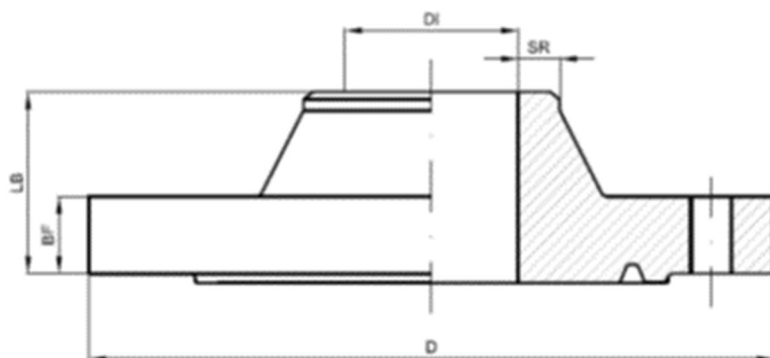
DN = Nominal Diameter (Nominal Pipe Size)

D = Outside Diameter of Flange (mm)


DA = Outside Diameter of pipe connection (mm)

SR = Wall thickness of pipe connection (mm)

LB = Overall length (mm) equals to "Y" from ASME

BF = Flange thickness (mm) equals to "t_f" from ASME

| DN | NPS | DA (mm) | SR (mm) | D (mm) | DI (mm) | Material | |
|-----|-----|------------|------------|-----------|------------|----------|--------|
| | | | | | | P355QH1 | P460QH |
| 25 | 1" | 33,7 | 4,0 | 125 | 25,7 | X | --- |
| 50 | 2" | 60,3 | 5,6 | 165 | 49,1 | X | --- |
| 80 | 3" | 88,9 | 5,6 | 210 | 77,7 | X | --- |
| 100 | 4" | 114,3 | 6,3 | 275 | 101,7 | X | --- |
| 150 | 6" | 168,3 | 7,1 | 355 | 154,1 | X | --- |
| 200 | 8" | 219,1 | 8,0 | 420 | 203,1 | X | --- |
| 250 | 10" | 273 | 10,0 | 510 | 253,0 | X | --- |
| 300 | 12" | 323,9 | 11,0 | 560 | 301,9 | X | --- |
| 350 | 14" | 355,6 | 12,5 | 605 | 330,6 | X | --- |
| 400 | 16" | 406,4 | 14,2 | 685 | 378,0 | X | --- |
| 450 | 18" | 457 | 11,0 | 745 | 435,0 | --- | X |
| 500 | 20" | 508 | 11,0 | 815 | 486,0 | --- | X |
| 600 | 24" | 610 | 12,5 | 940 | 585,0 | --- | X |

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9.1.1 Technical Specification, Flange WN, ASME B16.5, Class 600, RJ

Part:

Flange, Welding Neck

Pressure rating:

ASME B16.5, Class 600

Design:

- Flange facing RJ
- Tolerances:
 - according to ASME B16.5
- Preparation of welding ends in accordance with Section 3.10 of this document (unless otherwise stated in the inquiry / purchase order documents)

Material:

- P355QH1, P460QH
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base Material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 354/3, VdTÜV material data sheet 357/3 and additionally AD 2000 W13 for flanges produced by machining
- Product in accordance to AD 2000-W9 with ultrasonic testing of the welding ends at a Width of 25 mm for laminations according to DIN EN ISO 10893-8
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or finished part

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

according to AD 2000-W9, section 5 with heat number

Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

9.2 Flange WN, ASME B16.47, Class 600, RJ

Legend

DN = Nominal Diameter (Nominal Pipe Size)

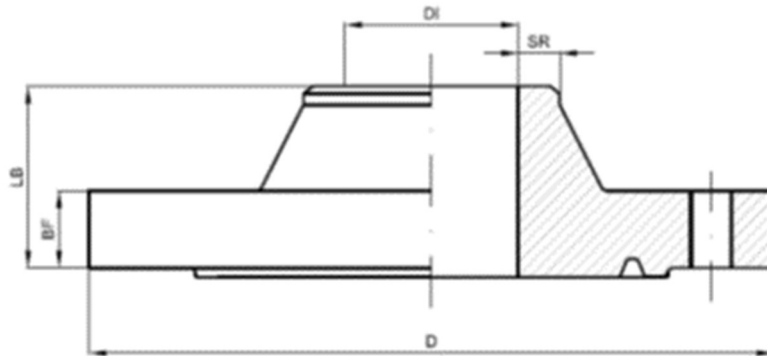
D = Outside Diameter of Flange (mm)

DA = Outside Diameter of pipe connection (mm)


SR = Wall thickness of pipe connection (mm)

LB = Overall length (mm) equals to "Y" from ASME

BF = Flange thickness (mm) equals to "t_f" from ASME



| DN | NPS | DA (mm) | SR (mm) | D (mm) | DI (mm) | Material P460QH |
|------|-----|------------|------------|-----------|------------|--------------------|
| 700 | 28" | 711 | 14,2 | 1075 | 682,6 | X |
| 750 | 30" | 762 | 14,2 | 1130 | 733,6 | X |
| 800 | 32" | 813 | 16,0 | 1194 | 781,0 | X |
| 900 | 36" | 914 | 17,5 | 1314 | 879,0 | X |
| 1000 | 40" | 1016 | 20,0 | 1321 | 976,0 | X |
| 1100 | 44" | 1118 | 22,2 | 1454 | 1073,6 | X |
| 1200 | 48" | 1219 | 22,2 | 1594 | 1174,6 | X |
| 1400 | 56" | 1422 | 28,5 | 1854 | 1365,0 | X |

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9.2.1 Technical Specification, Flange WN, ASME B16.47, Class 600, RJ

Part:

Flange Welding Neck

Pressure rating:

ASME B16.47 Series A, Class 600

Design:

- Flange facing RJ
- Tolerances:
 - Pipe connection - 0.5 mm / + 0.5 mm
 - Other according to ASME B16.47 Series A
- Preparation of welding ends in accordance with Section 3.10 of this document (unless otherwise stated in the inquiry / purchase order documents)

Material:

- P460QH
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 357/3 and additionally AD 2000 W13 for flanges produced by machining
- A yield strength $R_{p0.2}$ of at least 400 N/mm² must be guaranteed by the manufacturer.
- Product in accordance to AD 2000-W9 with ultrasonic testing of the welding ends at a Width of 25 mm for laminations according to DIN EN ISO 10893-8
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or finished part

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

according to AD 2000-W9, section 5 with heat number

Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

9.3 Flange WN, ASME B16.5, Class 600, RF

Legend

DN = Nominal Diameter (Nominal Pipe Size)

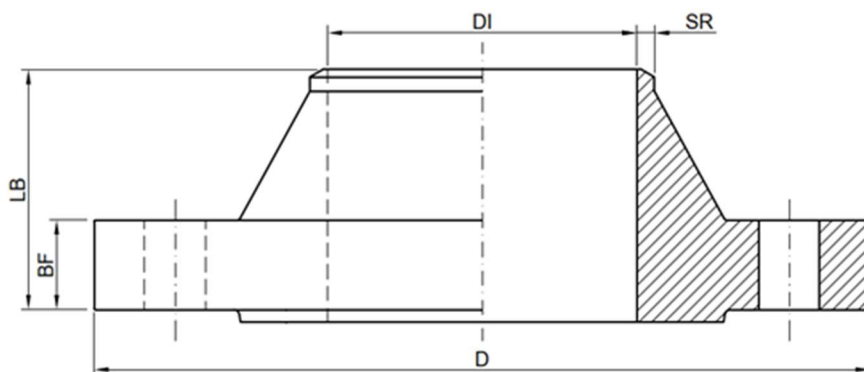
D = Outside Diameter of Flange (mm)

DA = Outside Diameter of pipe connection (mm)


SR = Wall thickness of pipe connection (mm)

LB = Overall length (mm) equals to "Y" from ASME

BF = Flange thickness (mm) equals "t_f" from ASME



| DN | NPS | DA (mm) | SR (mm) | D (mm) | DI (mm) | Material | |
|-----|-----|------------|------------|-----------|------------|----------|--------|
| | | | | | | P355QH1 | P460QH |
| 25 | 1" | 33,7 | 4,0 | 125 | 25,7 | X | --- |
| 50 | 2" | 60,3 | 5,6 | 165 | 49,1 | X | --- |
| 80 | 3" | 88,9 | 5,6 | 210 | 77,7 | X | --- |
| 100 | 4" | 114,3 | 6,3 | 275 | 101,7 | X | --- |
| 150 | 6" | 168,3 | 7,1 | 355 | 154,1 | X | --- |
| 200 | 8" | 219,1 | 8,0 | 420 | 203,1 | X | --- |
| 250 | 10" | 273 | 10,0 | 510 | 253,0 | X | --- |
| 300 | 12" | 323,9 | 11,0 | 560 | 301,9 | X | --- |
| 350 | 14" | 355,6 | 12,5 | 605 | 330,6 | X | --- |
| 400 | 16" | 406,4 | 14,2 | 685 | 378,0 | X | --- |
| 450 | 18" | 457 | 11,0 | 745 | 435,0 | --- | X |
| 500 | 20" | 508 | 11,0 | 815 | 486,0 | --- | X |
| 600 | 24" | 610 | 12,5 | 940 | 585,0 | --- | X |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

9.3.1 Technical Specification, Flange WN, ASME B16.5, Class 600, RF

Part:

Flange Welding Neck

Pressure rating:

ASME B16.5, Class 600

Design:

- Flange facing RF
- Tolerances:
 - according to ASME B16.5
- Preparation of welding ends in accordance with Section 3.10 of this document (unless otherwise stated in the inquiry / purchase order documents)

Material:

- P355QH1, P460QH
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 354/3 and additionally AD 2000 W13 for flanges produced by machining
- Product in accordance to AD 2000-W9 with ultrasonic testing of the welding ends at a Width of 25 mm for laminations according to DIN EN ISO 10893-8
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or finished part

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

according to AD 2000-W9, section 5 with heat number

Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

9.4 Flange WN, ASME B16.47, Class 600, RF

Legend

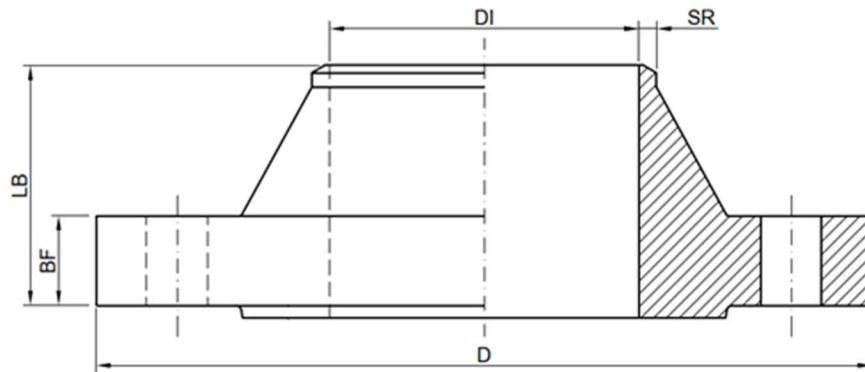
DN = Nominal Diameter (Nominal Pipe Size)

D = Outside Diameter of Flange (mm)


DA = Outside Diameter of pipe connection (mm)

SR = Wall thickness of pipe connection (mm)

LB = Overall length (mm) equals to "Y" from ASME

BF = Flange thickness (mm) equals to "t_f" from ASME

| DN | NPS | DA (mm) | SR (mm) | D (mm) | DI (mm) | Material P460QH |
|------|-----|------------|------------|-----------|------------|--------------------|
| 700 | 28" | 711 | 14,2 | 1075 | 682,6 | X |
| 750 | 30" | 762 | 14,2 | 1130 | 733,6 | X |
| 800 | 32" | 813 | 16 | 1195 | 781,0 | X |
| 900 | 36" | 914 | 17,5 | 1315 | 879,0 | X |
| 1000 | 40" | 1016 | 20,0 | 1320 | 976,0 | X |
| 1100 | 44" | 1118 | 22,2 | 1455 | 1073,6 | X |
| 1200 | 48" | 1219 | 22,2 | 1595 | 1174,6 | X |
| 1400 | 56" | 1422 | 28,5 | 1855 | 1365,0 | X |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

9.4.1 Technical Specification, Flange WN, ASME B16.47, Class 600, RF

Part:

Flange Welding Neck

Pressure rating:

ASME B16.47, Series A, Class 600

Design:

- Flange facing RF
- Tolerances:
 - Pipe connection - 0.5 mm / + 0.5 mm
 - Other according to ASME B16.47 Series A
- Preparation of welding ends in accordance with Section 3.10 of this document (unless otherwise stated in the inquiry / purchase order documents)

Material:

- P460QH
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Basic material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 357/3 and additionally AD 2000 W13 for flanges produced by machining
- A yield strength Rp0.2 of at least 400 N/mm² must be guaranteed by the manufacturer.
- Finished part in accordance to AD 2000-W9 with ultrasonic testing of the welding ends at a Width of 25 mm for laminations according to DIN EN ISO 10893-8
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the basic material or finished part

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

according to AD 2000-W9, section 5 with heat number

Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

10 Flanges, blind-type with threaded bore

10.1 Flange blind-type, ASME B16.5, Class 600, RJ, with NPT thread

Legend

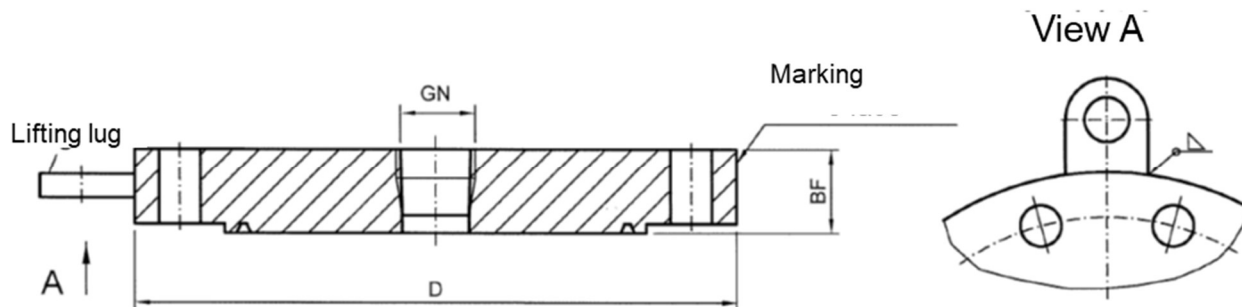
DN = Nominal Diameter (Nominal Pipe Size)

D = Outside Diameter of Flange (mm)

BF = Minimum Thickness (mm) including Flange Facing

GN = Nominal thread size

TYP = Thread type




Threaded bore according to ASME B1.20.1

For NPS ≥ 12" shall be provided with lifting lug in accordance with [Appendix G](#) of this Pipe Class.

100% surface crack inspection of the weld seam.

| DN | NPS | D (mm) | GN | Typ | Lifting lug Nominal size | Material | |
|-----|-----|-----------|------|-----|-----------------------------|----------|--------|
| | | | | | | P355QH1 | P460QH |
| 25 | 1" | 125 | 1/2" | NPT | ---- | X | --- |
| 50 | 2" | 165 | 1/2" | NPT | ---- | X | --- |
| 80 | 3" | 210 | 1/2" | NPT | ---- | X | --- |
| 100 | 4" | 273 | 1/2" | NPT | ---- | X | --- |
| 150 | 6" | 355 | 1" | NPT | ---- | X | --- |
| 200 | 8" | 420 | 1" | NPT | ---- | X | --- |
| 250 | 10" | 510 | 1" | NPT | ---- | X | --- |
| 300 | 12" | 560 | 1" | NPT | 1 | X | --- |
| 350 | 14" | 605 | 1" | NPT | 1 | X | --- |
| 400 | 16" | 685 | 1" | NPT | 1 | X | --- |
| 450 | 18" | 745 | 1" | NPT | 1 | --- | X |
| 500 | 20" | 815 | 1" | NPT | 1 | --- | X |
| 600 | 24" | 940 | 1" | NPT | 2 | --- | X |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

10.1.1 Technical Specification, Flange blind-type, ASME B16.5, Class 600, RJ

Part:

Flange blind-type, with NPT threaded bore

Pressure rating:

ASME B16.5, Class 600

Design:

- Flange facing RJ
- NPT threaded bore according to ASME B1.20.1
- For NPS ≥ 12 " with lifting lug in accordance with Appendix G of this Pipe Class

Material:

- P355QH1, P460QH
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 354/3 and additionally AD 2000 W13 for flanges produced by machining
- Product according to AD 2000-W9
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or product

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

- according to AD 2000-W9, section 5 with heat number
- Additional marking: Nominal thread size NPT

Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

10.2 Flange blind-type, ASME B16.47, Class 600, RJ, with NPT thread

Legend

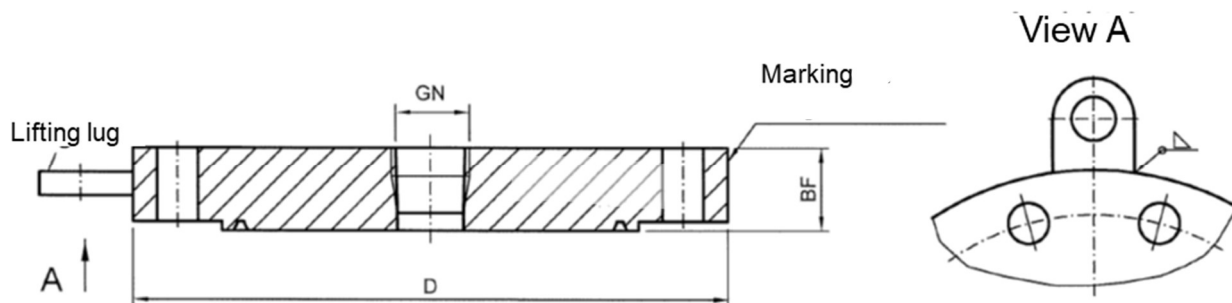
DN = Nominal Diameter (Nominal Pipe Size)

D = Outside Diameter of Flange (mm)

BF = Minimum Thickness (mm) including Flange Facing

GN = Nominal thread size

TYP = Thread type




Threaded bore according to ASME B1.20.1

With lifting lug in accordance with Appendix G of this Pipe Class.

100% surface crack inspection of the weld seam.

| DN | NPS | D (mm) | GN | Typ | Lifting lug Nominal size | Material P460QH |
|------|-----|-----------|----|-----|-----------------------------|--------------------|
| 700 | 28" | 1075 | 1" | NPT | 2 | X |
| 750 | 30" | 1130 | 1" | NPT | 2 | X |
| 800 | 32" | 1195 | 1" | NPT | 2 | X |
| 900 | 36" | 1315 | 1" | NPT | 2 | X |
| 1000 | 40" | 1320 | 1" | NPT | 3 | X |
| 1100 | 44" | 1455 | 1" | NPT | 3 | X |
| 1200 | 48" | 1595 | 1" | NPT | 3 | X |
| 1400 | 56" | 1855 | 1" | NPT | 3 | X |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

10.2.1 Technical Specification, Flange blind-type, ASME B16.47, Class 600, RJ, with NPT thread

Part:

Flange blind-type, with NPT threaded bore

Pressure rating:

ASME B16.47, Class 600

Design:

- Flange facing RJ
- NPT threaded hole according to ASME B1.20.1
- With lifting lug in accordance with Appendix G of this Pipe Class

Material:

- P460QH
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 354/3 and additionally AD 2000 W13 for flanges produced by machining
- Product according to AD 2000-W9
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or product

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

- according to AD 2000-W9, section 5 with heat number
- Additional marking: Nominal thread size NPT

Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

10.3 Flange blind-type, ASME B16.5, Class 600, RF, with NPT thread

Legend

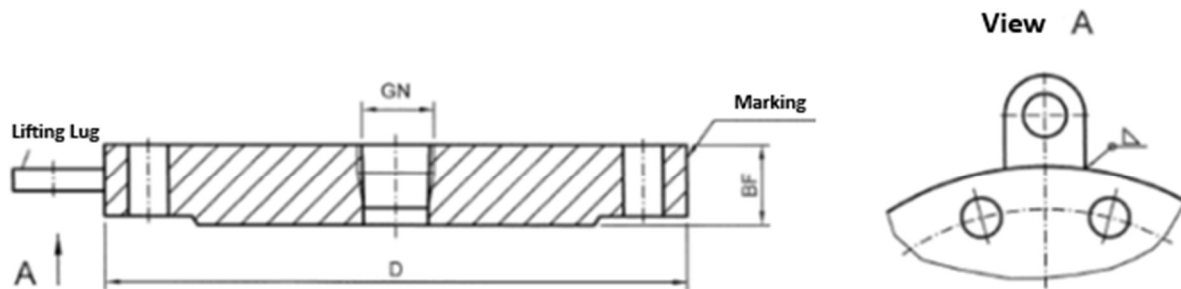
DN = Nominal Diameter (Nominal Pipe Size)

D = Outside Diameter of Flange (mm)

BF = Minimum Thickness (mm) including Flange Facing

GN = Nominal thread size

TYP = Thread type




Threaded bore according to ASME B1.20.1

For NPS ≥ 12" with lifting lug in accordance with [Appendix G](#) of this Pipe Class.

100% surface crack inspection of the weld seam.

| DN | NPS | D (mm) | GN | Typ | Lifting lug Nominal size | Material | |
|-----|-----|-----------|------|-----|-----------------------------|----------|--------|
| | | | | | | P355QH1 | P460QH |
| 25 | 1" | 125 | 1/2" | NPT | ---- | X | --- |
| 50 | 2" | 165 | 1/2" | NPT | ---- | X | --- |
| 80 | 3" | 210 | 1/2" | NPT | ---- | X | --- |
| 100 | 4" | 275 | 1/2" | NPT | ---- | X | --- |
| 150 | 6" | 355 | 1" | NPT | ---- | X | --- |
| 200 | 8" | 420 | 1" | NPT | ---- | X | --- |
| 250 | 10" | 510 | 1" | NPT | ---- | X | --- |
| 300 | 12" | 560 | 1" | NPT | 1 | X | --- |
| 350 | 14" | 605 | 1" | NPT | 1 | X | --- |
| 400 | 16" | 685 | 1" | NPT | 1 | X | --- |
| 450 | 18" | 745 | 1" | NPT | 1 | --- | X |
| 500 | 20" | 815 | 1" | NPT | 1 | --- | X |
| 600 | 24" | 940 | 1" | NPT | 2 | --- | X |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

10.3.1 Technical Specification, Flange blind-type, ASME B16.5, Class 600, RF, with NPT thread

Part:

Flange blind-type, with NPT threaded bore

Pressure rating:

ASME B16.5, Class 600

Design:

- Flange facing RF
- NPT threaded hole according to ASME B1.20.1
- For NPS ≥ 12 " with lifting lug in accordance with Appendix G of this Pipe Class

Material:

- P355QH1
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 354/3 and additionally AD 2000 W13 for flanges produced by machining
- Product according to AD 2000-W9
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or product

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

- according to AD 2000-W9, section 5 with heat number
- Additional marking: Nominal thread size NPT

Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

10.4 Flange blind-type, ASME B16.47, Class 600, RF, with NPT thread

Legend

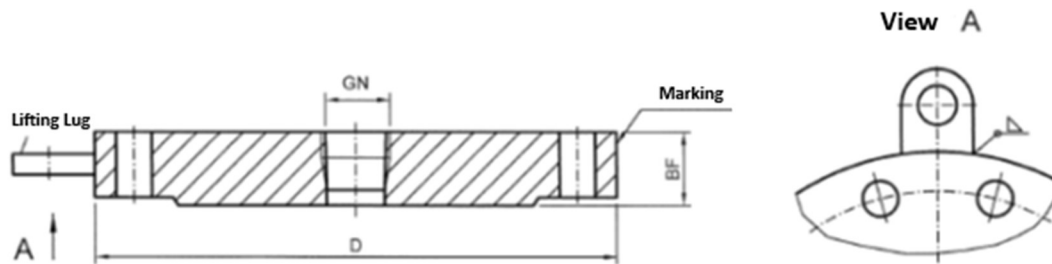
DN = Nominal Diameter (Nominal Pipe Size)

D = Outside Diameter of Flange (mm)

BF = Minimum Thickness (mm) including Flange Facing

GN = Nominal thread size

TYP = Thread type




Threaded bore according to ASME B1.20.1

With lifting lug in accordance with Appendix G of this Pipe Class.

100% surface crack inspection of the weld seam.

| DN | NPS | D (mm) | GN | Typ | Lifting lug Nominal size | Material P460QH |
|------|-----|-----------|----|-----|-----------------------------|--------------------|
| 700 | 28" | 1075 | 1" | NPT | 2 | X |
| 750 | 30" | 1130 | 1" | NPT | 2 | X |
| 800 | 32" | 1195 | 1" | NPT | 2 | X |
| 900 | 36" | 1315 | 1" | NPT | 2 | X |
| 1000 | 40" | 1320 | 1" | NPT | 3 | X |
| 1100 | 44" | 1455 | 1" | NPT | 3 | X |
| 1200 | 48" | 1595 | 1" | NPT | 3 | X |
| 1400 | 56" | 1855 | 1" | NPT | 3 | X |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

10.4.1 Technical Specification, Flange blind-type, ASME B16.47, Class 600, RF, with NPT thread

Part:

Flange blind-type, with NPT threaded bore

Pressure rating:

ASME B16.47, Class 600

Design:

- Flange rating RF
- NPT threaded hole according to ASME B1.20.1
- With lifting lug in accordance with Appendix G of this Pipe Class

Material:

- P460QH
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 354/3 and additionally AD 2000 W13 for flanges produced by machining
- Product according to AD 2000-W9
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or product

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

- according to AD 2000-W9, section 5 with heat number
- Additional marking: Nominal thread size NPT

Scope of delivery :

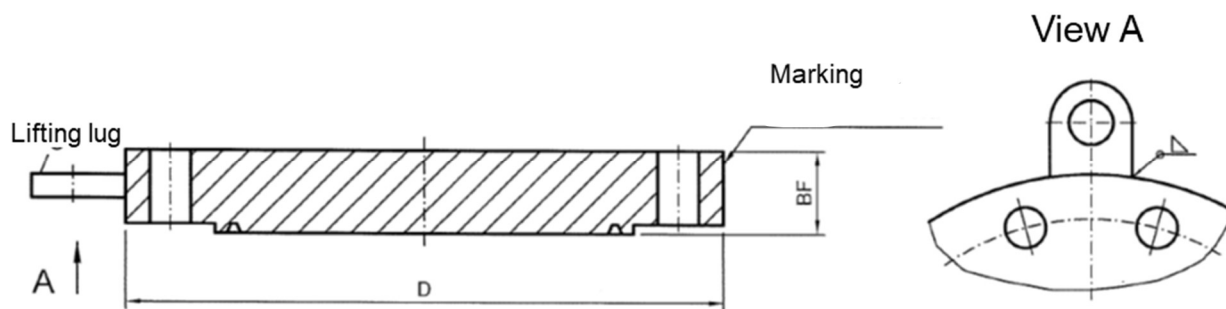
The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

11 Blind Flanges

11.1 Blind Flange, ASME B16.5, Class 600, RJ


Blind Flanges without threaded bore are NOT permitted for above-ground pipework.

Legend
 DN = Nominal Diameter (Nominal Pipe Size)
 D = Outer diameter flange (mm)
 BF = Minimum Thickness (mm) including Flange Facing



For NPS ≥ 12" with lifting lug in accordance with Appendix G of this Pipe Class.
 100% surface crack inspection of the weld seam.

| DN | NPS | D (mm) | Lifting lug Nominal size | Material | |
|-----|-----|-----------|-----------------------------|----------|--------|
| | | | | P355QH1 | P460QH |
| 25 | 1" | 123,8 | ---- | X | --- |
| 50 | 2" | 165,1 | ---- | X | --- |
| 80 | 3" | 209,5 | ---- | X | --- |
| 100 | 4" | 273 | ---- | X | --- |
| 150 | 6" | 355,6 | ---- | X | --- |
| 200 | 8" | 419,1 | ---- | X | --- |
| 250 | 10" | 508,0 | ---- | X | --- |
| 300 | 12" | 558,8 | 1 | X | --- |
| 350 | 14" | 603,3 | 1 | X | --- |
| 400 | 16" | 686,0 | 1 | X | --- |
| 450 | 18" | 743,0 | 1 | --- | X |
| 500 | 20" | 813,0 | 1 | --- | X |
| 600 | 24" | 940,0 | 2 | --- | X |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

11.1.1 Technical Specification, Blind Flange, ASME B16.5, Class 600, RJ

Part:

Blind Flange

Pressure rating:

ASME B16.5, Class 600

Design:

- Flange facing RJ
- For NPS ≥ 12 " with lifting lug in accordance with Appendix G of this Pipe Class

Material:

- P355QH1
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 354/3 and additionally AD 2000 W13 for flanges produced by machining
- Product according to AD 2000-W9
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or product

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

according to AD 2000-W9, section 5 with heat number

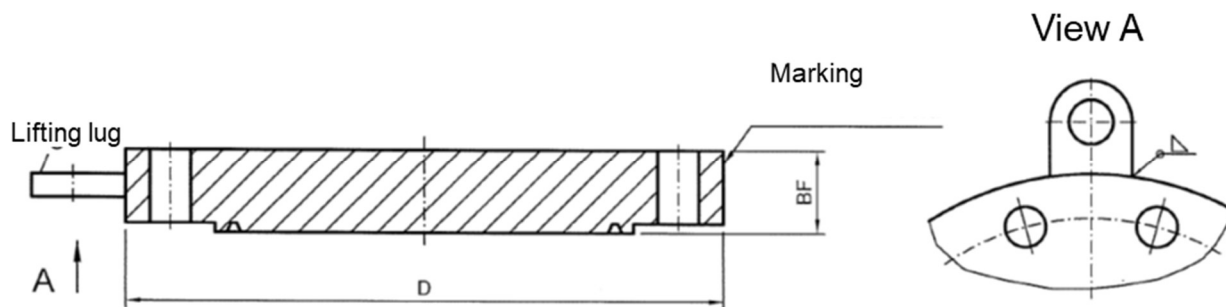
Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

11.2 Blind Flange, ASME B16.47, Class 600, RJ


Blind Flanges without threaded bore are NOT permitted for above-ground pipework.

Legend
DN = Nominal Diameter (Nominal Pipe Size)
D = Outside Diameter of Flange (mm)
BF = Minimum Thickness (mm) including Flange Facing



With lifting lug in accordance with [Appendix G](#) of this Pipe Class.
100% surface crack inspection of the weld seam.

| DN | NPS | D (mm) | Lifting lug Nominal size | Material P460QH |
|------|-----|-----------|-----------------------------|--------------------|
| 700 | 28" | 1075 | 2 | X |
| 750 | 30" | 1130 | 2 | X |
| 800 | 32" | 1195 | 2 | X |
| 900 | 36" | 1315 | 2 | X |
| 1000 | 40" | 1320 | 3 | X |
| 1100 | 44" | 1455 | 3 | X |
| 1200 | 48" | 1595 | 3 | X |
| 1400 | 56" | 1855 | 3 | X |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

11.2.1 Technical Specification, Blind Flange, ASME B16.47, Class 600, RJ

Part:

Blind Flange

Pressure rating:

ASME B16.47, Series A, Class 600

Design:

- Flange facing RJ
- With lifting lug in accordance with Appendix G of this Pipe Class

Material:

- P460QH
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 357/3 and additionally AD 2000 W13 for flanges produced by machining
- Product according to AD 2000-W9
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or product

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

according to AD 2000-W9, section 5 with heat number

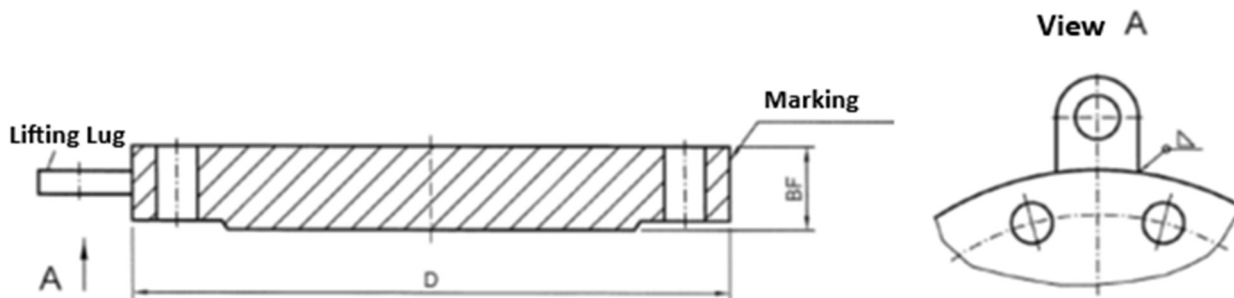
Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

11.3 Blind Flange, ASME B16.5, Class 600, RF


Blind Flanges without threaded bore are NOT permitted for above-ground pipework.

Legend
DN = Nominal Diameter (Nominal Pipe Size)
D = Outside Diameter of Flange (mm)
BF = Minimum Thickness (mm) including Flange Facing



For NPS ≥ 12" with lifting lug in accordance with [Appendix G](#) of this Pipe Class.
100% surface crack inspection of the weld seam.

| DN | NPS | D (mm) | Lifting lug Nominal size | Material | |
|-----|-----|-----------|-----------------------------|----------|--------|
| | | | | P355QH1 | P460QH |
| 25 | 1" | 123,8 | ---- | X | --- |
| 50 | 2" | 165,1 | ---- | X | --- |
| 80 | 3" | 209,5 | ---- | X | --- |
| 100 | 4" | 273 | ---- | X | --- |
| 150 | 6" | 355,6 | ---- | X | --- |
| 200 | 8" | 419,1 | ---- | X | --- |
| 250 | 10" | 508,0 | ---- | X | --- |
| 300 | 12" | 558,8 | 1 | X | --- |
| 350 | 14" | 603,3 | 1 | X | --- |
| 400 | 16" | 686,0 | 1 | X | --- |
| 450 | 18" | 743,0 | 1 | --- | X |
| 500 | 20" | 813,0 | 1 | --- | X |
| 600 | 24" | 940,0 | 2 | --- | X |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

11.3.1 Technical Specification, Blind Flange, ASME B16.5, Class 600 RF

Part:

Blind Flange

Pressure rating:

ASME B16.5, Class 600

Design:

- Flange facing RF
- For NPS ≥ 12 " with lifting lug in accordance with Appendix G of this Pipe Class

Material:

- P355QH1, P460QH
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 354/3 and additionally AD 2000 W13 for flanges produced by machining
- Product according to AD 2000-W9
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or product

Certification:

Inspection certificate 3.2 according to DIN EN 10204

Marking:

according to AD 2000-W9, section 5 with heat number

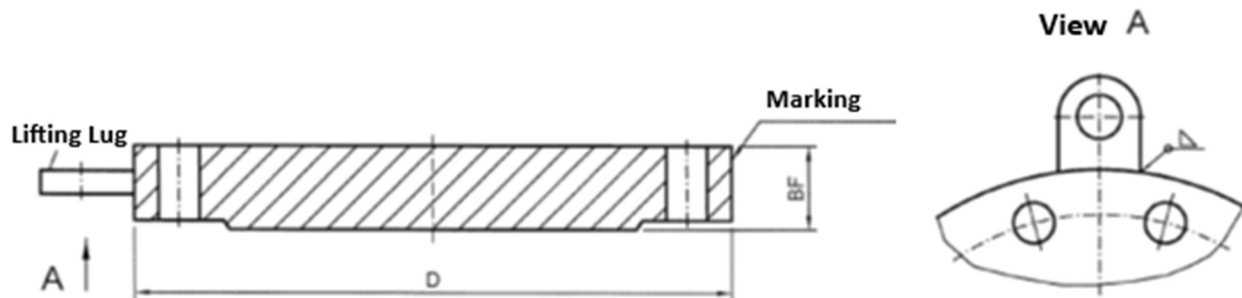
Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

11.4 Blind Flange, ASME B16.47, Class 600, RF


Blind Flanges without threaded bore are NOT permitted for above-ground pipework.

Legend
DN = Nominal Diameter (Nominal Pipe Size)
D = Outside Diameter of Flange (mm)
BF = Minimum Thickness (mm) including Flange Facing



For NPS ≥ 12" with lifting lug in accordance with Appendix G of this Pipe Class.
100% surface crack inspection of the weld seam.

| DN | NPS | D (mm) | Lifting lug Nominal Size | Material P460QH |
|------|-----|-----------|-----------------------------|--------------------|
| 700 | 28" | 1075 | 2 | X |
| 750 | 30" | 1130 | 2 | X |
| 800 | 32" | 1195 | 2 | X |
| 900 | 36" | 1315 | 2 | X |
| 1000 | 40" | 1320 | 2 | X |
| 1100 | 44" | 1455 | 3 | X |
| 1200 | 48" | 1595 | 3 | X |
| 1400 | 56" | 1855 | 3 | X |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

11.4.1 Technical Specification, Blind Flange, ASME B16.47, Class 600, RF

Part:

Blind Flange

Pressure rating:

ASME B16.47, Series A, Class 600

Design:

- Flange facing RF
- With lifting lug in accordance with Appendix G of this Pipe Class

Material:

- P460QH
- DIN EN 10222-4

Technical delivery conditions and requirements:

Material requirements and tests:

- Base material according to DIN EN 10222-4, AD 2000 W10, VdTÜV material sheet 357/3 and additionally AD 2000 W13 for flanges produced by machining
- Product according to AD 2000-W9
- Charpy Impact Test at -20°C or lower temperature
 - Charpy Impact Test values according to material standard
 - Depending on the manufacturing process on the base material or product

Certification:


Inspection certificate 3.2 according to DIN EN 10204

Marking:

according to AD 2000-W9, section 5 with heat number

Scope of delivery :

The required inspection certificates according to DIN EN 10204 are part of the scope of delivery, i.e. the delivery is considered complete after receipt of the goods and the certificates at the specified place of delivery.

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

12 Gaskets

12.1 Ring Gasket, oval

12.2 Grooved Metal Gaskets with Covering Layers

13 Bolts and Nuts

13.1 Stud Bolts, with two Heavy Hex Nuts

14 Bleeder Plug

14.1 Bleeder Plug with NPT thread

14.2 Threaded Plug with Hex Head

15 Weld-On Sockets

15.1 Weld-On Socket on main pipe \leq DN400

15.2 Weld-On Socket on main pipe \geq DN500

16 Nipples

16.1 Small Nipple on main pipe \leq DN400

16.2 Nipple DN 100 on main pipe \leq DN400

16.3 Small Nipple on main pipe \geq DN500

16.4 Nipple DN100 on main pipe \geq DN 500

16.5 Double-Nipple for hexagonal wrench, with NPT- Thread

17 Line Blanks

17.1 Spectacle Blank, for ASME B16.5, Class 600, RF

17.2 Spectacle Blank, for ASME B16.5, Class 600, RJ


17.3 Paddle Blank, ASME B16.47, Class 600, RF

17.4 Paddle Blank, for ASME B16.47, Class 600, RJ

17.5 Paddle Spacer, ASME B16.5, Class 600, RF

17.6 Paddle Spacer, ASME B16.47, Class 600, RF


17.7 Paddle Spacer for ASME B16.47, Class 600, RJ

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

Appendix A: Specification of the technical delivery conditions for piping components


A1 Welded fittings and fittings manufactured from welded pipes

| | | L360NE | L485ME |
|---|--|---|-----------------------------|
| A.1.1 For pipe body: | | | |
| Yield strength ratio | | ≤ 85 % | ≤ 90 % |
| 100 % ultrasonic testing in the pipe body for laminations | | DIN EN ISO 10893-8 / 9 | |
| 100 % ultrasonic inspection at plate edges for laminations | | DIN EN ISO 10893-8 / 9 | |
| 100 % ultrasonic inspection of the welding ends at a width of 50 mm for laminations | | DIN EN ISO 10893-8 | |
| A.1.2 For weld seams: | | | |
| Welded seam design | | HFI | Longitudinally seam, welded |
| Inside weld bead | | Grinded on the outside and inside 0.3 mm +0.05*t up to max. 1.5 mm | ----- |
| 100 % ultrasonic inspection of the weld seam including the pipe ends for longitudinal defects | | DIN EN ISO 10893-10 or DIN EN ISO 10893-11 | |
| Weld seam bending test | | One sample per lot Orientation and position according to DIN EN ISO 3183 Table A.8 | |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

A.2 Seamless pipes and fittings manufactured from seamless pipes

| | | L360NE | L485QE |
|---|--|---|---------------|
| Grain size | | according to ASTM E 112 max. grain size according to ASTM 8 | |
| Yield strength ratio | | ≤ 85 % | ≤ 90 % |
| 100 % ultrasonic testing in the pipe body for laminations | | DIN EN ISO 10893-8 / 9 | |
| 100 % ultrasonic inspection of welding ends for laminations | | DIN EN ISO 10893-8 / 9 | |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

Appendix B: Supplementary H₂ requirements for pipes and pipe fittings

Supplementary H₂ requirements are not necessary in case there is a fracture mechanics assessment and hardness test already been carried out for the same or comparable steel grade and hydrogen suitability has been confirmed.

The DVGW final report on the SyWeSt H₂ *) research project can serve as a source of information here.


Appendix F of this Pipe Class contains a list of the steel grades tested in this research project and found to be suitable for H₂.

If such hydrogen suitability cannot be demonstrated, a fracture mechanics assessment and hardness test in accordance with Table B1 must be carried out on pipes and fittings manufactured from pipes.

Table B.1

| Fracture mechanical evaluation | DVGW G 463 (A) and DVGW G 464 (M) Execution per steel grade |
|---|--|
| Crack propagation da/dN | ASME B31.12 PL-3.7.1 and Table PL 3.7.1.-5 -Test basis ASTM E647 |
| Fracture toughness K_{IC} or J-R | ASME B31.12 PL-3.7.1 and Table PL 3.7.1.-5 Unique proof that the fracture toughness under the medium hydrogen fulfils the condition $K_{IC} > 55 \text{ Mpa}\sqrt{\text{m}}$. The characteristic values K_{IC} and J-R must be determined on the basis of ASTM E399 and ASTM E1820. |
| -Test parameters for crack propagation and fracture toughness | -Test pressure $\geq 100 \text{ bar}$ -Test frequency $\leq 1 \text{ Hz}$ -Load ratio $R = K_{min}/K_{max} = 0.5$ -Sufficient exposure time and purity of the hydrogen atmosphere during the test |

**) DVGW project SyWeSt H₂, Random testing of steel materials for gas pipelines and systems to assess their suitability for hydrogen - final report January 2023*

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

Appendix C: Deviations from the MSW specifications of the GUNL

C.1 MSW-01-E , Pipe for gas lines

The following sections / contents from the **MSW-01-E** specification are **supplemented** for the implementation of this Pipe Class:

| Section No: | Heading (title) | Description | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|-------------------------------|--|---|---------------------------|--|--|--|----------|----------|-----|------|---------------------------|----------------|-------------------------------|----------------------------------|--|-------------|----------------|--------|--------|------------------|------------------|-----------------|-------------|-------------|------------------|------------------|
| 1 | SCOPE AND APPLICATION | <table><tr><th colspan="5">Table 1, Allowed pipe type and steel quality per diameter</th></tr><tr><th>Diameter</th><th>Seamless</th><th>HFI</th><th>SAWL</th><th>SAWH (excluding stations)</th></tr><tr><td>100 ≤ DN ≤ 500</td><td>L245NE L360NE/QE L415QE</td><td>L245ME/NE L360ME/NE L415ME</td><td>L245ME/NE L360ME/NE L415ME L485ME</td><td>not allowed</td></tr><tr><td>500 < DN ≤ 600</td><td>L415QE</td><td>L415ME</td><td>L415ME L485ME</td><td>L415ME L485ME</td></tr><tr><td>600 < DN ≤ 1400</td><td>not allowed</td><td>not allowed</td><td>L415ME L485ME</td><td>L415ME L485ME</td></tr></table> | Table 1, Allowed pipe type and steel quality per diameter | | | | | Diameter | Seamless | HFI | SAWL | SAWH (excluding stations) | 100 ≤ DN ≤ 500 | L245NE L360NE/QE L415QE | L245ME/NE L360ME/NE L415ME | L245ME/NE L360ME/NE L415ME L485ME | not allowed | 500 < DN ≤ 600 | L415QE | L415ME | L415ME L485ME | L415ME L485ME | 600 < DN ≤ 1400 | not allowed | not allowed | L415ME L485ME | L415ME L485ME |
| Table 1, Allowed pipe type and steel quality per diameter | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Diameter | Seamless | HFI | SAWL | SAWH (excluding stations) | | | | | | | | | | | | | | | | | | | | | | | |
| 100 ≤ DN ≤ 500 | L245NE L360NE/QE L415QE | L245ME/NE L360ME/NE L415ME | L245ME/NE L360ME/NE L415ME L485ME | not allowed | | | | | | | | | | | | | | | | | | | | | | | |
| 500 < DN ≤ 600 | L415QE | L415ME | L415ME L485ME | L415ME L485ME | | | | | | | | | | | | | | | | | | | | | | | |
| 600 < DN ≤ 1400 | not allowed | not allowed | L415ME L485ME | L415ME L485ME | | | | | | | | | | | | | | | | | | | | | | | |
| | | Supplement for this Pipe Class | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | The following nominal sizes are added to the scope of application for the realisation of this Pipe Class: -DN 25 to DN 80 | | | | | | | | | | | | | | | | | | | | | | | | | |

| Section No: | Heading (title) | Description | | | | | | | | | | | | | | |
|--|-----------------------------------|---|--|-----------------------------------|------|---|--------------|-----|--------------|-----|--------------|-----|----------------|-----|----------------|-----|
| 1 | SCOPE AND APPLICATION | <p>Table A.13, CVN impact test temperature</p> <table><thead><tr><th>specified wall thickness <i>t</i> mm</th><th>CVN impact test temperature °C</th></tr></thead><tbody><tr><td>< 14</td><td>0</td></tr><tr><td>≥ 14 to < 19</td><td>-10</td></tr><tr><td>≥ 19 to < 23</td><td>-20</td></tr><tr><td>≥ 23 to < 25</td><td>-30</td></tr><tr><td>≥ 25 to < 27,5</td><td>-40</td></tr><tr><td>≥ 27,5 to < 30</td><td>-50</td></tr></tbody></table> | specified wall thickness <i>t</i> mm | CVN impact test temperature °C | < 14 | 0 | ≥ 14 to < 19 | -10 | ≥ 19 to < 23 | -20 | ≥ 23 to < 25 | -30 | ≥ 25 to < 27,5 | -40 | ≥ 27,5 to < 30 | -50 |
| specified wall thickness <i>t</i> mm | CVN impact test temperature °C | | | | | | | | | | | | | | | |
| < 14 | 0 | | | | | | | | | | | | | | | |
| ≥ 14 to < 19 | -10 | | | | | | | | | | | | | | | |
| ≥ 19 to < 23 | -20 | | | | | | | | | | | | | | | |
| ≥ 23 to < 25 | -30 | | | | | | | | | | | | | | | |
| ≥ 25 to < 27,5 | -40 | | | | | | | | | | | | | | | |
| ≥ 27,5 to < 30 | -50 | | | | | | | | | | | | | | | |
| | | Supplement for this Pipe Class | | | | | | | | | | | | | | |
| | | <p>The test temperature for the Charpy Impact Test can be found in the table above; for pipes laid above ground, the test temperature must be at least the lowest design temperature.</p> <p>The information in the MTO list must be observed.</p> | | | | | | | | | | | | | | |

| | | |
|---------|---|---------|
| gasunie | Pipe Class for pipelines PN 84 with H ₂ -requirements | |
| | TSP-04G01-50_E | Rev. 02 |

C.2 MSW-05-E , Induction bends DN 100 and larger

The following sections / contents from the **MSW-05-E** specification are **supplemented** for the implementation of this Pipe Class:

| Section No: | Heading (title) | Description |
|-------------|-----------------------|---|
| 1 | SCOPE AND APPLICATION | <p>This specification contains requirements for bends with a bending radius of 3·DN, 5·DN or 10·DN made from pipe by the induction bending process. These bends are for use in onshore natural gas pipeline systems with the following design conditions:</p> <ul style="list-style-type: none"> nominal diameter : $100 \leq DN \leq 1200$; design pressure : $0 \text{ bar} < P_d \leq 80,0 \text{ bar}$; design temperature : $-20 \text{ °C} < T_d \leq + 50 \text{ °C}$. |
| | | Supplement for this Pipe Class |
| | | The scope of application is extended by the nominal diameter DN 1400 and the design pressure is increased to 84 bar. |

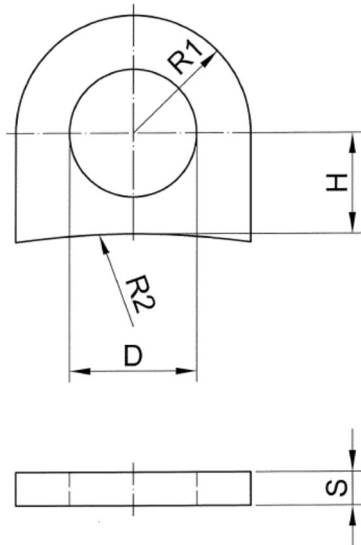
| Section No: | Heading (title) | Description | | | | | | | | | | | | | | |
|---------------------------------------|-----------------------------------|---|---------------------------------------|-----------------------------------|------|---|--------------|-----|--------------|-----|--------------|-----|----------------|-----|----------------|-----|
| 10 | TESTING END INSPECTION | <p>Table 3, Charpy V-notch impact test temperature</p> <table><thead><tr><th>specified wall thickness t mm</th><th>CVN impact test temperature °C</th></tr></thead><tbody><tr><td>< 14</td><td>0</td></tr><tr><td>≥ 14 to < 19</td><td>-10</td></tr><tr><td>≥ 19 to < 23</td><td>-20</td></tr><tr><td>≥ 23 to < 25</td><td>-30</td></tr><tr><td>≥ 25 to < 27,5</td><td>-40</td></tr><tr><td>≥ 27,5 to < 30</td><td>-50</td></tr></tbody></table> | specified wall thickness t mm | CVN impact test temperature °C | < 14 | 0 | ≥ 14 to < 19 | -10 | ≥ 19 to < 23 | -20 | ≥ 23 to < 25 | -30 | ≥ 25 to < 27,5 | -40 | ≥ 27,5 to < 30 | -50 |
| specified wall thickness t mm | CVN impact test temperature °C | | | | | | | | | | | | | | | |
| < 14 | 0 | | | | | | | | | | | | | | | |
| ≥ 14 to < 19 | -10 | | | | | | | | | | | | | | | |
| ≥ 19 to < 23 | -20 | | | | | | | | | | | | | | | |
| ≥ 23 to < 25 | -30 | | | | | | | | | | | | | | | |
| ≥ 25 to < 27,5 | -40 | | | | | | | | | | | | | | | |
| ≥ 27,5 to < 30 | -50 | | | | | | | | | | | | | | | |
| | | Supplement for this Pipe Class | | | | | | | | | | | | | | |
| | | <p>The test temperature for the Charpy Impact test can be found in the table above; for pipe bends installed above ground, the test temperature must be at least the lowest design temperature. The information in the MTO list must be observed.</p> | | | | | | | | | | | | | | |

Appendix D: Design of Baffle Plates**Appendix E: Bolting tightening torques****Appendix F: List of steel grades tested for H₂ suitability (informative)**

The following materials tested via the DVGW SyWeSt H₂ project have been found to be suitable for hydrogen according to the final report. And do not necessarily need to be re-evaluated:

| | Material | Product form |
|----|-----------------|---------------------|
| 01 | L290 NE | Pipe |
| 02 | 5L Grade A | Pipe |
| 03 | St35 | Pipe |
| 04 | 15k (St35) | Pipe |
| 05 | X42 | Pipe |
| 06 | RR St43.7 | Pipe |
| 07 | P355 NH/NL2 | Plate |
| 08 | L360NE | Pipe |
| 09 | L360NB (Melt 2) | Pipe |
| 10 | X46 I StE320.7 | Pipe |
| 11 | StE360.7 | Pipe |
| 12 | StE480.7 TM | Pipe |
| 13 | L360 NB | Pipe |
| 14 | 14HGS | Pipe |
| 15 | WSTE 420 | Plate |
| 16 | St53.7 | Pipe |
| 17 | X56.7 | Pipe |
| 18 | St60.7 | Pipe |
| 19 | P460 NH | Plate |
| 20 | X70 | Pipe |
| 21 | L485 | Pipe |
| 22 | L485 ME | Pipe |
| 23 | L485 (Melt 2) | Pipe |
| 24 | GRS550/X80 | Pipe |
| 25 | L415 | Pipe |
| 26 | P355 NL1 | Pipe |
| 27 | GJS400 | Ductile Cast iron |
| 28 | P460 QL1 | Plate |
| 29 | C22.3 | Forgging, steel bar |
| 30 | GS C25 N | Cast steel |
| 31 | TstE 355N | Plate |


Appendix G: Design of lifting lug



| Lifting lug Nominal size | D (mm) | H (mm) | S (mm) | R1 (mm) | R2 (mm) |
|-----------------------------|-----------|-----------|-----------|------------|--------------------------------------|
| 1 | 40 | 60 | 20 | 65 | Adapt to the flange axis diameter |
| 2 | 40 | 60 | 40 | 65 | |
| 3 | 50 | 75 | 60 | 75 | |

Requirements:

P265GH, DIN EN 10028-2, DIN EN 10204-3.1

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |


Appendix H: List of relevant regulations

Reference is made to the following regulations in connection with this Pipe Class; they are to be applied in the respective valid version.

| Regulation | Issue | Designation |
|-----------------------------|---------|--|
| GasHDLtgV | 05/2019 | Ordinance on high-pressure gas pipelines |
| DVGW G 463 (A) | 10/2021 | Gas pipes made of steel pipes for an operating pressure > 16 bar - Installation |
| DVGW G 464 (A) | 03/2023 | Fracture mechanics assessment concept for steel gas pipelines with a design pressure of more than 16 bar for the transport of hydrogen |
| DVGW G 492 (A) | 06/2021 | Gas measuring systems for operating pressures up to and including 100 bar; planning, production, installation, testing, commissioning, operation and maintenance |
| DVGW Information Gas No. 19 | 10/2019 | Flange connections in gas systems |
| AD-2000 | 2021 | Technical regulations for tanks, pipes and equipment |
| AD 2000 HP 5/3 | 12/2020 | Production and testing of joints - Non-destructive testing of welded joints |
| AD 2000 HP 8/3 | 03/2022 | Production and testing of fittings made of unalloyed and alloyed steels |
| AD 2000 W1 | 04/2020 | Flat products made of unalloyed and alloyed steels |
| AD 2000 W2 | 01/2024 | Austenitic and austenitic-ferritic steels |
| AD 2000-W7/1 | 05/2023 | Nuts and bolts made of ferritic steels |
| AD 2000 W9 | 07/2019 | Materials for low temperatures Ferrous materials |
| AD 2000 W10 | 05/2023 | Steel flanges |
| AD 2000 W13 | 07/2019 | Forgings and rolled parts made of unalloyed and alloyed steels |
| MSW-01 | 2023 | Material Specification Mechanical Pipe for natural gas lines Seamless and welded line pipe |
| MSW-05 | 2021 | Material Specification Mechanical Induction bends DN 100 and larger |
| DIN 267-13 | 05/2007 | Mechanical fasteners - Technical delivery conditions - Part 13: Parts for bolted joints with special mechanical properties for use at temperatures from -200 °C to +700 °C |
| DIN 2605 | 04/2007 | Pipe bend for welding in |
| DIN 3230-5 | 11/2014 | Technical delivery conditions for shut-off valves - Shut-off valves for gas pipelines and gas station piping - Part 5: Requirements and tests |
| DIN 28013 | 06/2012 | Curved shelves - basket arch shape |
| DIN 30690-1 | 05/2019 | Parts in gas supply systems - Part 1: Requirements for Parts in gas supply systems |
| DIN EN 1591-1 | 02/2021 | Flanges and their joints - Rules for the design of flanged joints with circular flanges and gasket - Part 1: Calculation |
| DIN EN 1591-4 | 12/2013 | Flanges and their joints - Part 4: Qualification of personnel for the assembly of bolted joints in pressurised systems in critical service |
| DIN EN 1594 | 11/2022 | Gas infrastructure - Pipelines for a maximum allowable working pressure above 16 bar - Functional requirements |

| Regulation | Issue | Designation |
|---------------------|---------|--|
| DIN EN 1759-1 | 02/2005 | Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, Class designated - Part 1: Steel flanges, NPS 1/2 to 24" |
| DIN EN 10028-2 | 10/2017 | Flat products made of steels for pressure purposes - Part 2: Non-alloy and alloy steels with specified elevated temperature properties |
| DIN EN 10028-3 | 10/2017 | Weldable fine-grained structural steels, normalised |
| DIN EN 10028-6 | 10/2017 | Flat products made of steels for pressure purposes - Part 6: Weldable fine grain structural steels, quenched and tempered |
| DIN EN 10088-3 | 12/2014 | Stainless steels - Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire rod, drawn wire, sections and bright products of corrosion resisting steels for general purposes |
| DIN EN 10160 | 09/1999 | Ultrasonic testing of flat steel products with a thickness greater than or equal to 6 mm (reflection method) |
| DIN EN 10204 | 01/2005 | Metallic products - Types of inspection certificates |
| DIN EN 10220 | 03/2003 | Seamless and welded steel pipes |
| DIN EN 10222-4 | 08/2021 | Weldable fine-grain structural steels with high yield strength |
| DIN EN 10222-5 | 06/2017 | Steel forgings for pressure purposes - Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels |
| DIN EN 10253-2 | 11/2021 | Unalloyed and alloyed ferritic steels with special testing requirements |
| DIN EN 10269 | 02/2014 | Steels and nickel alloys for fasteners for use at elevated and/or low temperatures |
| DIN EN 10272 | 10/2016 | Stainless steel bars for pressure vessels |
| DIN EN 10273 | 10/2016 | Hot-rolled weldable steel bars for pressure vessels with specified properties at elevated temperatures |
| DIN EN 12560-5 | 04/2001 | Flanges and their joints - Gaskets for Class-designated flanges - Part 5: Metal RJ gaskets for steel flanges |
| DIN EN 12560-6 | 03/2004 | Flanges and their joints - Gaskets for Class-designated flanges - Part 6: Comb profile gaskets for steel flanges |
| DIN EN 13555 | 04/2021 | Flanges and their joints - Gasket characteristics and test methods for the application of the rules for the design of flanged joints with circular flanges and gaskets |
| DIN ISO 2768-1 | 06/1991 | General tolerances; tolerances for linear and angular dimensions without individual tolerance entry |
| DIN EN ISO 3183 | 02/2020 | Steel pipes for pipeline transport systems |
| DIN EN ISO 5817 | 07/2023 | Welding - heat welded joints on steel, nickel, titanium and their alloys (without beam welding) |
| DIN EN ISO 7539-7 | 05/2018 | Corrosion of metals and alloys - Stress corrosion cracking test - Part 7: Slow strain rate test |
| DIN EN ISO 9692-1 | 12/2013 | Manual arc welding, gas-shielded arc welding, gas welding, TIG welding and beam welding of steels |
| DIN EN ISO 10893-8 | 10/2020 | Non-destructive testing of steel pipes - Part 8: Automated ultrasonic testing of seamless and welded steel pipes for the detection of laminar imperfections |
| DIN EN ISO 10893-9 | 10/2020 | Non-destructive testing of steel pipes - Part 9: Automated ultrasonic testing of strip/sheet used in the manufacture of welded steel pipes for the detection of laminar imperfections |
| DIN EN ISO 10893-10 | 10/2020 | Automated ultrasonic testing of seamless and welded (except submerged arc welded) steel pipes over the entire |

| Regulation | Issue | Designation |
|----------------------|---------|---|
| | | circumference of the pipe to detect imperfections in the longitudinal and/or transverse direction |
| DIN EN ISO 10893-11 | 10/2020 | Automated ultrasonic testing of the weld seam of welded steel pipes to detect imperfections in the longitudinal and/or transverse direction |
| DIN EN ISO 12737 | 02/2008 | Metallic materials - Determination of fracture toughness |
| DIN EN ISO 19598 | 04/2017 | Metallic coatings - Galvanic zinc and zinc alloy coatings on ferrous materials with additional Cr(VI)-free treatments |
| ASME B1.20.1 | 2013 | Pipe Threads, General Purpose, Inch |
| ASME B1.20.2m | 2006 | Pipe Threads, 60deg, General Purpose |
| ASME B16.5 | 2020 | Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard |
| ASME B16.47 Series A | 2020 | Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric/Inch Standard |
| ASME B16.20 | 2017 | Metallic Gaskets for Pipe Flanges |
| ASME B18.2.2 | 2022 | Nuts for General Applications: Machine Screw Nuts and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series) |
| ASME B31.12 | 2023 | Hydrogen Piping and Pipelines |
| ASTM E112 | 2013 | Standard Test Methods for Determining Average Grain Size |
| ASTM E399 | 2023 | Standard Test Method for Linear-Elastic Plane-Strain Fracture Toughness of Metallic Materials |
| ASTM E647 | 2023 | Standard Test Method for Measurement of Fatigue Crack Growth Rates |
| ASTM E1820 | 2023 | Standard Test Method for Measurement of Fracture Toughness |
| VdTÜV-MB 1055 | 02/1970 | Guideline for the end machining of pipes, fittings and valves for pipelines |
| VdTÜV-MB 1062 | 02/2023 | Guideline for the manufacture and testing of pipelines |
| VdTÜV-WB 354/1 | 09/2020 | Weldable fine-grained structural steels with a minimum yield strength of 355 MPa; sheet, wide flat steel, strip, mould and bar steel |
| VdTÜV-WB 354/3 | 08/2023 | Weldable fine-grain structural steels with a minimum yield strength of 355 MPa; flange, ring, hollow body, forging, bar steel |
| VdTÜV-WB 357/1 | 09/2020 | Weldable fine-grain structural steels with a minimum yield strength of 460 MPa Plate, wide flat steel, bar steel |
| VdTÜV-WB 357/3 | 02/2020 | Weldable fine-grained structural steels with a minimum yield strength of 460 MPa; flange, ring, hollow body, forging, bar steel |
| VdTÜV-WB 380 | 09/2001 | Rolled and forged steel 40 NiCrMo 8 4 I, II and III for bolts and nuts |

| | | |
|--|---|---------|
|  | Pipe Class for pipelines PN 84 with H₂-requirements | |
| | TSP-04G01-50_E | Rev. 02 |

Appendix I: Abbreviations / Definitions

| Abbreviation / Term | Description |
|---------------------|---|
| GUD | Gasunie Germany |
| Parts / Component | Pipes, fittings, flanges, bolts, gaskets, plugs, line blanks |
| Pipe Fittings | Elbows, T-Pieces, reducers and bases/caps |
| GW/WEZ-SN-WEZ/GW | Base material / Heat-affected zone - Weld seam - Heat-affected zone / Base material |
| Lot | Parts of the same dimensions, material, lot and heat treatment |
| RT | Radiographic testing |
| Notified Body | Authorised technical monitoring organisation |
| UT | Ultrasonic testing |
| VT | Visual inspection |

| | | | |
|-------------|-------------|-----------------|---|
| 02 | 11.11.2025 | Luebbe | Limit the scope to the relevant part: flanges |
| 02 | 07.04.2025 | ILF | English translation |
| 02 | 12.03.2024 | GME Soehrich | After preliminary examination Table for pipe bends type 3D and 5D, table caps, table reducers and Appendix C adapted. |
| 01 | 02.02.2024 | GME Soehrich | Appendix A and C, notched bar impact bending updated |
| 0 | 29.01.2024 | GME Soehrich | |
| Rev. | date | Created | Description of the main changes / additions |

Revision notes