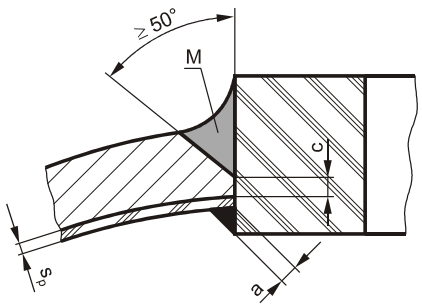
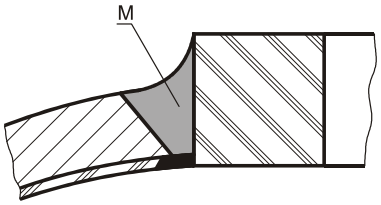
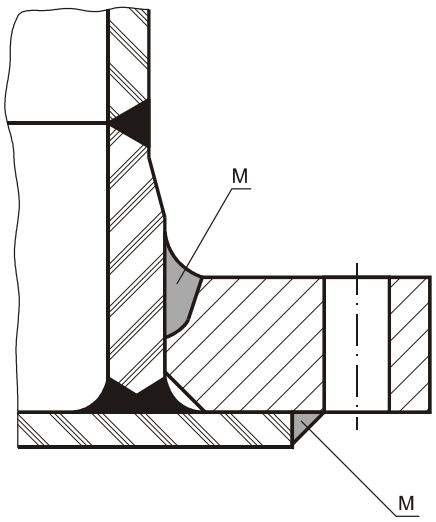
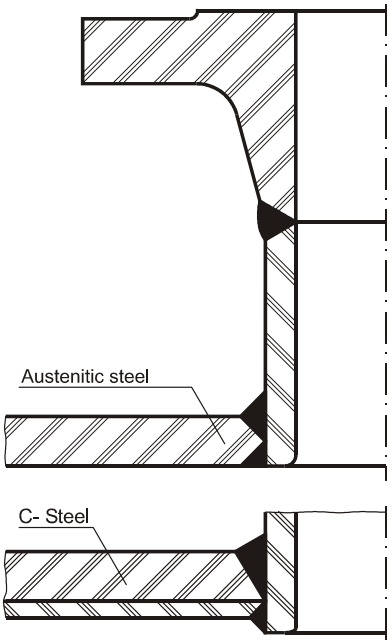
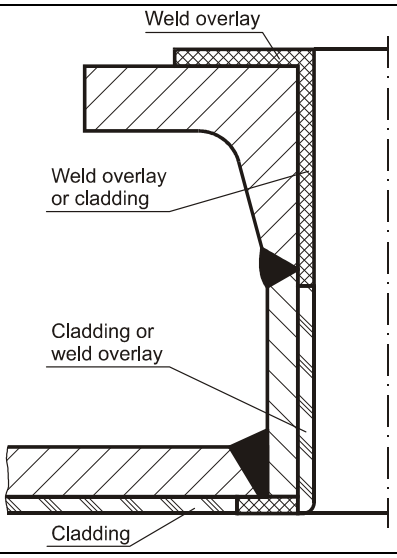
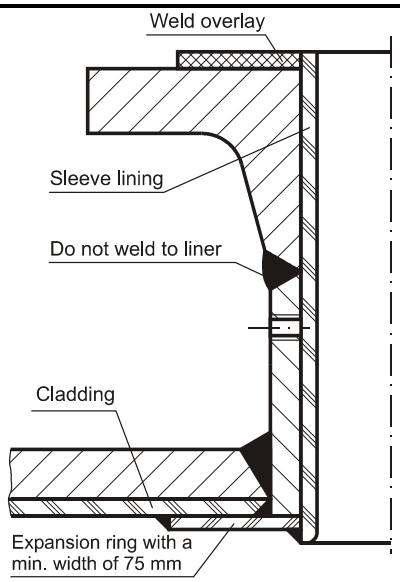
Item	Figure	Application	Requirements	Notes
U 54.8	  Alternative: The cladding may also be welded by deposit welding	Small pad type flanges of austenitic steel, clad vessel walls.	c ≥ 3 mm or with buttering a ≈ s_p	Vessel wall is lined. Refer to U 52.9.
U 54.9		Tubesheet and shell of austenitic steel, flange of carbon or low-alloy steel.	Joint configuration according to U 9.2 and U 2.5 (with single J - groove)	

Item	Figure	Application	Requirements	Notes
U 55 Vessel nozzles with alloy cladding or lining				
U 55.1		DN ≤ 100 Vessel of stainless steel or clad steel. Nozzle of stainless steel.	For clad vessels only allowed up to 220 °C.	For clad vessels thermal stresses due to the different coefficient of thermal expansion between C. S. and S. S. are to be observed. For higher temperature use Type U 55.2 or U 55.3.
U 55.2		DN > 100 If the vessel is of stainless steel, the nozzle pipe shall also be stainless steel.	Weld overlay min. 2 layers. Thickness of weld overlay at facing min. 3 mm after machining.	If stainless steel is required for reasons other than corrosion (such as low temperature service), the flange shall also be of solid stainless steel.

Item	Figure	Application	Requirements	Notes
U 55.3		100 < DN < 300 If the temperatures are low, the expansion ring may be omitted.	Not permissible for vacuum service unless the liner is designed for full vacuum. Weld overlay according to U 55.2 Not permissible for vessels which must be heat-treated after welding or with design temperatures over 400 °C. In this case U 55.2 shall apply.	Sleeve liners shall be welded to nozzle extremities with welds of sufficient cross-section to develop the full strength of the sleeve liner and to withstand forces due to differential expansion.

Uhde	Vessels and equipment SURFACE TREATMENT OF AUSTENITIC STAINLESS STEELS AFTER WELDING	UN V416-03 Part 1 (M) Page 1 of 3

[Modified On: 29/08/2008]

Contents

1 Scope 1
2 Purpose 1
3 Pretreatment 1
4 Mechanical processes 1
5 Chemical processes 2
6 Safety precautions 3

1 Scope

This works standard covers the surface treatment of austenitic stainless steels after welding. It applies to austenitic stainless steels such as 18 10 CrNi steels, e.g. material SS 321, and 18 12 2 CrNiMo steels, e.g. material SS 316 Ti. It is of no significance whether these steels are stabilized or non-stabilized or low-carbonized with or without the addition of nitrogen.

2 Purpose

Already under the influence of atmospheric oxygen the steels mentioned under "Scope" become covered with an invisible protective coating, the passive film. Films of oxides, scale, tempering colours and remnants of welding slag, such as may form during annealing or welding do not constitute passive films. These may reduce the chemical resistance of the steel and must, therefore, be removed.

This can be performed by mechanical means, such as brushing, grinding, blasting, or chemically by pickling.

3 Pretreatment

When applying mechanical processes for removing tempering colours and scale, no pretreatment of the surfaces is required. For chemical processes, any substances, such as oil, grease, adhesives and paint, which prevent the surface from becoming uniformly wetted, must be removed by appropriate pretreatment.

4 Mechanical processes

4.1 Brushing

This cleaning method, which can be effected using austenitic wire brushes, can be used on items which do not have to meet high requirements as regards chemical resistance, such as outer walls of vessels and piping, providing these are only exposed to the atmosphere of the chemical plant. The austenititc wire brushes must not be used for cleaning other materials. This process is not suited for removing scale and adhering slag residues to the full extent.

4.2 Grinding

For grinding off welding scale and welding beads, use is normally made of grinding disks and rotary fan-type grinding wheels. The grain size shall be adapted to the desired cleaning efficiency.

If no higher requirements have been agreed upon as to the surface quality, it is sufficient to use grain size 180 for finishing. It shall be ensured that no clogged or blunt grinders are used and that the material surface is not heated excessively. Tempering colours are inadmissible. The grinders must not be used for materials other than austenitic steels

When performing grinding work using tools with a coarseness of beyond 180, thin surface zones of steels may be subjected to such internal stresses and cold deformations that the steel becomes more susceptible to stress corrosion cracking. This may, in turn, reduce the resistance to general-type corrosion and pitting.

4.3 Drilling, turning, milling

Similar disadvantages as during grinding may occur as a result of machining or mechanical defects, e.g. in the form of scratches. In order to eliminate the negative influence of such surface defects to the full extent, it is necessary that the respective surface zone be removed by chemical treatment to a certain depth (see section 5). Practical experience has shown that it may be sufficient to remove 3 to 10 µm of the surface in order to reduce the increased susceptibility sufficiently. If required, exact values may have to be determined by tests.

4.4 Blasting

For blasting austenitic materials, only glass beads may be used. The size of the beads shall be selected in line with the desired treatment efficiency. Small beads have a higher cleaning efficiency; large beads lead to increased surface compression. The material surface should not unnecessarily be roughened. In general, beads of 100 to 200 µm in diameter will be sufficient.

This process leads to cold deformation and internal stresses in the material surface. In addition, inclusions of fine particles of blasting agent cannot be avoided. As a result, the susceptibility to pitting and the resistance to stress corrosion cracking can be increased.

In order to achieve a high cleaning efficiency with glass-bead blasting (similar to that of pickling), the following requirements must be met:

a) The blasting pressure must be at least 4 bar.

b) The angle of impact of the blasting material must be larger than 30°.

c) The blasting material must not be contaminated, i.e. when performing work using a high-pressure blasting set, provision must be made for a treatment unit; for performing work by the injection principle, only new blasting material may be used.

d) After blasting, the surface must show bare metal (tempering colours and welding slag residues must not be visible with the naked eye). If the desired cleaning efficiency has not been achieved, pickling must be performed.

e) If glass-bead blasting is intended to build up internal stresses for the purpose of preventing stress corrosion cracking, theangle of impact must be about 90°.

Blasting pressure, blasting period and distance of the blasting head from the steel surface must be determined by preliminary tests on suitable specimens.

5 Chemical processes

5.1 Preliminary remarks

The composition of a pickling solution must be adapted to the chemical composition of the material, to the desired working temperature and to the intended efficiency. Depending on the layer depth, expressed in µm to be removed from the surface to be pickled, a distinction is made between weak and strong pickling solutions.

The temperature of the pickling bath shall not exceed 50 °C; room temperature is generally sufficient. The pickling period depends on the composition of the bath and on the temperature and should last only until the desired efficiency is reached. Moving the material being pickled or the pickling bath is suitable to assist pickling.

5.2 Pickling

Using chloride-free pickling agents

5.2.1 Pickling in pickling baths

(1) Weak pickling solution for 18-10 CrNi steels and 18 12 2 CrNiMo steels

5 % by vol. nitric acid
(1,39 g/cm³ ≙ 65 % by wt.)

0,5 % by vol. hydrofluoric acid
(1,23 g/cm³ ≙ 70 % by wt.)

94,5 % by vol. water

(2) Strong pickling solution to achieve an additional material removal rate of 3 to 5 µm

a) for 18 10 CrNi steels

8 % by vol. nitric acid
(1,39 g/cm³ ≙ 65 % by wt.)

1,5 % by vol. hydrofluoric acid
(1,23 g/cm³ ≙ 70 % by wt.)

90,5 % by vol. water

b) for 18 12 2 CrNiMo steels

8 % by vol. nitric acid
(1,39 g/cm³ ≙ 65 % by wt.)

12 % by vol. hydrofluoric acid
(1,23 g/cm³ ≙ 70 % by wt.)

90,5 % by vol. water

In both cases, a pickling period of 30 minutes in the bath at room temperature is required.

5.2.2 Pickling using pastes

The pickling solutions described under section 5.2.1 can be thickened to form a spreadable paste. This is done with the aid of a thickener resistant to hydrofluoric acid, e.g. barium sulphate or aluminium oxide.

When using pastes consisting of acid mixtures according to section 5.2.1 (2), a pickling period of 3 hours is required at 20 °C in order to remove a surface layer of 3-5 µm Lower temperatures require a longer pickling period. Due to the limited portion of acid in such a paste, exceeding the respective minimum pickling period, e.g. leaving the paste to react over night, will not cause any damage.

5.3 Post-treatment

5.3.1 Rinsing

After pickling, the surface shall be rinsed with water until acid can no longer be traced even in critical places, e.g. in gaps. The neutrality can be checked by means of indicator paper.

Rinsing, together with the simultaneous influence of the atmospheric oxygen, causes the desired passive film to form on the steel. No additional passivation is necessary. Any scale loosened up after pickling and rinsing but still adhering to the surface can be removed with the aid of a root brush or a rag.

Wire brushes may only be used if they are made of austenitic material and if they are free of impurities.

5.3.2 Neutralization

Neutralization is not required when using chloride free pickling solutions.

5.3.3 Water quality

Experience has shown that river or well water without potable water quality are not suitable for use in pickling solutions, as they entrain substances that impair the pickling efficiency.

The quality of potable water used for preparing pickling solutions and for rinsing after pickling, shall meet the requirements of Uhde standard UN V416-04 Part1 (M), but the chloride ion content shall be in no case more than 50 ppm and in special cases not more than 1 ppm.

6 Safety precautions

Surface treatment may only be performed by properly trained and experienced personnel while observing the applicable safety regulations.

Uhde	WATER QUALITY FOR PRESSURE TESTS AND FLUSHING of equipment and other components	UN V416-04 Part 1 (M)
		Page 1 of 3

[Modified On: 29/08/2008]

Contents

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2	Minimum admissible water quality for different materials	1
3	Records	2
4	Exceptions	2
5	Remarks	2

1 General

1.1 Application

This standard covers hydrostatic tests and water-flushing of equipment and other components in manufacturers' workshops and on job sites.

It specifies the admissible chloride ion content of the water to be used.

In the event that the requirements of this standard contradict the technical specification, the latter shall have precedence.
Any deviations from this standard shall be agreed in writing.

1.2 Introduction

The water must be virtually free of impurities, such as dirt particles, iron oxides, organic substances, etc. Water containing chloride ions, for instance, may cause pitting and stress corrosion cracking, particularly to stainless steel, nickel and nickel alloys, if the chloride ions are present in critical concentrations and in dry state due to the high temperature. Corrosion proceeds faster as the temperature rises.

If a water analysis is not available, the water must be analyzed prior to use. If the same water is used several times, an analysis must be performed before each application.

1.3 Water qualities

WSN = Sea water with a chloride ion content in excess of 10 000 ppm,
WSB = Brackish water with a chloride ion content between 1000 and 10 000 ppm,
WSDB = Water with a chloride ion content between 200 and 1000 ppm,
WSDA = Potable water with a chloride ion content between 50 and 200 ppm,
WSD = Potable water with a chloride ion content between 1 and 50 ppm,
WDS = demineralized water (e.g. condensate) with a chloride ion content of less than 1 ppm,
WCI = Potable water with a chloride ion content between 50 and 200 ppm with the addition of a corrosion inhibitor (e.g. 2% by vol. sodium carbonate)

2 Minimum admissible water quality for different materials

2.1 Protective coats, rubber lining, plastics, sea-water-resistant materials

Water quality: WSN, WSB and WSDB

2.2 Carbon steel or low-alloy steel

Water quality: WSDA; if nothing to the contrary has been agreed

Subject to approval by Uhde, WSN, WSB and WSDB may be used in the case of equipment and systems with a large volume, provided the system is thoroughly flushed with WSDA after the test.

2.3 Stainless steel

The chloride ion content of the the water shall conform to the following water qualities:

2.3.1 Accessible interior surfaces

Table 1.

Surfaces without gaps	Surfaces with structural gaps
Water quality: WSDA Drain immediately after pressure test and wipe off any residual water	Water quality: WSDA Drain immediately after pressure test, Flush surfaces with gaps with WSD and then wipe off any residual water.

2.3.2 2.3.2 Inaccessible interior surfaces

Table 2.

Surfaces without gaps	Surfaces with structural gaps
Water quality: WSD or WCI Drain after pressure test	Water quality: WSD or WCI Drain and dry after pressure test (without surface contamination due to ingress of dust). Vacuum method preferred. Special case: heat exchanger with - rolled-in tubes - welded-in and expanded tubes (rolled-in or otherwises expanded) Water quality: WDS, Drain after pressure test

A higher chloride ion content may be admissible for extremely corrosion-resistant stainless steel, such as materials SS 317L, Inconel 600, Incoloy 800.

3 Records

Records shall be kept of all pressure tests and flushing operations performed.

Uhde reserves the right to request an additional analysis as proof of the chloride ion content.

4 Exceptions

Exceptions to the requirements specified in item 2 are only admissible if:

- the system can be completely drained, thoroughly dried and stored in dry storage areas (special care required in the case of expansion joints),
- the temperature of the components cannot exceed 50°C,
- the start-up commences with prolonged flushing using process fluid at temperatures below 50°C immediately after draining. (The purpose of this flushing operation is to dilute or remove the chloride-bearing residual water that may have collected in the crevices before any dangerous concentrations can form at higher temperatures),
- approval has been given by Uhde's job leader.

5 Remarks

a) The above does not take into account the influence of the temperature and the oxygen content of the water. Water with a higher chloride ion content (up to max. 200 ppm) does not cause corrosion if it is completely free of oxygen. This requirement cannot be observed for pressure tests and flushing. At temperatures below 50°C, corrosion is not to be expected either, even in the presence of oxygen. However, it is most likely that each equipment component will be exposed to temperatures in excess of 50°C prior to commissioning, e.g. due to solar radiation during the storage period.

b) Ferritic and ferritic austenitic steels are less susceptible to stress corrosion cracking than purely austenitic steels.
Resistance to pitting increases with a rise in the Cr content and, in particular, the Mo content (3.3 × Cr) of the steels.

c) Pressure testing or flushing on the job site:
Pressure testing and flushing of stainless steel components shall be performed separately from the remaining systems.

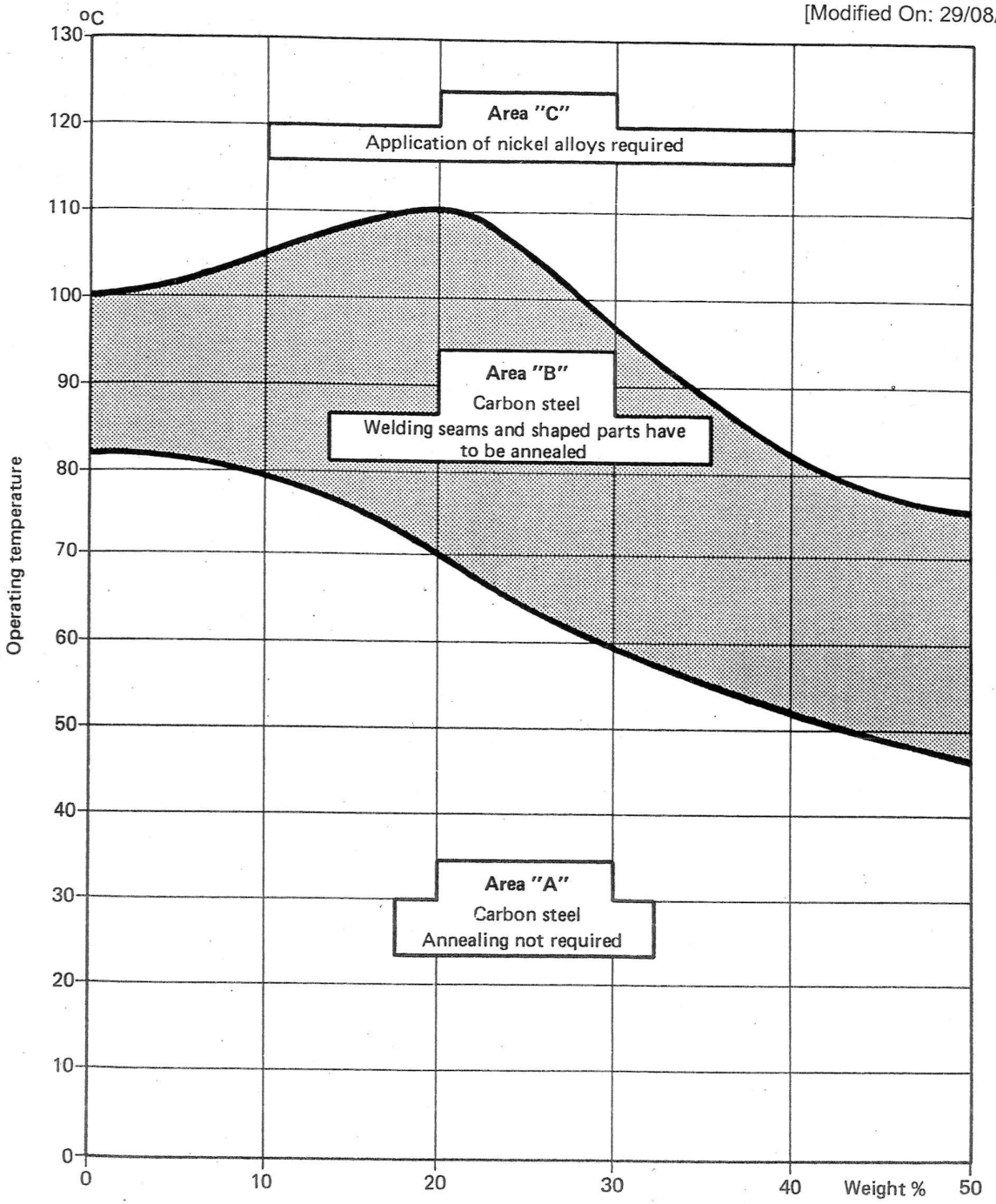
d) It is recommended that the pressure test be delayed until deionized water is available. This should, if possible, be taken into account by the job leader and the commissioning team when planning site activities.

e) Dirt particles or sand in process equipment or other components of stainless steel is not admissible. The following should always be remembered when cleaning or purging equipment and systems: Sand, soil, etc. **always** contain salts/chlorides which, if they remain in the system, will convert deionized water into water with a high chloride ion content.

f) In the event that the technical specifications should contain more stringent requirements regarding the water for pressure tests, these requirements must be observed.
This particularly applies to equipment with small volumes.

Uhde	Vessels and equipment LIMITS FOR THE APPLICATION OF CARBON STEEL in caustic service	UN V462-01 Part 1 (M) Page 1 of 1

[Modified On: 29/08/2008]



Notes:
1. Annealing is not required for use with caustic soda concentration ≤ 1,2 %.
2. No clips or other attachments shall be welded to the vessel after annealing.
3. Nickel alloys have to be used for valve seats in area "B" service.

Source:
CORROSION DATA SURVEY
1974 EDITION

[Modified On: 29/08/2008]

Dimensions in mm

1 Scope

This standard covers swivel devices for vertical or horizontal manhole closures.

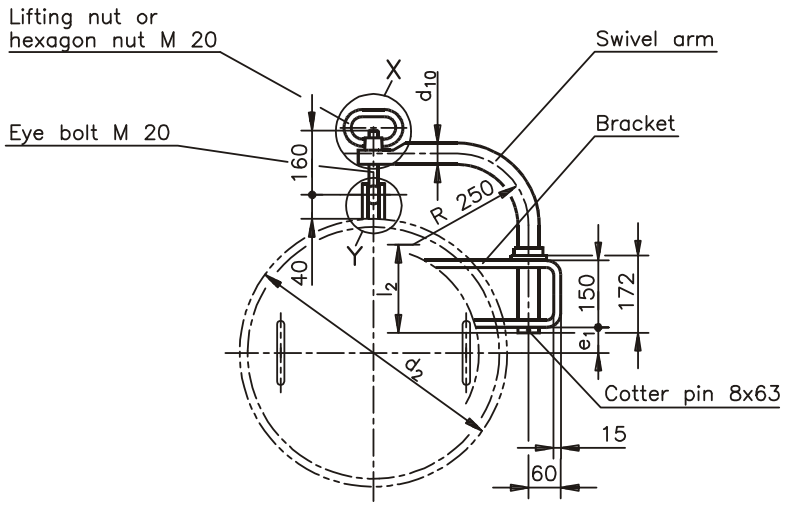
In the case of flanges and covers fabricated according to standards other than those stated above, dimensions d_2, l_1, l_2, e_1 and e_2 shall not be selected from Table 1 but be recalculated. The other dimensions remain unchanged.

In the case of nominal diameters and pressures deviating from Table 1, diameter d_{10} of the swivel arm shall be rated according to Table 2.

2 Design

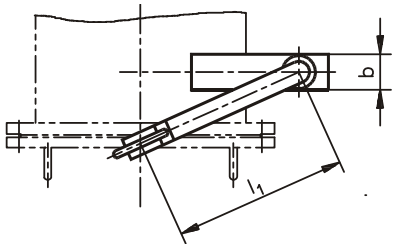
In the case of vertical (V) and horizontal (H) arrangement, the arms of the swivel devices can be exchanged. If the manhole flanges are inclined, the swivelling axis shall be perpendicular.

The swivel devices need not comply with the configurations below, but the dimensions stated shall be adhered to.



Attachment to Nozzle pipe

for manhole closures
(purchaser's approval required)



Attachment to Flange ring

for manhole closures

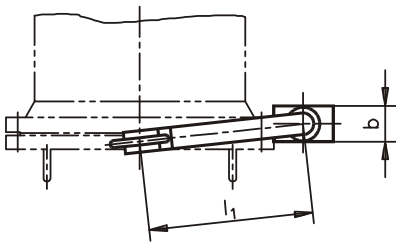
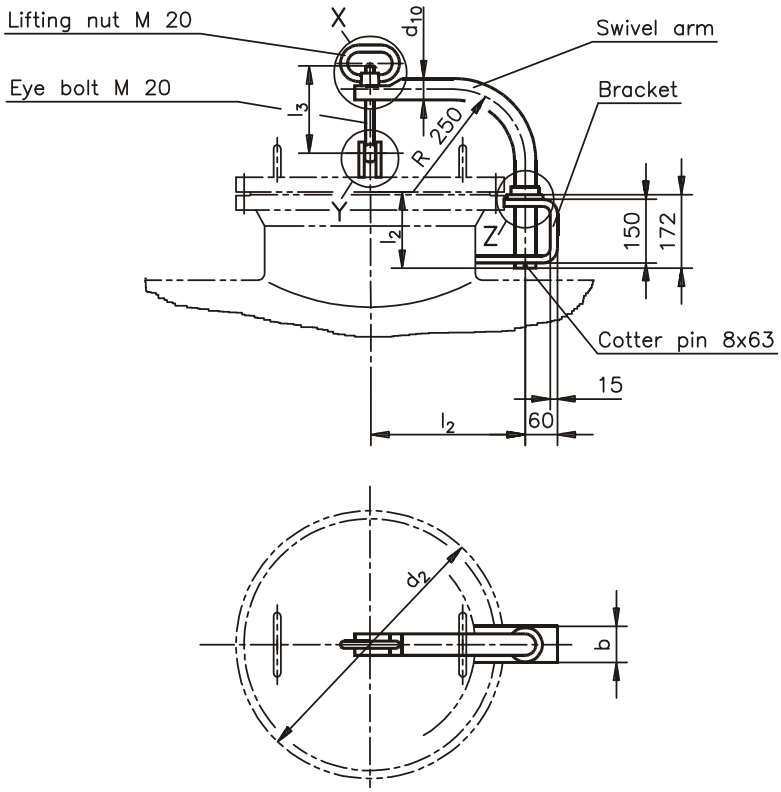


Figure 1. Vertical arrangement (V) of the swivel devices

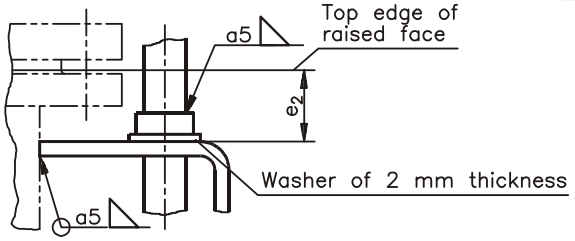


For details X and Y,
refer to Figure 3

Attachment to Nozzle pipe

for manhole closures (purchaser's approval required)

Z



Attachment to Flange ring

for manhole closures

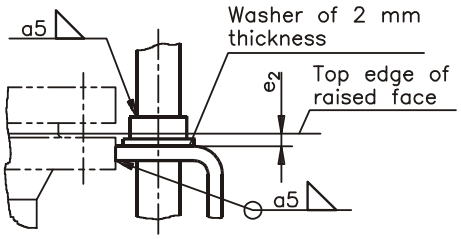


Figure 2. Horizontal arrangement (H) of the swivel devices

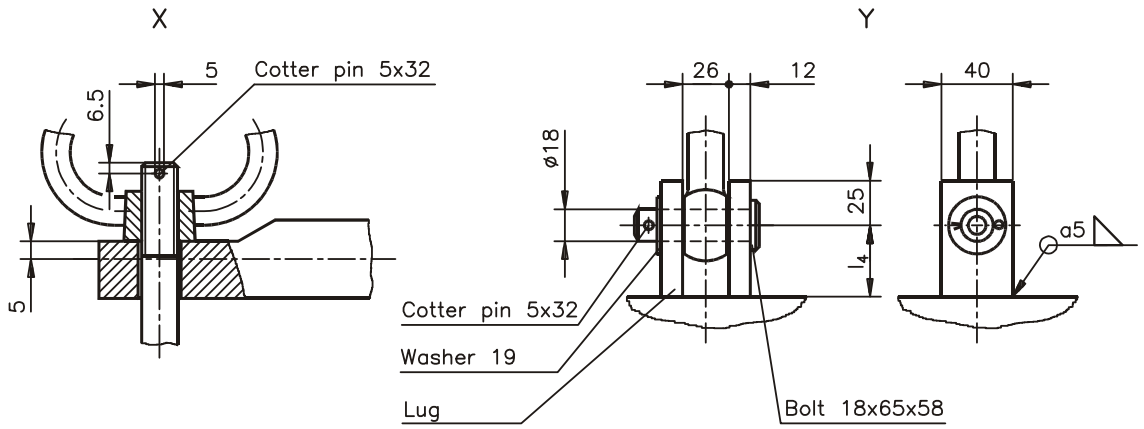


Figure 3. Details X and Y of the swivel devices

Table 1. **Dimensions and weights**

Nominal diameter DN	Nominal pressure PN	d_2	b	d_{10}	l_1	l_2	Vertical arrangement e_1	Horizontal arrangement E_2	Horizontal arrangement l_3	Horizontal arrangement l_4	Weight[1] ~ in kg
500	atmospheric pressure	600	70	40	380	205	18	57	180	40	12
	10	670					53	22	240	45	
	16	635					36	24		40	
	25	645					41	16			
600	atmospheric pressure	700			400	230	43	62			
	10	710					48	27	260	45	
	16	730	80	50	430		58	24		40	17
	25	760					73	16			
800	atmospheric pressure	900			500	260	113	69			19

1) Total weight of the swivel devices.

Table 2. **Diameter of arm if nominal diameter/pressure deviates from Table 1**

Manhole DN	Swivel arm diameter d_{10} (mm) PN 10	PN 16	PN 25 ANSI 150 lbs.	PN 40 ANSI 300 lbs.	PN 63 ANSI 600 lbs.
400 or 16"	30	30	35	40	45
450 or 18"					50
500 or 20"	Refer to Table 1			45	55
600 or 24"				55	60

3 Materials

Brackets and lugs: killed carbon steel, in the case of alloyed steel and temperatures below -10°C and above 250°C: vessel material.

Swivel arm: carbon steel

Uhde	Vessels and equipment CONNECTION PLATES FOR VESSELS SUPPORTED BY STEEL STRUCTURES	UN 2000-15 (M) Page 1 of 3

[Modified on: 29/08/2008]

Dimensions in mm

1 Scope

This standard applies to the design of connection plates for the installation of horizontal and vertical vessels supported by steel structures not hot-galvanized. The connection plates shall be bolted beneath the saddles or the brackets, the vessels aligned with the supporting steel structure and the connection plates welded to the steel structure.

2 Connection plates for horizontal vessels with support saddles

Support saddles according to Uhde standard UN 2000-05 Part 1 (M).

2.1 Fixed saddle

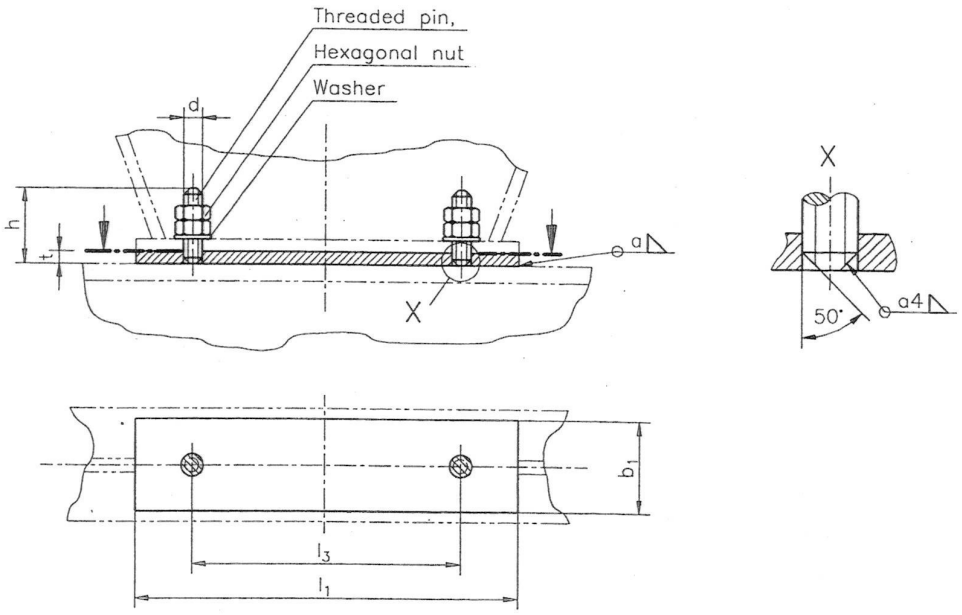


Figure 1.

Table 1.

Outside diameter of vessel d_1	Connection plate l_1	b_1	t	l_3	Fillet weld min. a	Threded pin 1) d	h
219	200	120	12	150	3	M 16	60
273	240			190			
324	280			230			
356	300			250			
406	350			300			
508	420			350			
600	500		16	450	4	M 20	80
700	600			600			
800				750			
900	750			1000			
1000				1300			
1100	900	160		1550			90
1200				1800			
1400	1150	200		2050	6	M 24	100
1600				2300			
1800	1450			2600			
2000				2900		M 30	120
2200	1750	240		3200			
2400				3500			
2600	2050	300					
2800							
3000	2300	350					
3200							
3400	2600	400	20				
3600							
3800	2900						
4000							
4200	3200	450					
4400							
4600	3500						
4800							
5000	3800						

1) Unless otherwise specified.

2.2 Sliding saddle

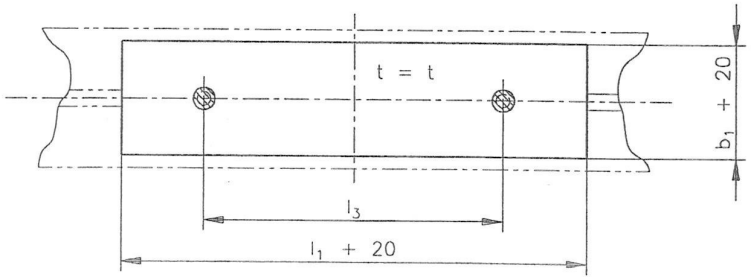


Figure 2.

For dimensions l_1, l_3, b_1 and t refer to Table 1. Design with threaded pins, washers and hexagonal nuts same as fixed saddle.

3 Connection plates for vertical vessels with brackets

Brackets according to DIN 28 083 Part 1.

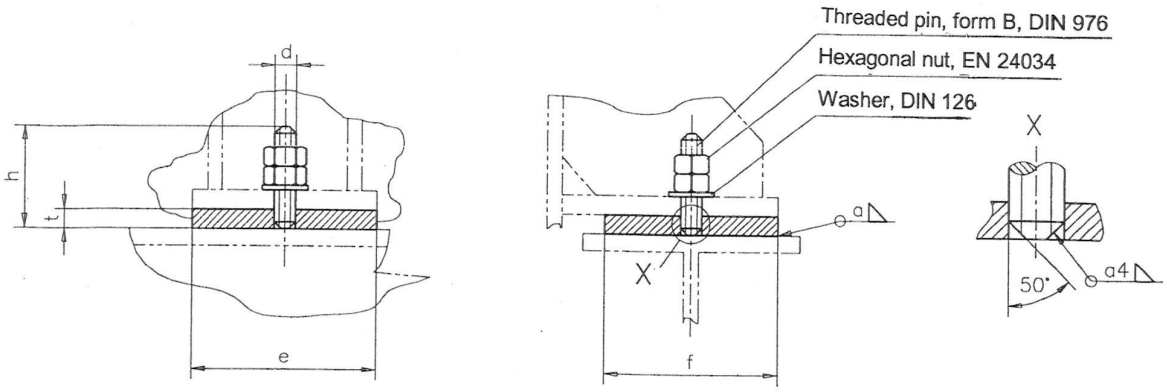


Figure 3. Nominal size of bracket 1 to 3

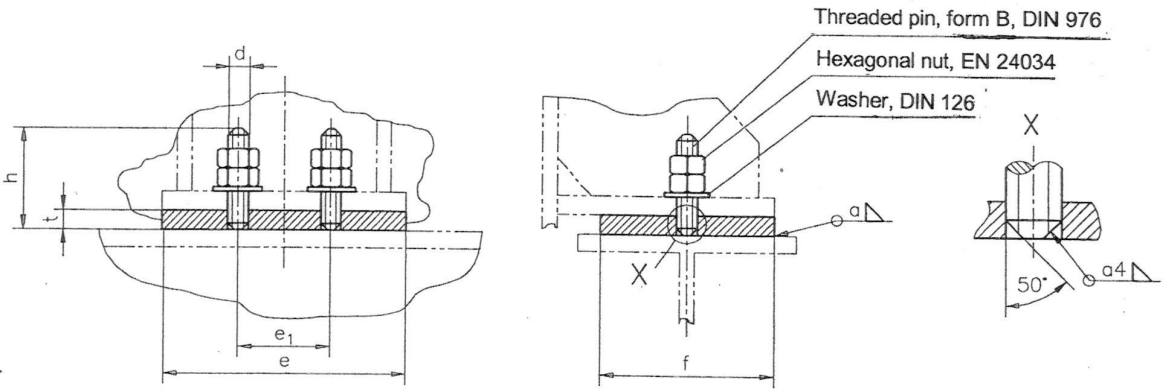


Figure 4. Nominal size of bracket 4 to 8

Table 2.

Nominal size of bracket	Connection plate				Fillet weld min.	Threaded pin	
	f	e	t	e_1	a	d	h
1	100	100	20		6	M 20	80
2		125					
3		160					
4		200		80			
5		250		110			
6		315		150			90
7		355		170			
8		400		190			

For brackets according to Uhde standard UN 2000-05 Part 6, connection plate dimensions shall be decided in consultation with Uhde.

Reference Standards

Uhde Standards :

UN 2000-05 Part 1 (M) Vessels and equipment; Support saddles for horizontal steel vessels
UN 2000-05 Part 6 Vessels and equipment; Supports for verticsl steel vessels; Brackets (Lugs)

DIN Standards :

DIN 28083 Part 1 Bracket Supports; Dimensions and maximum loads

Uhde	Vessels and equipment CLASSIFICATION GROUPS FOR VESSELS AND EQUIPMENT Design according to ASME code	UN 2000-14 Part 2 (M) Page 1 of 1

[Modified On: 29/08/2008]

1 General

Vessels and equipment are classified by Uhde in groups on the basis of criteria listed below. Inspection data sheets (IDS) are available for classification groups 1 to 4. In special cases, vessels and equipment may be classified under a higher or lower group. For instance, vessels and equipment containing dangerous fluids (e.g. high toxic) which are lethal in the event of leakage may be classified under a higher group or more stringents may be imposed.

In the case of multi-chamber vessels operating at different pressures, the classification group for each chamber shall apply.

If vessel materials cannot be classified under one of the available groups, the classification group has to be agreed.

The applicable IDS shall be attached to the design data sheet (DDS).

1.1 Classification group 1

a) Vessels operating at a design pressure of > 150 bar
b) Vessels subject to fatigue loading according to ASME-Code, Sect. VIII, Div. II, AD 160
c) Materials acc. to ASME-Code, Sect. IX, QW-422 and Sect. II Part D Table 1A, 2A
P-No. 6; 11A group 4; 11B.

1.2 Classification group 2

a) Materials according to ASME-Code, Sect. IX, QW-422 and Sect. II Part D Table 1A, 2A, wall thickness of the cylindrical shell as indicated below:

P-No. 1 group 1 and 2; P-No. 3 group 1 and 2	> 65 mm
P-No. 1 group 3; P-No. 9A; P-No. 9B; P-No. 11A group 2	≥ 50 mm
P-No. 1 group 4; P-No. 3 group 3; P-No. 10A	≥ 20 mm
P-No. 4 group 1; P-No. 5 group 1 and 2	≥ 30 mm

b) Brick- or concrete-lined vessels operating at a design pressure of > 20 bar.

1.3 Classification group 3

Materials according to ASME-Code, Sect. IX, QW-422 and Sect. II Part D Table 1A, 2A, wall thickness of the cylindrical shell as indicated below:

P-No. 1 group 1 and 2; P-No. 3 group 1 and 2	30 bis 65 mm
P-No. 1 group 3; P-No. 9A, P-No. 9B; P-No. 11A group 1 and 2	< 50 mm
P-No. 1 group 4; P-No. 3 group 3; P-No. 10A	< 20 mm
P-No. 4 group 1; P-No. 5 group 1 and 2; P-No. 10C	< 30 mm
P-No. 8 group 1	≥ 30 mm
P-No. 21 and 22	≤ 50 mm

1.4 Classification group 4

a) Materials according to ASME-Code, Sect. IX, QW-422 and Sect. II Part D Table 1A, wall thickness of the cylindrical shell as indicated below:

P-No. 1 group 1 and 2; P-No. 3 group 1 and 2; P-No. 8 group 1	< 30 mm

b) Atmospheric vessels

Remarks

In the case of vessels and equipment for pressurized hydrogen and/or H_2s (sour gas), at least classification group 3 shall be selected.