A company of ThyssenKrupp Technologies	**Uhde India**	PROJECT	UAN	
		KCIL-FORMALDEHYDE	**66-6481-700**	

DESCRIPTION
GENERAL ENGINEERING SPECIFICATION
PRESSURE VESSELS

DOCUMENT NO.	PAGE	REV.
6481-MQ-UGS-0001	**1**	**0**

STATUS OF REVISION:

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3. REFERENCE UHDE STANDARDS

Standard No.	Part	Title	Issue Dt
UN 2000-01	1(M)	VESSELS & EQUIPMENT: PRESSURE VESSELS GENERAL SPECIFICATION	08-2008
UN 2000-01	3(M)	VESSELS & EQUIPMENT: FIELD FABRICATION GENERAL SPECIFICATION	08-2008
UN 2000-02	1(M)	VESSELS & EQUIPMENT: DIMENSIONAL TOLERANCES FOR STEEL VESSELS	08-2008
UN 2000-04 (M)	-	VESSELS & EQUIPMENT: HINGED MANHOLE COVERS	08-2008
UN 2000-05	1(M)	VESSELS & EQUIPMENT: SUPPORT SADDLES FOR HORIZONTAL STEEL VESSELS	08-2008
UN 2000-05	4(M)	VESSELS & EQUIPMENT: SUPPORTS FOR VERTICAL VESSELS;SKIRT	08-2008
UN 2000-05	5(M)	VESSELS & EQUIPMENT: SUPPORTS FOR VERTICAL STEEL VESSELS; LEGS	08-2008
UN 2000-05	6	VESSELS & EQUIPMENT: SUPPORTS FOR VERTICAL STEEL VESSELS; BRACKETS (LUGS)	07-2001
UN 2004-06 (M)	-	VESSELS & EQUIPMENT: INSULATION CLIPS FOR VERTICAL STEEL VESSELS	08-2008
UN 2000-06	2(M)	VESSELS & EQUIPMENT: CLIPS FOR LADDERS & PLATFORMS	08-2008
UN 2000-06	3(M)	VESSELS & EQUIPMENT: CLIPS FOR GUIDE AND SUPPORT BRACKETS FOR PIPING : TYPE 'C'	08-2008
UN 2000-07	1(M)	VESSELS & EQUIPMENT: LIFTING LUGS & LIFTING TRUNNIONS FOR ERECTION OF STEEL VESSELS	08-2008
UN 2004-05 (M)	-	VESSELS & EQUIPMENT: INTERNALS, VORTEX BREAKERS, FEED DEFLECTORS & LADDER RUNGS	08-2008
UN 2000-09	1(M)	VESSELS & EQUIPMENT: NAME PLATE FOR VESSELS AND EQUIPMENT	08-2008
UN 2000-10	1(M)	VESSELS & EQUIPMENT:TITLE BLOCKS FOR MANUFACTURER'S DRAWINGS	08-2008
UN 5222-02	1(M)	WIREMESH (DEMISTER)	08-2008
UN 2003-01 (M)	-	VESSELS & EQUIPMENT: EARTHING CONNECTIONS FOR VESSELS & EQUIPMENT	08-2008
UN V370-03	1(M)	PACKING INSTRUCTIONS: SEAWORTHY PACKING	08-2008
UN V401-01	1 (M)	TECHNICAL DRAWINGS PRINCIPLES OF EXECUTION: GENERAL REQUIREMENTS	08-2008
UN V416-01	1 (M)	WELDING: WELDED JOINTS FOR VESSELS & EQUIPMENT – REQUIREMENTS	08-2008
UN V416-01	2 (M)	WELDING: WELDED JOINTS FOR VESSELS & EQUIPMENT – EXAMPLES	08-2008
UN V416-03	1 (M)	VESSELS & EQUIPMENT: SURFACE TREATMENT OF AUSTENITIC STAINLESS STEELS AFTER WELDING	08-2008
UN V416-04	1 (M)	WATER QUALITY FOR PRESSURE TESTS & FLUSHING OF EQUIPMENT AND OTHER COMPONENTS	08-2008
UN V462-01	1 (M)	VESSELS & EQUIPMENT: LIMITS FOR APPLICATION OF CARBON STEEL IN CAUSTIC SERVICE	08-2008
UN 2000-11	1 (M)	VESSELS & EQUIPMENT: SWIVEL DEVICES FOR MANHOLE CLOSURES	08-2008
UN 2000-15 (M)	-	VESSELS & EQUIPMENT: CONNECTION PLATES FOR VESSELS SUPPORTED BY STEEL STRUCTURES	08-2008
UN 2000-14	2(M)	VESSELS & EQUIPMENT: CLASSIFICATION GROUPS FOR VESSELS AND EQUIPMENT; DESIGN ACCORDING TO ASME CODE	08-2008
UN 4001-05	1(M)	STEEL STRUCTURES: DAVITS ON VESSELS WITH HEAT INSULATION	08-2008
UN 5222-01	1(M)	FRACTIONATING TRAYS; GENERAL SPECIFICATION	08-2008
UN 5222-02	2(M)	SUPPORT GRID	08-2008
UN 5222-02	3(M)	HOLD DOWN GRID	08-2008
UF V360-21	1	WELDING PROCEDURE & TESTING SCHEDULE	12-2001
UN 5017-01	1(M)	VESSELS & EQUIPMENT: COLD INSULATION FOR SUPPORT SADDLES OF HORIZONTAL STEEL VESSELS	08-2008

4. OTHER REFERENCE STANDARDS

Standard No.	Rev.	Title
CI-USD-0001	0	STANDARD ANCHOR BOLT DETAILS

1.0 SCOPE

This General Engineering Specification is applicable when specified in the equipment specification/fabrication drawing. Uhde Standard UN 2000-01 Part 1(M) forms an integral part of this specification along with the modifications / additions made under the title “Specific requirements of the Project.”

2.0 GENERAL

Unless otherwise stated elsewhere, following guarantees are included in the scope of the fabricator.

a) Design

b) Fabrication & Workmanship

c) Materials

In case of conflict between equipment specification, this specification and Uhde Standard UN 2000-01 Part 1 (M), the following shall apply.

(I) The equipment specification will take precedence over this specification and Uhde Std. UN 2000-01 Part 1 (M).

(ii) This General Engineering Specification will take precedence over Uhde Standard UN 2000-01 Part 1 (M).

Any information given in Clause 3.0 viz. specific requirements for the project takes precedence over the information given in any other part of this General Engineering Specification.

In case of conflict between design code and the applicable standards, more stringent of the two shall apply.

If deviation from UN 2000-01 Part 1 (M) and from other UN standards referred in the reference standards list are not agreed separately by Uhde India Private Limited (UIPL) then, all requirements in UN standards referred in the index shall apply as it is unless they are modified somewhere else.

3.0 SPECIFIC REQUIREMENTS OF THE PROJECT

3.1 Following wind pressure shall be followed in the design.

Height (m)	Design Wind Pressures at different Height , (N / Sq.m)		
	Class `A'	Class `B'	Class `C'
10	2117.016	2033.182	1831.007
15	2334.01	2202.543	1991.9
20	2423.772	2334.01	2117.016
30	2655.585	2561.589	2289.765
50	2897.983	2799.754	2561.589

Note: - Linear Interpolation for intermediate heights

Legend: - As per IS-875

Basic wind speed = 55 m/s

K1= 1.08

Class `A': Structures having max. horizontal or vertical dimension < 20 m

Class 'B': Structures having max. horizontal or vertical dimension > 20m but < 50m

Class 'C': Structures having max. horizontal or vertical dimension > 50 m

K3 =1.0

3.2 Seismic data

Following shall be used for Seismic design:

Applicable Standard : - IS 1893 Part 4(2005)
Seismic Zone : III
Zone factor : 0.16
Importance factor, I = 1.5
Response reduction factor, R = 2
Soil type = Medium soil.

3.3 In case design calculations, fabrication drawings and related drawings require approval from statutory authorities such as IBR, CCE, etc. or from a third party inspection agency like LRIS, the same is vendor's responsibility. However all requirements of UIPL are also to be included during progress of engineering.

3.4 Chloride content of test water used for testing of austenitic stainless steel vessels shall be limited to 30 ppm. Test certificate issued by an independent testing laboratory shall be made available prior to filling of vessel with the test water.
For shell side of fixed tube sheet exchanger, chloride content of test water shall be 1 PPM. (Refer table 2 of UN V416-04 Part 1(M))

Uhde	ADDITIONAL LOADS ON NOZZLES	STD-MQ-UZ-0010
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1.0 GENERAL

Stress analysis of shell / head for local loads resulting from external piping shall be performed by the vendor.

When an agitator is supported on the nozzle, then appropriate dead weight of the agitator and its accessories shall be considered while stiffening the dished end / flat cover.

If no other loads are given in the Technical Specification, the following preliminary additional external loads shall be used excluding Inspection and instrumentation nozzles.

External forces Fj = DN x 40 (N)

Bending moments Mj = DN x 80 (Nm)

Where J = x-, y-, z-direction

and DN = nominal size of nozzle in mm.

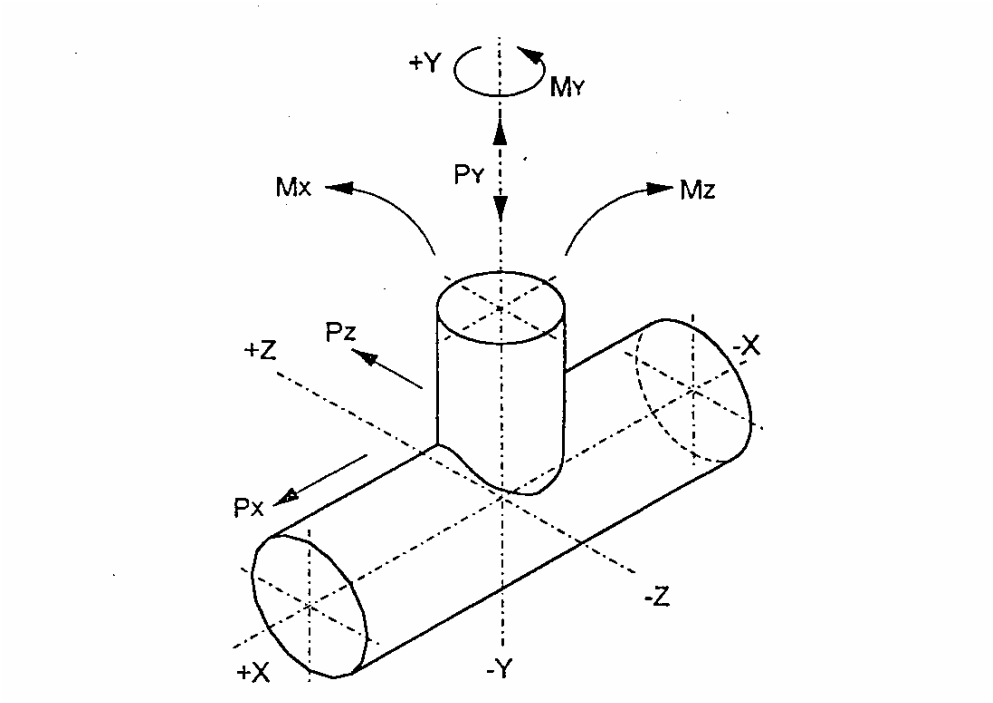

Figure 1

Forces and moments shall be assumed to act simultaneously at the junction nozzle / shell in each of the possible axes x, y, z. At the flanges or welded junction between nozzle and pipe, the loads may deviate depending on the position of the nozzle end. For a schematic sketch for forces and moments, see Figure 1. Loads Fj, Mj have to be converted to loads shown in Figure1.

The equivalent loads according to ″Welding Research Council Bulletin No. 107“ are

Py	=	P	Mz	=	M_L
Px	=	V_L	Mx	=	M_C
Pz	=	Vc	My	=	M_T

Above loads shall be assumed for Type I and Type II nozzles (see Table 1 below). For Type III nozzles, the loads may be reduced to one half for temperatures 100 °C and above. For temperatures below 100 °C, the load effects are assumed to be negligible in most cases and shall be considered in accordance with normal engineering practice.

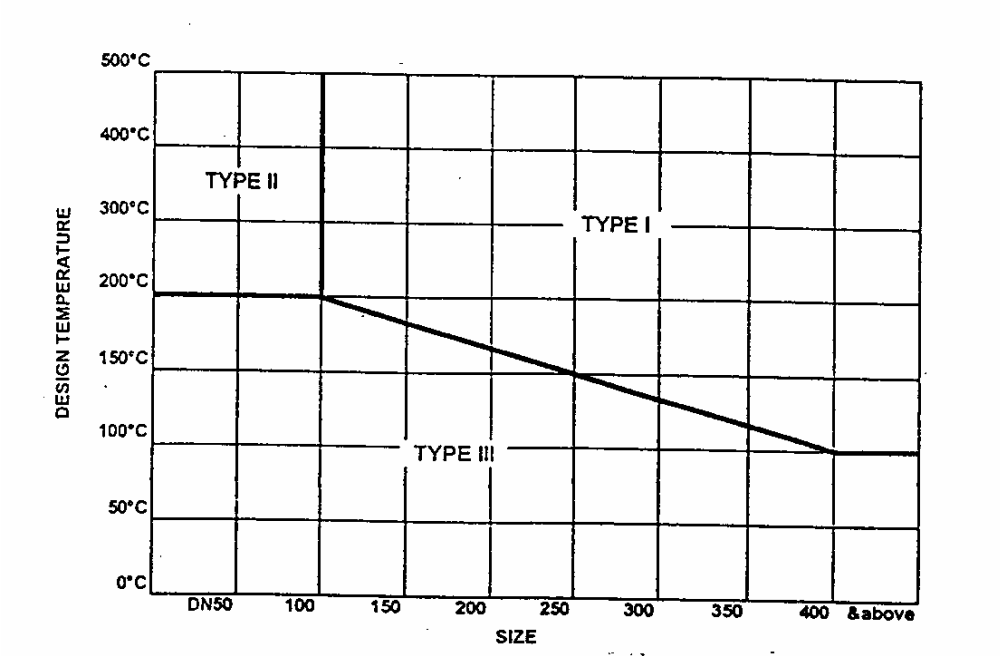

Table 1

Piping loads in excess of the above mentioned loads shall be informed to the manufacturer sufficiently in advance.

The stress analysis shall be undertaken by the vessel manufacturer at the manufacturer’s expense in accordance with ″Welding Research Council Bulletin No. 107“.

The piping loads must also be included in the calculation of support structures, foundation loads and anchor bolts as well. Verification of such calculation shall be performed at the expense of the manufacturer as soon as the final data are available and shall be included in the documentation.

Contents

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1.0 Objective and Scope

This specification covers the requirements for non-destructive testing indicated in the related ESA, DDS or IDS and it shall apply unless more stringent requirements are specified in the relevant standards such as the ASME code.

In the event of discrepancies between UN 2000-01 Part 1(M)/ UN 2100-01 Part 1(M), DDS and/or IDS, the stringent requirements shall apply.

In case of doubt, the scope of tests shall be agreed upon in writing between the manufacturer and UIPL.

Deviations from this specification shall be submitted in writing for approval by the manufacturer.

Abbreviations used in this specification

ESA = engineering specification acc. to ASME, ASTM & API Standards.
DDS = design data sheet
IDS = inspection data sheet
UT = ultrasonic test
RT = radiographic test
MT = magnetic particle test
PT = dye penetration test
HV = Vickers hardness test
HAZ = heat-affected zone (of welds)
ESA-AD3 (M) = Additional requirements relating to high pressure hydrogen and / or sour gas
Normal operating condition = Without H2 and/or H2S service

2.0 Ultrasonic test (UT) of steel plates

2.1 Scope

This specification covers the requirements for ultrasonic tests of carbon and low-alloyed steel plates and applies to the tests specified in ESA, DDS or IDS.

2.2 Test conditions and requirements

2.2.1 Normal operating conditions:

2.2.1.A For plates having thickness >= 40 mm If specified in the DDS or IDS, Ultrasonic test of the whole surface according to SA-435, scanning grid < 225 mm.

The manufacturer shall test the zones of longitudinal, circumferential and nozzle welds with a width equal to plate thickness or minimum 50 mm.

2.2.1B For plates having thicknesses 20 to 40 mm (both inclusive):

If specified in the DDS or IDS, Ultrasonic test of the whole surface according to SA 435, scanning grid <= 225 mm.

The manufacturer shall test the zones of longitudinal, circumferential and nozzle welds with a width equal to plate thickness or minimum 50 mm.

2.2.1.1 Acceptance Standard:

The acceptance standards are in accordance with SA-435 Section 6.

2.2.2 Operating conditions according to ESA-AD3 (M):

Ultrasonic test according to SA-578 except the scanning grid shall be <= 100 mm. The zones of longitudinal, circumferential and nozzle welds shall be tested by the manufacturer with a width equal to plate thickness or minimum 50 mm.

2.2.2.1 Acceptance Standard:

The acceptance standards are in accordance with the requirements of SA-578 quality level B and supplementary requirements S 2.1 imposed, except that the maximum acceptable encompassed diameter circle for discontinuities shall be 35 mm, and for scanning of weld edges the maximum acceptable encompassed diameter circle for discontinuities shall be 11 mm.

2.3 Test report

The results of ultrasonic tests and the test conditions shall be recorded in an inspection test certificate.

2.4 Personnel Qualification

The manufacturer shall certify that the personnel performing ultrasonic examination has been qualified to SNT-TC-1A ("Personnel Qualification and Certification in Non destructive Testing" published by American Society for NDT) or an approved equivalent.

3.0 Ultrasonic test (UT) of forgings

3.1 Scope

This specification covers the requirements for ultrasonic tests of forgings made of carbon or low-alloyed steel and applies to the tests specified in the ESA, DDS or IDS.

3.2 Test conditions and requirements

3.2.1 Test specification: SA-388.

3.2.2 Date of test:

The test shall be carried out after the heat treatment if called for by Material specification.

3.2.3 Test surfaces:

The surfaces to be tested shall be prepared according to SA-388, Section 6.

3.2.4 Normal operating conditions:

All surfaces shall be tested according to SA-388. The whole cross section of the forging shall be scanned. In addition forgings for tubesheets shall be scanned by the Angle probe method on the side where the tubes are welded to the tubesheet. The scanning depth shall be 20 mm of the machined tubesheet.

The same method shall be used for concave fillets which are susceptible to local stress, e.g. in transitions from tubesheet to shell.

3.2.5 Operating conditions according to ESA-AD3 (M):

The test shall correspond to 3.2.4. Moreover, the fluid side(s) of the tubesheets shall be scanned by Angle probe method. The scanning depth shall be 10 % of the thickness of the machined tubesheet sections.

3.3 Admissible defects

The following conditions are considered rejectable:

3.3.1 Straight beam examination:

3.3.1.1 Complete loss of back reflection not associated with forging configurations or surface and accompanied by an indication of discontinuity. For this purpose a back reflection less than 5% of full screen height shall be considered complete loss of back reflection.

3.3.1.2 Indications whose amplitude equals or exceeds that of the back reflection established in an indication free area of the forging.

3.3.1.3 One or more indications equal in amplitude to that of the applicable reference hole, when properly corrected for distance.

3.3.1.4 For twin probe examination indications showing an amplitude equal or exceeding the reference amplitude of 6.4 mm flat bottom hole.

3.3.2 Angle beam examination:

Discontinuities which results in indications exceeding the amplitude of the reference notch or the amplitude reference line.

3.3.3 The vessel manufacturer shall provide any details for above examination to the forging manufacturer.

3.4 Recording level

The recording level shall be 6 dB below the admissible echo level. Indications exceeding the recording level shall be recorded.

3.5 Recording

The report of the ultrasonic inspection shall be in compliance with SA-388, Section 8 and 9.

In addition the following shall be recorded:

a) Indications exceeding the calibration back reflection.

b) For twin probe examination indications exceeding 50% of the amplitude of 6.4 mm diameter reference hole.

c) For angle beam examination of weld edges or weld joining areas indications of discontinuities exceeding 25% of the amplitude of the reference line.

3.6 Personnel Qualification

The manufacturer shall certify that the personnel performing ultrasonic examination has been qualified to SNT-TC-1A (" Personnel Qualification and Certification in Non-destructive Testing" published by American Society for NDT) or an approved equivalent.

4.0 Ultrasonic Test (UT) of cladding

4.1 Scope

This specification covers the requirements for ultrasonic tests of rolled, explosion-bonded and deposit weld cladding and applies to the tests indicated in the ESA, DDS or IDS.

4.2 Test conditions and requirements

4.2.1 Test according to SA-578.

4.2.2 Date of test:

The test shall be carried out after forming i.e. after rolling the shell sections or pressing the heads. If the test is performed according to ESA-AD3 (M), it shall take place after the final heat treatment. For weld overlays in the case that PWHT is required before the application of the final layer, the 1st layer also to be scanned after the PWHT.

4.2.3 Test surfaces:

The surfaces to be tested shall be prepared such that the probe is supported properly. However, the surface condition shall ensure the echo reflection ratio specified under 4.2.4.

4.2.4 Calibration of sensitivity:

The calibration block shall comply with SA-578. It shall be clad by the same procedure as the test specimen.

The difference between the echo level to be recorded and the indication shall be min. 6 dB.

4.2.5 The dimension of a defect shall be determined according to Section 5 of SA 578.

4.3 Test of rolled or explosion-bonded cladding

The material shall be tested for lack of bond between cladding and base metal by means of straight-beam probe according to SA-578.

4.3.1 Normal Operating Conditions:

Surface shall be scanned according to a grid of <= 225 x 225 mm. 100% of the weld edges shall be scanned, the test zone width being 50 mm. Tubesheets shall be 100% scanned.

In the case of clad sections where components intended for load transmission are welded to the structure, the scanning width shall be 150 mm from the weld. The test shall take place prior to and after welding.

4.3.1.1 Admissible defects:

According to SA-578 Acceptance Standard-Level B with the following additions:

A defect shall be considered as individual defect if the distance to the adjacent defect is greater as described in SA-578 paragraph 8.

Plates which have lack of bond of > 5% referred to the overall surface shall be rejected.

Individual defects with a surface of maximum 20 cm² shall be repaired by welding. If required, the manufacturer shall submit a valid process qualification and a certificate for the repair method of the component in question. After the pressure test, the repaired sections shall be subjected to ultrasonic and dye penetration test. Repair welding shall be in accordance with the requirements of SA-264 paragraph 14.

Tubesheets for heat exchanger, lack of bonds which have a surface of > 10 cm^2 shall be inadmissible. For < 10 cm^2, repair procedure shall be discussed on a case to case basis with Uhde. The outer zones of the cladding shall not have any continuous lack of bond from the bore hole to the perimeter.

4.3.2 Operating conditions according to ESA-AD3 (M):

The surfaces shall be tested according to a grid of <=100 x 100 mm. 100% of the weld edges shall be scanned, the test zone width being 50 mm. Tubesheets shall be 100% scanned.

4.3.2.1 Admissible defects:

According to SA-578 Acceptance level S 7 with the following additions:

Defects with lack of bond and with a surface area of > 1cm² shall be inadmissible. Moreover, the requirements according to 4.3.1.1 shall apply if more stringent than level S 7. Admissible defects for the base metal shall be in accordance to 2.2.2.1.

4.4 Test of weld overlays

The test shall be performed by means of a straight beam probe according to ASME Sec. V, Article 4, T-473.1.

Tests to be carried out by means of TR probe for longitudinal waves using the angle-beam method shall be agreed upon in writing with the Purchaser.

4.4.1 Normal operating conditions:

25% of the surface shall be scanned. In the case of strip overlay welding, the overlapping sections shall be tested. Tubesheets shall be 100% scanned.

4.4.1.1 Admissible defects:

Indications exceeding the echo level of the calibration reflector by > 50% and <100% shall be recorded.

Defects causing indications above the echo level of the calibration reflector shall be inadmissible.

Systematic defects such as pores, scale rocks, lack of fusion, etc. are inadmissible and shall be repaired irrespective of the size of the defects listed above.

For tubesheets, outer zone of the cladding shall not have any continuous lack at bond from the bore hole to the perimeter.

4.4.2 Operating conditions according to ESA-AD3 (M):

100% of the surface shall be scanned.

4.4.2.1 Admissible defects:

The requirements according to 4.4.1.1 shall apply.

4.5 Test Report

The test report shall comply with SA-578 paragraph 13.

4.6 Personnel Qualification

The manufacturer shall certify that the personnel performing ultrasonic examination has been qualified to SNT-TC-1A ("Personnel Qualification and Certification in Non-destructive Testing" published by American Society for NDT) or an approved equivalent.

5.0 Ultrasonic test (UT) of welds

5.1 Scope

This specification covers the requirements for ultrasonic tests of ferritic steel welds and applies to the tests indicated in the ESA, DDS or IDS.

5.2 Test conditions and requirements

5.2.1 Test specification:
ASME Section V and ASME Section VIII

5.2.2 Date of test:

If heat treatment is specified, the test shall be carried out after the last heat treatment or, if specifically requested in DDS or IDS after the pressure test.

5.2.3 Calibration of Instruments:

The methods shall meet the requirements of ASME, Section V, Article 4. Other techniques may be used if approved by the purchaser.

5.2.3.1 For pressure vessels, basic calibration block shall be in accordance with ASME Section V, Article 4, T-434. The Alternate Block T-434.2.4 shown in Appendix J Fig. J-431 shall be used. For pipe welds, basic calibration block shall be in accordance with T-434.3, Fig. 434.3 and T-464.

5.2.3.2 For straight beam examination the gain control shall be set to 80% of full screen by basic calibration block at 3/4 T hole.

5.2.3.3 For angle beam examination the calibration shall meet the requirements of ASME, Section V, Article 4, Appendix B as a general technique.

5.2.3.4 In addition the distance amplitude correction curve (DAC) shall be adjusted in such a way, that the grain control is set 80% of full screen by basic calibration block at the 1/4 T hole. Position the search unit for maximum responses from the next holes and connect the peaks of the indications on the screen. Because of the loss of sensitivity by scanning of thicker plates start with a second DAC curve for 3/4 T hole by similar 80% screen height of the grain control and note the dB increase which is necessary to achieve the same sensitivity as for the 1/4 T hole.

5.2.4 Scanning Requirements:

5.2.4.1 Plates around connection holes shall be ultrasonically tested. This is to be done prior to beveling, using the normal beam technique over a continuous annular band at least 75 mm (3-in) wide around the opening in the plate.

5.2.4.2 The adjacent base metal to the weld joint shall be scanned according to ASME, Section V, Article 4, T-472.

5.2.4.3 The weld shall be scanned for reflectors oriented parallel to the weld according to ASME, Section V, Article 4, T-471, T-472 and Article 4, I-471, I-472 and I-473 with two different beam angles.

5.2.4.4 The weld shall be scanned for reflectors oriented transverse to the weld according to ASME, Section V, Article 4, T-471, T-472.1.3 and Article 4, I-471, I-472, I-473. Where the weld surface interferes with the examination, the weld surface shall be prepared as needed to permit the examination.

5.2.4.5 To examine nozzle welds exceeding 150 mm (6-in) internal diameter to shell plates exceeding 38 mm thickness an additional scan shall be done from the bore of a set-through nozzle or the inner shell surface of a set-off nozzle with the straight beam technique.

5.2.5 Welds on pipes shall be examined according to the requirements of ASME, Section V, Article 4, T-434.3, T-464.

5.2.6 Weld seams thicker than 75 mm (3-in) may be divided in sections of max. 60 mm thickness for scanning and evaluation to ensure optimal testing sensitivity for the whole thickness. Wherever possible the scanning shall be done from the inside and the outside surface.

5.2.7 Welds for non-pressure attachments as for lifting lugs and lifting trunnions to the vessel shall be ultrasonically inspected from the opposite side of the plate or forging. The final inspection shall be done after the post weld heat treatment of the welds.

5.3 Marking

Each weld and examination area shall be located and identified by a system of reference points placed on the component or in a sketch. An example is given in ASME, Section V, Article 4, Appendix A.

5.4 Recording

Record all reflectors that produce a response equal to or exceeding 50% of DAC curve. The length of the reflector shall be obtained by measurement according to ASME, Section V, Article 4, T-470 and T-480. The Report of examination shall contain the information required by ASME, Section V, Article 4, T-490, T-491, T- 492 and T-493 and the Pressure Vessel Code, Section VIII, Div. 1, App. 12 and Div. 2, Article 7.5.4.1.

5.5 Acceptance Standard

5.5.1 The Standard for unacceptable discontinuities shall be in accordance with the requirements of ASME, Section VIII, and Div. 1, Appendix 12 or Div. 2, Article 7.5.4.1, except for weld edges the Standard shall be according to 2.2.2.1.

5.5.2 Repairs to correct weld defects shall be made in accordance with approved repair welding procedure.

5.5.3 The Inspector shall be informed of all major repair work prior to commencing repair.

Major repairs are defined as follows:

(a) A repair which requires the excavation of base material to a depth exceeding 3/8 inches (10 mm) or one-half the base material thickness, whichever is the smaller.

(b) A repair which requires welding and the area exceeds 6 square inches (39 cm^2) at any spot.

(c) A re-repair which requires welding after excavation of the repaired part of the base material and weld metal.

(d) A repair which requires welding after PWHT.

5.6 Test report

The results of ultrasonic tests and the test conditions shall be recorded in an inspection test certificate. See also 5.4.

5.7 Personnel Qualification

The manufacturer shall certify that the personnel performing ultrasonic examination has been qualified to SNT-TC-1A (" Personnel Qualification and Certification in Non-destructive Testing" published by American Society for NDT) or an approved equivalent.

6.0 Radiographic test (RT) of welds

6.1 Scope

This specification covers the requirements for radiographic tests of welds and applies to the tests indicated in the ESA, DDS or IDS.

6.2 Test conditions and requirements

6.2.1 Test specification:

All welded joints to be examined as specified in the Uhde Specification shall be tested in accordance with the requirements in ASME, Section V, Article 1 and Article 2 and Subsection B, Article 22, SE-94, T-277, T-280 and Section VIII Div. 1, UW 51, UW52 and Div. 2 Part 7, 7.5.3.

6.2.2 Date of test:

If post-weld heat treatment is specified, the radiographic test shall be performed after the last heat treatment. If radiographic and ultrasonic tests are required, the RT can be carried out after welding and the UT after the last heat treatment.

6.2.3 Surface Preparation:

The finished surface of the butt-welded joints may be flush with the base material or have reinforcements not exceeding the limits specified in ASME, Section VIII, Div. 1, UW 35 and Div.2, Part 6, 6.2.4.1 (d) and will meet the requirements in ASME, Section V, Article 2 T-222.

6.2.4 Selection of Energy of Radiation - Film Type:

The energy of radiation shall be selected according to the requirements in ASME, Section V, Article 2, T-272. Radiographs shall be made using film type SE-1815 Table X1.1 with the requirements in ASME, Section V, SE-94 Table 1 and 2 as a guide.

6.2.5 Radiographic Density:

The transmitted film density shall be in the ranges according to ASME, Section V, Article 2, T-282.1. If the density varies more than that allowed, then an additional penetrameter shall be used for each exceptional area. For joints between plates of different wall thicknesses one radiograph with allowable density range for each thickness shall be taken.

6.2.6 Shims under Penetrameter:

A shim of material radiographically similar to the weld metal shall be placed under the penetrameter if the reinforcement is not removed. Selection of the shims shall be according to ASME, Section V, Article 2, T-277.3.

6.2.7 Back Scatter Check:

The lead symbol "B" shall be used for check of back scattered radiation according to ASME, Section V, Article 2, T-223 and Appendix I, Section I-223.

6.2.8 Sharpness of Radiographic Image:

The requirements of ASME, Section V, Article 2, T-285 are to be used only as a guide. Final acceptance of radiographs shall be based on the ability to see the prescribed penetrameter image and the specified hole.

6.2.9 Image Quality Indicators (Penetrameters):

The sensitivity of the radiograph shall be confirmed by using penetrameter according to the requirements in ASME, Section V, Article 2 T-233, T-276, T-277, T-283 and Appendix I, Section I-277. The quality Level shall be 2-2 T as per ASME Sec. V,

Article 22, SE-747, article 6 unless otherwise specified in an Uhde "Equipment Specification".

6.3 Acceptance Standard

The acceptance standards shall be according to the requirements in ASME, Section VIII, Div.1 UW 51, UW 52 or Div. 2, Part 7, 7.5.3.2.
Prior to being presented for inspection for acceptance the radiographs shall be examined and interpreted by the manufacturer, and a written report according to section 6.5 issued.

6.4 Identification of and Location Marks on Radiographs

Each radiograph must be identified so that there is a permanent correlation between part radiographed and the film. The method shall be agreed between manufacturer and purchaser (see ASME, Section V, Article 22, SE-94, Section 15.1)

Location markers which are to appear as radiographic images on the film shall be placed on the part. See the requirements in ASME, Section V, Article 2, T-275 and SE-94, Section 15.2.

The placement shall be subject to the radiographic technique according to the requirements in ASME, Section V, Article 2, T-271 and the Non-mandatory Appendix in Article 2.

6.5 Test Reports

Written reports of radiographic examinations are required. They should include as a minimum:

6.5.1 Identification of part, material and weld number.

6.5.2 Radiographic job number.

6.5.3 Specified data such as:

a) Location mark
b) Penetrameter used - hole to be visible
c) Radiation method (e.g. x ray, gamma ray)
d) Radiographic technique (including screens employed)
e) Film density range
f) Name of evaluator

6.6 Personnel Qualification

The manufacturer shall certify that the personnel performing radiographic examinations have been qualified to SNT-TC-1A ("Personnel Qualification and Certification in Non-destructive Testing" published by American Society for NDT) or an approved equivalent.

7.0 Magnetic particle test (MT)

7.1 Scope

This specification covers the requirements for tests intended to detect surface cracks by the magnetic particle method and applies to the tests indicated in the ESA, DDS or IDS.

7.2 Test Conditions and requirements

7.2.1 Test specification:

All weld bevels or welded joints to be examined as specified in the Uhde Specification shall be tested in accordance with the requirements of methods and procedures described in ASME, Section V, Article 7 and Article 1 and Subsection B, Article 25.

7.2.2 Surface preparation:

The surface to be examined shall be dry and clean. The preparation shall meet the requirements in ASME, Section V, Article 7, T-741.

7.2.3 Sequence of operation:

The examination shall be done by the continuous method.

7.2.4 Direction of Magnetization:

At least two separate examinations shall be performed on each area. During the second examination the lines of magnetic flux shall be approximately perpendicular to those during the first examination.

7.2.5 Magnetizing Field Adequacy:

At the beginning of every examination the Magnetic Particle Field Indicator described in SA-275, Article 10.5.6, Fig 8 shall be used to verify the adequacy of the magnetic field.

7.2.6 Examination coverage:

All examination shall be conducted with sufficient overlap to assure 100% coverage at the established test sensitivity.

7.2.7 Magnetization Technique:

For the examination, an alternating current electromagnetic yoke having a lifting power of at least 4, 5 kg (10 lb) shall be used.

Other examination methods shall be agreed by the purchaser prior to implementation.

7.2.8 Examination Medium:

The dry magnetic powder or the wet magnetic particle technique fluorescent or non fluorescent shall be used according to Section V, Article 7, T-731 and Section V, Article 25, SE-709.

7.3 Acceptance Standard

7.3.1 The evaluation and acceptance shall be according to the requirements in ASME, Section VIII, Div. 1, Appendix 6 or Div. 2, Part 7, 7.5.6.

7.3.2 Additional requirements for weld edges under operating conditions according to ESA-AD3 (M):

The maximum length of discontinuities parallel to the weld edge which have to be considered shall be 25 mm. Larger discontinuities shall be eliminated by grinding and re- welding.

7.4 Report

The manufacturer shall prepare examination records which contain joint no., state of fabrication, date, name or examiner, result and result of examination after repair, if necessary.

7.5 Personnel Qualification

The manufacturer shall certify that the personnel performing magnetic particle examination has been qualified to SNT-TC-1A ("Personnel Qualification and Certification in Non-destructive Testing" published by American Society for NDT) or an approved equivalent.

8.0 Dye penetration test (PT)

8.1 Scope

The specification covers the requirements for surface crack tests by the dye penetration method and applies to all tests indicated in the ESA, DDS or IDS.

8.2 Test conditions and requirements

8.2.1 Test specification:

All weld bevels or welded joints to be examined as specified in the Uhde Specification shall be tested in accordance with the requirements of methods described in ASME, Section V, Article 1, Article 6 and Subsection B, Article 24.

8.2.2 Test fluids (penetrants):

8.2.2.1 Only an approved system of test fluids shall be used.

8.2.2.2 The test fluids used for austenitic materials and non- ferrous metals shall not contain any corrosive substances such as halogen or sulphur. A record as per ISO 3452-2 or ASTM D 808 and D 129 is required for this purpose.

8.2.3 Preparation of the test surface:

The test surfaces shall be clean and free of scale, oil, grease, paint, weld spatter etc. When the test surfaces are cleaned prior to testing, defects shall not be closed by shot blasting or grinding. If the test surfaces have been cleaned thoroughly by such a method, they shall be heated to approximately 100º C prior to testing. This method is recommended to re-open such defects. The test surfaces shall be carefully dried after cleaning.

The cleaning and drying shall meet the requirements in ASME, Section V, Article 6, T-642 and T-643.

8.2.4 Penetration process:

8.2.4.1 The penetrant may be applied by any adequate method.

8.2.4.2 As a standard technique the temperature of the penetrant and the tested surface shall not be below 16 °C nor above 52 °C. When it is not practical to conduct an examination within this temperature range a requalification is required according to T-653.

8.2.4.3 The minimum period of penetration shall correspond to table No.1. The test surface shall not dry out during this period. The penetrant shall be applied several times, if required.

8.2.5 Intermediate cleaning:

8.2.5.1 The excess of penetrant shall be thoroughly removed. This does not apply to the penetrant in the defects. Excessive cleaning with solvent or water jet is not permitted. The maximum temperature of the water shall be 50 °C.

8.2.5.2 After cleaning, the test surface shall be dried as quickly as possible, but the penetrant in the defects shall not dry prior to the application of the developer.

8.2.6 Developing process:

8.2.6.1 The developer shall be sprayed such that a uniform thin film can form. A painting brush shall not be used.

8.2.6.2 Normally the time of development equals the period of penetration (see table No.1).

8.2.7 Inspection:

The test surface shall be closely observed during drying of the developer to ensure reliable evaluation of the type of defect in cases where the dye is marking off. The interpretation shall be based on the time values indicated in Table No.1.

8.2.8 Repetition of tests:

If a test has to be repeated, the whole test from the pre-test cleaning to the inspection shall be carried out.

8.2.9 After evaluation, the surface shall be cleaned from the test fluids.

8.3 Acceptance Standards

8.3.1 The evaluation of indications shall be in accordance with ASME, Section VIII, Div. 1, Appendix 8 or Div 2, Part 7, 7.5.7.2.

8.3.2 The following indications are unacceptable:

8.3.2.1 Any relevant linear indication.

8.3.2.2 Four or more rounded defects in a line separated by 1,6 mm or less.

8.3.2.3 Any indication in tube-to-tubesheet welds.

8.4 Test report

The report shall contain the following information:-

- Information of the part tested (joint number, designation, dimensions, material, surface condition, product stage)
- Purpose of testing
- Used penetrant system
- Test instructions

- Deviations from the test instructions with explanation
- Test result including description of discontinuities detected
- Test location, date of testing, name and signature of the operator
- Name, certification and signature of the test supervisor.

8.5 Personnel Qualification

The manufacturer shall certify that the personnel performing liquid penetrant examination has been qualified to SNT-TC-1A ("Personnel Qualification and certification in Non-destructive Testing" published by American Society for NDT) or an approved equivalent.

Table 1 - Reaction time and evaluation times for the dye penetration test

Sr. No.	Test Specimen	Penetration Time (in minutes)	Interpretation after the drying of developer (in minutes)			
			1st	2nd	3rd	4th
1.	Ferritic steels & alloys	15	5	15	-	-
2.	Austenitic & ferritic austenitic steel, non-ferrous metals, special materials	30	5	30	-	-
3.	Austenitic weld overlay on ferritic base alloys	60	5	30	60	-
4.	Welding of nickel and nickel-basic alloys	120	5	30	60	120
5.	Tests during individual welding steps such as test of every pass, test of root pass except : 1st layer of tube-to tubesheet weld according to 1,2, or 4	7	7	-	-	-

9.0 Hardness test of welds

9.1 Scope

This specification shall apply if the Uhde engineering specification ESA-AD3 (M) is also mentioned in the related DDS or IDS.

The hardness of the base metal, heat-affected zone and filler metal shall be determined by tests in order to check the effectiveness of pre-heating, welding procedure and post-weld heat treatment.

Figure 1 to 3 and EN 1043-1 shall apply to the arrangement of the measuring points.

9.2 Scope of test

9.2.1 Hardness test of specimens for Welding Procedure Qualification (PQR) and Production Control Test:

Prior to starting the fabrication, each procedure qualification specimen shall be tested for hardness. For this purpose a macro section shall be placed across the weld and the Vickers hardness shall be determined at a load of 98 N (HV 10) at the

points indicated in Fig.1. The minimum test load shall be 3 N but loads of >98 N (10 kg) are inadmissible.

In the heat-affected zone, adjacent indentations shall be spaced according to Fig.2. For HV 10 the value I shall be 1 mm. The dimensions ≤ 0.5 mm in Fig. 2 and 3 indicates that indentations located in a range of 0.5 mm in the heat-affected zone shall be placed along the fusion line in the base metal.

In addition to the indentations with the highest hardness in the heat-affected zone at least two adjacent indentations are required for comparison and shall be placed near the heat-affected zone and spaced as indicated above. The individual measured values shall be recorded. It is not permitted to calculate the mean hardness of the values measured in the heat-affected zone.

Depending on the structure of the layers, it might be expedient to use other test patterns and test forces in addition to the hardness scale indicated. This must be agreed by the purchaser.

9.2.2 Hardness test of production welds:

9.2.2.1 After welding and post-weld heat treatment, all welds including sections repaired by welding, tack welds, etc. shall be tested to determine the hardness of the base metal, heat-affected zone and filler metal. The test results shall be recorded.

If these welds cannot be tested because of inadequate access, the manufacturer shall use other methods to meet the specification requirements and he shall furnish test specimens produced and heat-treated under the same conditions as those of the production welds. (e.g. Production control test plates).

9.2.2.2 The production welds shall be tested for hardness at least in the heat-affected zone by a method similar to Vickers (HV 10). The method must be suited for detection of the critical hardness in the heat-affected zone and the indentations shall not exceed HV 10 (suitable hardness testers are Equotip, Sonadur or DHV 10).

If the results of the manufacturer's tests differ from those of the purchaser's tests, comparison measurements shall be taken according to the standard Vickers method.

9.2.2.3 Preparation of the test surface:

The test surface of the weld shall be ground such that it is flush with the steel plate and the surface finish shall comply with EN ISO 1302 Annex I, Table I.2, class N7 (Arithmetic average roughness Ra ≤ 1.6 µm or ≤ 63 µin).

The position of the weld and heat-affected zone shall be marked by etching.

9.2.2.4 Measurement:

The measuring shall be done of all points, given in 9.2.2.1.

In the Equotip test, the measuring points shall be spaced at a minimum distance of 3 mm, otherwise one measurement might be influenced by the other. The measuring points must be located in an area of =< 0.5 mm along the fusion line in the heat-affected zone. Measuring points outside this area shall not be considered.

For each test, one series of measurements across the weld is required (See Fig 3). A series consists of at least three measuring points each in the base metal/ heat-affected zone/filler metal / heat-affected zone / base metal. The position of the series shall be agreed upon with the inspector.

Tack and temporary welds and the sections repaired by welding shall be marked in an indelible and temperature resistant manner. They shall be tested by the same method as the production welds and the results shall be recorded.

9.2.2.5 Test requirements:

The hardness of base metal, heat-affected zone and filler metal shall not exceed the values indicated in engineering specification ESA-AD3 (M) or in the purchase order specification.

9.3 Additional measurements in cases where the measured values exceed the admissible hardness

At least 3 additional measurements shall be taken in the adjacent sections. The mean values shall not exceed the admissible hardness and the individual values shall not exceed the maximum hardness by more than 10 HV.

9.4 Test report

The test report shall contain:-

- The hardness values
- Base material and used welding consumables
- Test method
- Test load
- A sketch showing the location of the test point
- Welding process
- Heat treatment details

10. Vendor to submit the procedure of repairing and numbering of the repaired welds to Uhde India Inspection Department for approval before starting any repairing work. Repairing work should be started only after written permission of Uhde India Inspector.

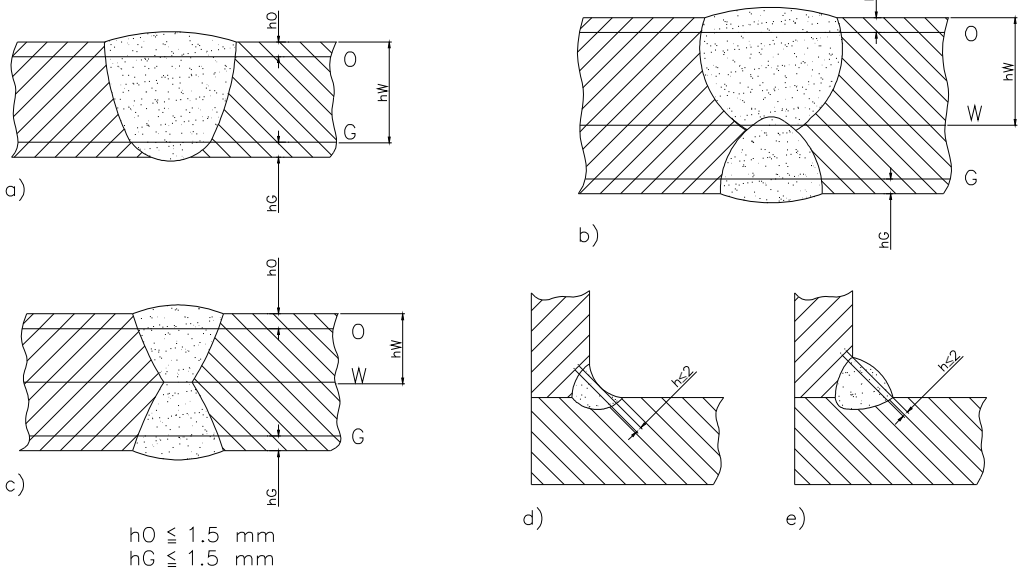

FIGURE 1) TEST EXAMPLES WITH HARDNESS SCALE

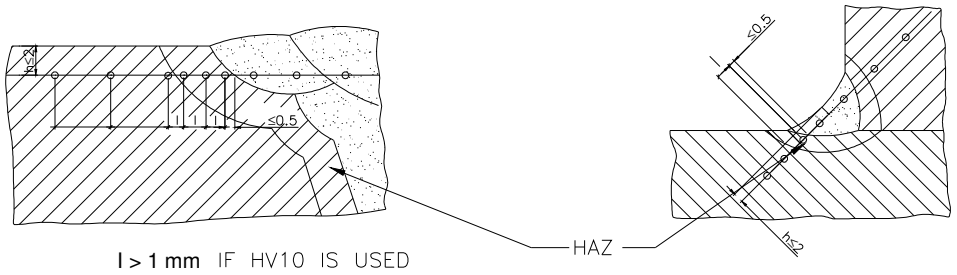

FIGURE 2) POSITIONS OF INDICATIONS IN THE HEAT–AFFECTED ZONES (HAZ)

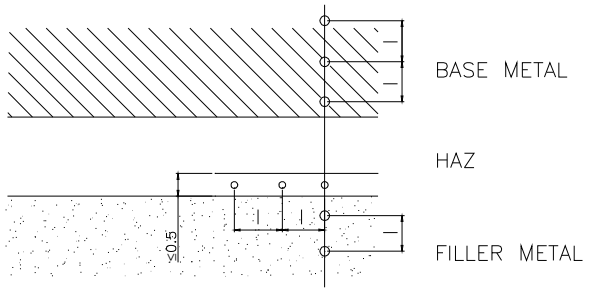

FIGURE 3) POSITIONS OF INDENTATIONS ON THE WELD SURFACE

Uhde	PICKLING AND PASSIVATION	STD-MQ-UZ-0009
		Page 1 of 1

1.0 SCOPE

This standard is applicable when specified in the equipment specification / fabrication drawing.

If discrepancies are found between equipment specification and UN V416-03 Part 1(M) then equipment specification will govern.

Uhde Standard UN V416-03 Part 1(M) forms an integral part of this specification along with the modifications / additions made as under.

Whenever surface treatment of stainless steel is required to be performed, only chemical process shall be used. Mechanical processes as mentioned in Uhde standard UN V416-03 Part 1 (M) shall not be used unless specifically agreed upon by Uhde India Private Limited.

Fabricated equipments are to be packed carefully before dispatch so as to avoid damage during transit by road / rail / ship. Care should be taken so as not to impair the dimensional accuracy obtained during manufacture.

In particular the following points are to be noted:

1. Equipment shall be well dried and thoroughly cleaned both inside and outside and all water, dirt, sand, weld metal spatter, welding electrode stubs and foreign matter shall be removed.

2. Items to be marked conspicuously with item number of adequately sized figures (100 mm): use white oil paint.

3. All steel sealing flange surfaces and other machined surfaces shall be coated with a suitable rust preventive (e.g. Tectyl) and shall be covered with wooden covers with at least four bolts and nuts and soft gasket / plastic sheet in position to prevent mechanical damage during transportation.

4. Bolt threads shall be lubricated with Molykote (Molybdenum disulphide grease).

5. Tapped holes are to be filled with acid-free grease.

6. All blind flanges shall be bolted onto the nozzle flanges with gaskets and all bolts and nuts in position.

7. Wherever possible, all internals are to be fixed in position before dispatch. Any other internals that are not installed by the manufacturer into the equipment at the time of shop assembly shall be well packed into boxes to prevent damage to or loss of such parts, which shall be marked for easy identification.

8. Horizontal equipment with saddle support should be transported using saddles for support during transport.

9. All other equipments are to be supported during transport with sufficient number of wooden saddles which are to be provided by the vendor; minimum one-third of the circumference should rest on these.

10. If stiffeners are required for safe transport of the equipment to site, these are to be provided by the vendor.

11. Loading of the equipment at the vendor's works into the truck/trailer/wagon is the responsibility of the vendor.

12. During handling and transport of stainless steel and non-ferrous equipment, it should be ensured that no ferrous material like clamps, chains etc. come into contact with the equipment.

NOTE

Equipment shall not be dispatched by the manufacturer before receipt of the written release note and of the dispatch instructions from the purchaser even though they have been finally inspected.

13. For ocean shipment, flanged openings should also be covered with heavy plastic bags taped securely to the nozzle. It should also be ensured that the packing of material / equipment is "sea-worthy".

A company of ThyssenKrupp Technologies	**Uhde India**	PROJECT **KCIL- FORMALDEHYDE**	UAN **66-6481-700**	

DESCRIPTION

SUMMARY OF ENGINEERING & FINAL DOCUMENTS FOR ITEMS FOR WHICH UIPL WILL ISSUE SPECIFICATIONS / DRAWINGS & VENDOR'S DRAWINGS ARE REVIEWED / APPROVED BY UIPL

DOCUMENT NO.	PAGE	REV.
6481-MQ-UGS-0011	**1**	**0**

The following engineering and final documents shall be furnished by the manufacturer :

Version and delivery date shall be as specified.

	Sr.	Documents	Quantity: Reproducible	Quantity: Copy	Version	Delivery Date
1.0		**For engineering and approval**				
	1.	Assembly drawing - arrangement drawing		8	II	B
	2.	Foundation plan - load plan		8	II	B
	3.	Workshop drawing with part list		8	II	B
	4.	Engineering data and specifications		8	II	B
	5.	Piping plan or piping diagram				
	6.	Electrical diagrams				
	7.	Delivery schedule for equipment		8	II	D
	8.	Sketch for equipment transport		8	II	2)
	9.	Erection instructions		8	II	2)
	10.	Stress analysis (for review)		8	II	B
	11.	Material status report		8	II	B
	12.					
	13.	Documents bearing Uhde notes shall be resubmitted	As indicated above			C
2.0		**Spare parts**				
	1.	Quotation for 2 year (s) operation				A
	2.	Spare parts list with itemized drawings or sketches				
3.0		**Final documents**				
	1.	"As built" version of documents listed under 1.0	1	8	II	G
	2.	Spare parts list with itemized drawings or sketches				
	3.	Erection instructions		8	II	G
	4.	Table of lubricants and lubrication schedule				
	5.	Test certificates for explosion proof items of equipment				
	6.	Summary of antifriction bearings				
	7.	Stress analysis		8	II	G
	8.					
4.0		**Inspection**				
	1.	Shop inspection certificate / Hydro-static test Certificate		8	II	E
	2.	Material certificate to EN 10204 / 3.1 A - 3.1 B - 3.1 C		8	II	E
	3.	Inspection reports issued by inspection authority such as TÜV		8	II	F
	4.	Inspection reports, stress relieving diagrams, etc.		8	II	E
	5.	Inspection reports issued by statutory authorities				

5. Explanation of figures listed in column "version"

I	Lettering or wording in German
II	Lettering or wording in English
III	Lettering or working in German and English
IV	Lettering or working in German and

A	To be submitted with quotation
B	2 weeks after order placement
C	2 weeks after return of documents
D	2 weeks after order placement, , thereafter monthly
E	Not later than date of final inspection
F	2 weeks after final inspection; to be submitted with shipping Documents if the equipment has to be shipped abroad
G	After release, but not later than 2 weeks Prior to the final inspection

6. Remarks

1) Standard size DIN A4 and smaller on white sheets, larger sizes on transparent paper (plastic sheets).

2) 3 months after order placement or two weeks before final shipment, whichever is earlier.

3) CD-ROM containing electronic copies of all drawings/sketches and documents shall be submitted by vendor along with final documentation.

Master Document Rev. 01_2008

A company of ThyssenKrupp Technologies	**Uhde India**	PROJECT **KCIL- FORMALDEHYDE**	UAN **66-6481-700**	

DESCRIPTION
SUMMARY OF ENGINEERING & FINAL DOCUMENTS FOR ITEMS FOR WHICH UIPL WILL ISSUE DESIGN DRAWINGS & VENDOR'S DRAWINGS ARE NOT REQUIRED / NOT REVIEWED BY UIPL

DOCUMENT NO.	PAGE	REV.
6481-MQ-UGS-0012	**1**	**0**

The following engineering and final documents shall be furnished by the manufacturer :

Version and delivery date shall be as specified.

		1.0 For engineering and approval	Quantity			
Pos	Documents	Reproducible	Copy	Version	Delivery Date
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2.	Foundation plan - load plan				
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10.	Stress analysis (for review)				
11.	Material status report		8	II	B
12.					
13.	Documents bearing Uhde notes shall be resubmitted	As indicated above			C
	2.0 Spare parts				
1.	Quotation for 2 year (s) operation				A
2.	Spare parts list with itemized drawings or sketches				
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A company of ThyssenKrupp Technologies	**Uhde India**	PROJECT	UAN	
		KCIL- FORMALDEHYDE	**66-6481-700**	

DESCRIPTION

SUMMARY OF ENGINEERING & FINAL DOCUMENTS FOR ITEMS FOR WHICH UIPL WILL ISSUE SPECIFICATIONS & VENDOR'S DRAWINGS ARE NOT REQUIRED / NOT REVIEWED BY UIPL

DOCUMENT NO.	PAGE	REV.
6481-MQ-UGS-0013	**1**	**0**

The following engineering and final documents shall be furnished by the manufacturer :

Version and delivery date shall be as specified.

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Sr.		Documents	Reproducible	Copy	Version	Delivery Date
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[Modified: 29/08/2008]

Contents

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1.0 SCOPE

This Uhde standard applies to pressure vessels and other vessels including accessories of metallic materials. This Uhde standard does not absolve the user from meeting the requirements specified in the statutory regulations, codes and standards.

The scope of supplies covers the complete vessels or equipment according to the relevant specification including all internals, bolts, gaskets and blind covers as well as the prime coat according to the painting specification.

If the requirements outlined in this Uhde standard are in contradiction to those outlined in the relevant technical specification, the latter shall take precedence.

2.0 CALCULATION

2.1 Permissible stresses

The permissible tensile stress of the vessel materials is specified in the relevant standard.

The permissible compression stress in the longitudinal direction of the vessel (stress resulting from weight, wind moment, etc.) shall not exceed the lowest value of the following two types of stresses.

(a) Permissible tensile stress.

(b) Permissible compression stress derived from the buckling strength calculation according to ASME-Code Sec. VIII Div.1, Paragraph UG-23 (b) (2).

Selection of anchor bolts for pressure vessels shall be based on the reference standard listed on page 2 of General Engineering Specification. Diameters of the anchor bolts indicated in the above referred standard are exclusive of corrosion allowance. Same is to be added by designer.

The allowable concrete bearing pressure under the base ring shall be 5 N/mm². For erection/hydrotest condition the same shall be 6.6 N/mm².

2.2 Stress Analysis

In addition to calculating the wall thicknesses, the manufacturer shall make the following stress analysis for the corroded condition of the vessel.

■ Erection condition

Weights: dead weight of the vessel without internals (to be installed later). In case of heat exchangers, dead weight includes weight of the tube bundle.

Moments: Wind moments for vessels including all attachments plus moments from eccentric loads, plus wind moment from the scaffolding.

■ Operation condition

Weights: dead weight plus weight of all internals, attachments, insulation and inventories.
Moments: wind moments for vessels including all attachments, plus moments from eccentric loads plus other moments (e.g. nozzle loads: 10% of force acting on bigger nozzles shall be applied). Earthquake loads are to be considered for all calculations whenever they are higher than wind loads.

■ Test condition

Weights: dead weight plus weight of all internals, attachments, insulation and water inventory.

Moments: wind moments for vessels including all attachments, plus moments from eccentric loads.

The maximum induced stress under test condition shall not exceed 90% of yield stress for tension and code allowable compressive stress for compression.

- The effect of the forces acting on the nozzles or supports and of the moments acting on the vessel wall shall be examined as per the method of analysis WRC Bulletin 107 or PD 5500.

- The vessel shall have adequate shell rigidity for transport.

- Supporting brackets shall be designed in such a manner that the maximum load (operating weight or weight with water inventory, wind moment etc.) can be absorbed by half the number (by at least 2) of supporting brackets.

- The permissible compression stress according to section 2.1 also applies to the supports (skirts) of vertical vessels and shall also be applied analogously to the hydrostatic test of vessels in their operating position.

- Allowance factor FB for platforms, ladders, piping and insulation given in Uhde equipment specification shall be used for computing wind loads and moments.

- A rigidity analysis shall be made for saddles. Method of analysis shall be PD 5500.

- Vertical vessels/columns exceeding total height of 10 meters shall be checked for vibration due to vortex shedding from wind to ensure their structural safety and the calculation shall be submitted for approval.

- Local stresses from lifting lug and trunnion on shell/head shall be analysed and calculations shall be submitted for approval.

- For calculations, following applies in addition to above references -

  a) Anchor chair/base plate design and reaction of anchor bolts on skirts - Process Equipment Design by Brownell & Young.
  b) Other calculations not covered in ASME Sec. VIII Div.1 shall be done as per Pressure Vessel Design Handbook by Bedner or PD 5500.

2.3 Deflection

Deflection of the vessel shall not exceed L/200 for process columns with tray type internals and L/100 for other types of internals. L is the total height of the column/vessel.

3.0 DESIGN

3.1 Drawings and technical documents

Drawings shall be prepared according to Uhde standard UN V401-01 Part 1 (M). The metric system shall be used for the dimensions and weights indicated in the drawings. Regarding form and contents, the manufacturer's drawings shall correspond to the data specified in Uhde standard UN 2000-10 Part 1 (M).

In case fabrication drawings and related drawings require approval from statutory authorities such as IBR, CCE, etc. or from a third party inspection agency like LRIS, the same is vendor's responsibility. However, all requirements of Uhde are also to be included during progress of engineering.

3.2 Wall thickness allowances

Wall thickness allowance : The allowance shall take into consideration the minus tolerances permitted according to manufacturer's and dimensional standards for plates and pipes and the reductions in wall thickness resulting from the fabrication process (e.g. in the case of cast or deep-drawn components).

Wear allowance (corrosion allowance):

This allowance shall be applied to all components coming into contact with process fluid. It is specified in the design data sheet.

For multi-chamber vessels, this wear allowance shall be applied to both sides of the partitioning walls.

Removable internals of non-corrosion-resistant materials shall be provided with the same corrosion allowance as the vessel, but on one side only. Welded-in internals shall be provided with the corrosion allowance on all sides coming into contact with the process fluid.

Vessels and vessel internals of corrosion-resistant materials require no wear allowance. If erosion or similar phenomena are to be expected, the wear allowance shall be applied.

Cladding and lining of corrosion-resistant materials are considered as wear allowance. This does not apply to electro-plated components. Plastic coatings may only be considered as wear allowance if approved by Uhde.

Further wall thickness allowances, e.g. allowance for bricklining shall be taken into consideration depending on the requirements.

3.3 Materials

Material test certificates according to the applicable standard shall be furnished for pressure-bearing components and for parts which are welded to pressure-bearing components.

Shells, heads, and reinforcements shall be fabricated from killed carbon steels unless unkilled steel has been expressly specified.

For hydrogen service components which are subjected to mechanical loads and which are welded on Mo or Cr-Mo steels, shall be fabricated from the same material as the vessel or from another steel resistant to hydrogen under pressure. When selecting the materials, API 941 "Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants" shall be observed.

For vessels containing caustic soda solution, the application limits regarding carbon steel for operation with caustic soda solution shall be taken into consideration. Refer to Uhde standard UN V462-01 Part 1 (M).

The materials shall be selected with a view to proper weldability.

Structural steel shall be minimum tested quality as per IS 2062. Only new and first quality materials shall be used for manufacture. Rusted and pitted material shall not be used on the job.

3.4 Construction

3.4.1 Heads and reducing shell sections

Dished heads shall preferably be made from single piece. If this is not possible, one weld seam with 100% radiography is acceptable which shall not completely lie in the knuckle zone. If a theoretical wall thickness of > 20 mm is required, flanged dished heads or ellipsoidal heads (2:1) or hemispherical heads shall be used.

The cone angle of conical reducing shell sections shall not exceed 60°.

3.4.2 Openings and reinforcements

The reinforcements of the openings shall preferably be tubular. This particularly applies to high-strength materials and to theoretically required wall thicknesses of > 20 mm. In the case of dished heads, the edge of the nozzle or reinforcement ring shall be located in the spherical segment of the head.

The distance between the weld of the nozzle or reinforcement ring and a longitudinal or circumferential weld of the vessel shall be three times the shell wall thickness, but not less than 50 mm. If this is not possible, the welds shall be arranged in such a manner that the shell weld is completely interrupted by the nozzle. This arrangement may only be used in exceptional cases and require Uhde's written approval. In such a case, the area concerned shall be subjected to a surface crack test after the hydrostatic test has been completed.

The reinforcements of sheet steel shall be fabricated from the same materials as the shell and be provided with a test hole NPT 1/8".

3.4.3 Nozzles

The nozzle-to-shell weld shall be performed as per Uhde standard UN V416-01 Part 1 (M). Nozzles subjected to high loads or to additional loads caused by temperature variations, thermal shocks, changing or pulsating stress, shall be attached to the shell by full-penetration welding. The inner edge of the nozzle pipe or opening shall be rounded to a radius of approx. 3 mm. However, in the case of shell wall thickness of > 50 mm, the radius shall correspond to the smallest value of the following:

(a) 1/4 of the shell wall thickness

(b) 19 mm

Nozzle Flanges:

(1) **Carbon Steel**

Up to 2" NB - use WNRF flanges
>2" NB use forged SORF flanges with following exceptions:

i) Low Temp service i.e. below –20 °F.
ii) Hydrogen or lethal service.
iii) Very high temperature service i.e. above 500 °F.
iv) Where the flange is subjected to cyclic loading condition.
v) Where design pressure is above 300 psi.

In case of these exceptions, use WNRF flanges only.

(2) **Stainless steel**

Up to 2" NB use WNRF flanges
> 2" NB use carbon steel forged SORF flanges with weld overlay of SS with minimum finished thk. of 3 mm. The composition of weld overlay shall match with respective SS grade at least up to a depth of 1 mm from the top finished surface.

In case of exceptions mentioned in clause (1) above (for Carbon Steel Flanges), use WNRF flanges of SS material.

(3) **Carbon steel blind flanges**

These shall be made from plate.

(4) **Stainless steel blind flanges**

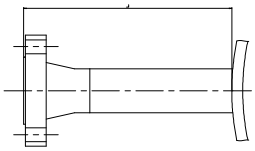
Up to 2" NB - these shall be made from SS plate.
> 2" NB - these shall be carbon steel plate with SS liner welding.

The neck thickness of the welding neck flanges shall not be smaller than the required minimum wall thickness of the nozzle pipe. If this wall thickness is smaller than the neck thickness indicated in the flange standard, a stress analysis shall be performed for the flange concerned.

The nozzle lengths shall correspond to the table below:

Table 1

Nozzle Length 1) **L**



DN	Insulation thickness (mm)			
	> 0 <= 50	> 50 <= 100	> 100 <= 150	> 150 <= 200
< = 100	200	200	250	300
>=125 <=250	200	250	300	350
> = 300	250	250	300	350

1) Welding necks shall have the same length as nozzles with flanges

Nozzle for level gauges and controllers attached to the vessel bottom shall protrude 50 mm into the vessel to prevent fouling.

Drain nozzles shall not protrude into the vessel.

The nozzle pipes shall have a diameter of at least DN 50 (2" NB) and an appropriate reducing section for the flange connection concerned. Deviations require Uhde's written approval.

The bolt holes of the flanges shall straddle the flange centrelines which shall coincide with or be parallel to the centrelines of the vessel.

Nozzle pipes shall be seamless up to 12" size for CS and 6" size for SS. Nozzle pipes exceeding above limits may be welded type with 100% radiography.

For internal atmospheric pressure tubing, steel plate flanges may be used which, however, shall have the companion dimensions of standard flanges.

Wherever welded connection is specified, edge preparation shall be performed in shop and shall be closed with pad plate and cap for hydrotest and shipment.

Surface finish for flanges shall be as follows:-

Type of Gasket Contact Face	Surface finish
Tongue & groove and Small male & female joint	< 125 Ra
Metallic ring joint	< 63 Ra
Other flange facings	125 to 250 Ra

All above values are in micro-inch.

Unless otherwise stipulated the facing of the nozzle flange > 24" NB and all girth flanges, shall be finished only after final welding operation and heat treatment, if any.

When the vessel is falling in low temperature service category as per code, machined surface of all forgings shall be examined by M.P / D.P. tests after machining, if machining is done in vessel manufacturer's shop.

Threaded sleeves are not permitted unless specifically required.

3.4.4 Manholes and inspection openings

If the lower manhole of a vessel is located 1200 mm or more above the tangent line or a foot rest, ladder rungs shall be provided inside the vessel. In addition, a holding grip shall be installed above the manhole. Refer to Uhde standard UN 2004-05 (M) for the design.

Forged flanges shall be used for all manholes of carbon steel. Block flanges are permitted for hand holes. Other types of flanges are only permitted if approved by Uhde.

The manhole cover shall be provided with a davit. In the case of cold insulation, the cover shall be hinged. Refer to Uhde standard UN 2000-11 Part 1 (M) or Uhde standard UN 2000-04 (M).

3.4.5 Bolted connections and gaskets

If membrane or weld-ring gaskets are used, same shall be replaceable without necessitating post-weld heat treatment of the flanges, e.g. by buttering.

Unless otherwise indicated in the specification, hexagonal bolts may be used for external connections provided the pressure is < 40 bar, the temperature is < 300 °C and the thread diameter is < 30 mm. In all other cases, stud bolts with two nuts shall be used. Hexagonal bolts may be used for internal connections which are not subjected to pressure.

The tightening torques for pressure - bearing connections shall be specified by the manufacturer.

All fasteners up to 1" shall be UNC fully threaded and above 1" shall be 8-UN fully threaded.

3.4.6 Base ring template

Two base ring templates shall be fabricated to determine the exact positions of the anchor bolt holes in the skirt of vertical vessels. One template shall be forwarded to the job site within 1½ to 2 months for the casting of the vessel foundation. The second template shall remain in the manufacturer's works. The templates shall be fabricated from steel plates of approx. 5 mm thickness and be adequately reinforced for transport.

If the outside diameter is > 2000 mm, the templates may be split into two segments which shall be joined by fitting bolts.

The top sides of the templates shall be marked with white oil paint and die-stamped letters as follows:

- 0° / 90° / 180° / 270°
- 0° to be supplemented by “North”
- “Uhde order number”
- “Item Number”
- “Top”

3.4.7 Supports

The skirts shall be designed with manholes and vents according to Uhde standard UN 2000-05 Part 4 (M), legs according to Part 5 (M), brackets according to Part 6.

Horizontal Vessels shall be equipped with saddles.

Depending on the max. allowable working temperature, the support saddles shall be made of the following materials:
> 120 °C - Steel
5 to 120 °C - Steel or concrete with plates of min. 6 mm thickness for corrosion protection.
< 5 °C - Steel

For steel saddles of horizontal vessels, refer to Uhde standards UN 2000-05 Part 1 (M) and UN 2000-15 (M).

Saddle analysis for horizontal vessel shall be performed unless it is waived expressly. Saddle plate material shall be that of shell material and remaining portion of the saddle shall be as per UN 2000-05 Part 1 (M).

3.4.8 Erection clips

For field erection of vessels, the erection clips shall be fabricated according to Uhde standard UN 2000-07 Part 1 (M). The erection clips for columns and vertical vessels shall be arranged in such a manner that the vessel transported in horizontal position can be lifted. If a vessel consists of several sections, the erection clips, clamps, etc. required for each section shall be agreed upon between the erection contractor and Uhde.

3.4.9 Supports for internals

Supports for internals such as supporting grids, vortex breakers, internal manifolds, etc. and all clips welded in place shall be supplied by the vessel manufacturer. When designing the supporting grid, the pressure drop shall be taken into consideration as an additional load.

The use of securing devices for the bolts of the internals shall be agreed upon between the manufacturer and Uhde.

Installation of trays at site after erection of column shall be carried out by Erection Contractor under the supervision of tray manufacturer, process licensor, client and Uhde.

Vendor shall conduct a trial assembly for one set of tray at vendor’s shop in presence of tray manufacturer, Uhde, Client, to ensure proper fitment of trays.

In case trays are ordered separately, following is applicable:

a) Column vendor shall furnish drawings for review by tray vendor and comments made by tray vendor shall be incorporated by column vendor.

b) All welded internals like tray supports etc. shall be in the scope of column vendor.

Table 2

Minimum thickness of internals (without wear allowance)

Components	Non-ferrous metals and stainless steel	Non-corrosion resistant steel
Partitioning plates, downcomer plates, Weirs, draw-off pans, clamps etc.	2 mm	2 mm
Supports of steel plate, supporting grids	2 mm	3 mm
Supports of sectional steel	3 mm	3 mm
Bolts	M 10	M 10

Table 3

Support rings and downcomer bolting bars

Inside diameter of column mm	Width of support ring mm	Width of vertical downcomer bolting bars mm	Plate thickness mm
< = 900	40	Lateral downcomer - 2.5 to 3 x support ring width Central downcomer 2.5 x support ring width	6 mm + 2 x Corrosion Allowance
> 900 < = 1700	50		
> 1700 < = 2600	60		
> 2600 < = 3600	70		
> 3600 < = 4700	80		
> 4700	90		

If the tray manufacturer specifies other dimensions, same shall apply.

It must be possible to install and remove all internals through the manhole. They shall not obstruct the access through the manholes. It is recommended to have approximately 30 mm clearance between manhole ID and internal sections.

Unless otherwise specified, all internals shall be installed prior to delivery.

Internal components such as support rings, braces, webs, supports, etc. shall be attached to the vessel shell or tray by a continuous full-fillet weld, to be welded from both sides. If the components can only be welded on one side or if the partial pressure of the hydrogen is > 7 bar, full penetration welding shall be performed. In the case of vessels with a diameter of > 1000 mm, the welded-in fractionating trays, transverse baffles and partitioning plates shall be provided with a folded edge and attached to the vessel by a continuous full-fillet weld. The height of the folded edge shall be four times the plate thickness but at least 50 mm. The edge shall be folded by 75°. The folding angle shall be determined to permit welding of the major portion of the fillet welds from both sides. Internal manifolds shall be provided with flanged connections.

3.4.10 Insulation Clips

Vertical vessels with insulation shall be provided with clips according to Uhde Standard UN 2004-06 (M).

3.4.11 Earthing Connections

The vessels shall be equipped with earthing connections according to Uhde standard UN 2003-01 (M).

4.0 FABRICATION

4.1 General

The shell plates shall be dimensioned to permit fabrication of the vessel with a minimum of welds. The minimum distance between the circumferential welds and the support rings or fractionating trays, etc. shall be 100 mm. Refer to Uhde standard UN V416-01 Part 1 (M) for the preparation of the welding bevels.

Shell sections shall not be rolled until the actual diameters of the heads have been determined.

When matching shell sections of different wall thicknesses, the vessels equipped with removable internals (e.g. fractionating trays) shall have the same inside diameter. The shell plates of larger thickness shall be chamfered (slope of 1:4) on the outside of the vessel.

Refer to Uhde standard UN 2000-02 part 1 (M) for the dimensional tolerances for vessels.

The joint between skirt and bottom head shall have smooth transition by grinding.

All inside welds of equipment with internals shall be ground smooth unless otherwise specified.

4.2 Welding

Refer to Uhde standard UN V416-01 Part 1(M) and/or UN V416-03 Part 1 (M) for welding including testing, post-weld heat treatment and surface treatment.

Closing butt weld of heat exchanger or vessel where back chipping is not possible, root and final pass shall be DP tested.

All welds (except fillet) shall be chipped back to sound metal and re - welded from the other side. Wherever back - chipping is not possible, the equipment shall be purged with suitable inert gas and TIG process shall be used for root and one subsequent pass. The root pass shall be D.P. / M.P. checked.

4.3 Painting

For carbon steel material, surface preparation and primer painting as per the painting system specified in the equipment specification is in the manufacturer's scope unless otherwise specified elsewhere.

For austenitic stainless steel, all welds, heat effected zones and shapes of double curvature shall be pickled from inside and outside as a minimum requirement. If any working is done on austenitic stainless steel which will interrupt the oxide film, then the same area will be pickled.

Bolt threads shall be protected with suitable grease.

5.0 NAME PLATES

All vessels shall be provided with a name plate as per Uhde standard UN 2000-09 Part 1 (M).

Unless otherwise specified the name plate of vertical vessels shall be attached above the lowest manhole and the name plate of horizontal vessels at the level of the vessel centreline.

Order number, item number and weight shall be indicated in 300 mm block letters with due consideration of the transport position at a conspicuous place on the vessel with weather-proof white paint.

In the case of vessels of several shell sections including their internals, each section shall be marked individually for positioning and assembly purpose.

6.0 TESTS AND INSPECTIONS

Also refer to Uhde standard UN V416-01 Part 1 (M) for procedure and welder's qualification.

6.1 Radiographic and ultrasonic tests

Where random radiographic and/or ultrasonic testing is required, at least one radiograph per weld and welder, including all junctions shall be made. Additional verification radiographs can be requested by the Uhde inspector in justified exceptional cases.

6.2 Testing of the skirt-to-shell weld

In the case of vertical vessels with a height/diameter ratio of > 18, the preparation of the skirt-to-shell weld shall be witnessed by the Uhde inspector prior to welding. The root pass and completed weld shall be examined for cracks by a magnetic particle test. In the case of austenitic steels, a dye-penetration test shall be performed.

6.3 Testing the reinforcement pads

All reinforcement pads of openings shall be tested for leaks by means of a foaming agent and air at a pressure of approx. 0.5 bar. The test pressure shall start at 0.2 to 0.3 bar. After the test, the test holes of vessels designed at a temperature of > 150 °C shall be sealed with grease paste or wax. If the design temperature is ≤ 150 °C, threaded plugs shall be provided.

6.4 Hydrostatic test

All vessels shall be subjected to a hydrostatic test. Any other tests, e.g. pressure test with air, are only permitted if approved by Uhde.

The hydrostatic test pressure shall be maintained for a period of 2 hours per 25 mm wall thickness (min. period 2 hours, max. period 5 hours).

The test pressure shall be determined according to the applicable standard, i.e. for the operating position of the vessel measured at the highest point.

Prior to despatch, after hydrotesting, the manufacturer shall reduce the fillet weld of the end caps on nozzles with welding ends to 2 mm.

Lined vessels (e.g. rubber lining, brickwork) shall be subjected to a hydrostatic test prior to the application of the lining.

In case of vessels fabricated completely or partly from austenitic steel or equipped with an austenitic lining, the permissible chloride content indicated in Uhde standard UN V416-04 Part 1 (M) shall be taken into consideration for the hydrostatic test.

The test temperature shall be min. 16 °C. Higher test temperatures may be required for thick-walled vessels or vessels sensitive to brittle fracture. In the case of test temperatures of <16°C, the manufacturer shall obtain Uhde's approval, stating the reasons for the test temperature selected and furnishing proof of the notched-bar impact strength at the test temperature concerned. The vessel manufacturer is responsible for the selection of the test temperature.

After completion of all hydrostatic tests, all connections shall be opened, the vessel thoroughly cleaned and dried and all connections shall be re-closed.

Column and vertical vessels shall be tested in horizontal position in vendor shop. If the same is not possible, vendor should point out during offer stage. Vendor shall provide adequate number of temporary supports during hydrotesting. Vendor shall give number, locations and details of supports for approval.

In case of pressure vessels with internal coil, the coil shall be hydrotested after forming but before welding to the pressure vessel wall. Complete vessel along with coil shall be hydrotested after completion of the work.

In case of stacked heat exchangers or vessels, individual unit shall be hydrotested separately and complete stack shall be hydrotested in assembled condition.

6.5 Inspection

All vessels designed and fabricated according to this Uhde standard are subject to inspection by Uhde and/or their client(s) and, if necessary, by the competent inspection authority.

The scope of inspection shall be as per enquiry specification/applicable design code/general engineering specification whichever is stringent.

6.6 Inspection documentation

The inspection documentation shall correspond to the applicable standard or technical specification or to the purchase order.

7.0 SHIPMENT

The shipping procedures shall correspond to Uhde's shipping and packing instructions. It is essential that the erection clips be located on the horizontal centre lines.

Process column shall preferably be sent to site in single piece. Wherever this is not possible the number of pieces in which the column is sent to site shall be discussed and agreed upon with Uhde prior to order. Refer UN 2000-01 Part 3 (M) for "Field fabrication". In addition following shall apply.

The circumferential seam weld at site, 100% radiography of this site weld, post weld heat treatment if required as per the code and hydrotesting of equipment at site is in vendor's scope of work.

For all equipment involving site joint and site testing, electricity shall be provided by client on chargeable basis unless agreed otherwise.

However, water for hydrotest shall be provided by client free of cost unless agreed otherwise.

[Modified: 29/08/2008]

1 Scope

In addition to Uhde standard UN 2000-01 Part 1(M) or 2(M), this general specification applies to vessels and equipment, the size of which does not permit transportation in completed state, and which must therefore be transported in sections and assembled on site.

2 Scope of supplies and services

Unless otherwise agreed upon, the following shall apply:

- The vessel manufacturer shall perform all work required for the erection of the equipment concerned, assign supervising personnel and provide auxiliary means such as tools, fixing elements, scaffoldings, welding equipment, electrodes, connecting cables including switchgears, cable connectors, valves, etc. from the main connection up to the place of erection.
- Erection cranes will be provided.
- Utilities such as air, water, electric power (for welding) will be made available to the vessel manufacturer. The supply of fuel gas and electric power (for heat treatment) shall be agreed upon. If possible, a lockable storage room for small tools will be made available to the vessel manufacturer.
- Earth and masonry works are not part of the vessel manufacturer's scope of supplies and services.
- If the erection of the vessel is not performed by the vessel manufacturer but by an erection contractor, the vessel manufacturer shall elaborate detailed erection instruction including indication of the necessary tools and the sequence of erection, and a welding specification. The erection instructions shall also include the scope of tests and details of the pressure test.

3 Fabrication of the vessel

3.1 Pre-fabrication in the workshop

Work on the job site shall be kept to a minimum. For this reason, as much of the vessel as possible shall be pre-fabricated.

To facilitate assembly on the job site, all components shall be marked property. In the case of vessels of sophisticated design, a test assembly shall be performed in the workshop.
Adequate measures shall be taken to prevent deformation during transport. Welding bevels which have been prepared in the workshop for field welding shall not be used for test assembly. Tack welds on claddings and alloyed linings are not permitted.

3.2 Fabrication on site

All vessel components shall be mounted and welded according to the workshop markings.

The components shall be aligned by means of spacer plates, wedges, clamping devices, etc. Welding-on of erection aids shall be kept to a minimum. Refer to Uhde standard UN V416-01 Part 1(M) "Welded joints for vessels and equipment" for the welding-on and removal of the erection aids.

Hammering on claddings or linings is not permitted.

The gap between reinforcement plate and shell shall not exceed 3 mm. The reinforcement plates shall not be tack welded but only clamped prior to welding.

4 Welding

Preparation and performance of the welding work shall be effected according to Uhde standard UN V416-01 Part 1(M).

5 Heat treatment

Heat treatment shall be effected according to Uhde standard UN V416-01 Part 1(M). The heat treatment process and the power requirement shall be specified by the vessel manufacturer in his quotation, but in no case later than the contract award.

6 Tolerances

Dimensional checks shall be performed during fabrication in order to ensure that the dimensions of the vessel are within the tolerance ranges specified in Uhde standard UN 2000-02 Part1(M). The specified fabrication tolerances may only be obtained by cold forming if they are less than 5%.

7 Inspection and tests

Unless otherwise specified in the purchase order documents, the requirements contained in Uhde standards UN 2000-01 Part 1(M) and UN V416-01 Part 1(M) as well as the applicable codes and standards apply. The tests shall be performed in the presence of Uhde inspector / client's inspector.

Test reports including evaluation shall be supplied for all tests performed.

Reference standards

Uhde standards:

UN V416-01 Part 1 (M)	Welded joints for vessels and equipment
UN 2000-01 Part 1 (M)	Pressure vessels, general specification
UN 2000-02 Part 1 (M)	Atmospheric vessels, general specification

[Modified: 29/08/2008]

Dimensions in mm

1 Scope

This standard applies to vessels and columns which are fabricated according to Uhde specification and for which dimensions but no dimensional tolerances are indicated and no other tolerances have been agreed. Should the relevant codes and standards (e.g. ASME Code Section VIII) prescribe any other tolerances, the closer ones shall apply.

2 Vertical vessels and columns

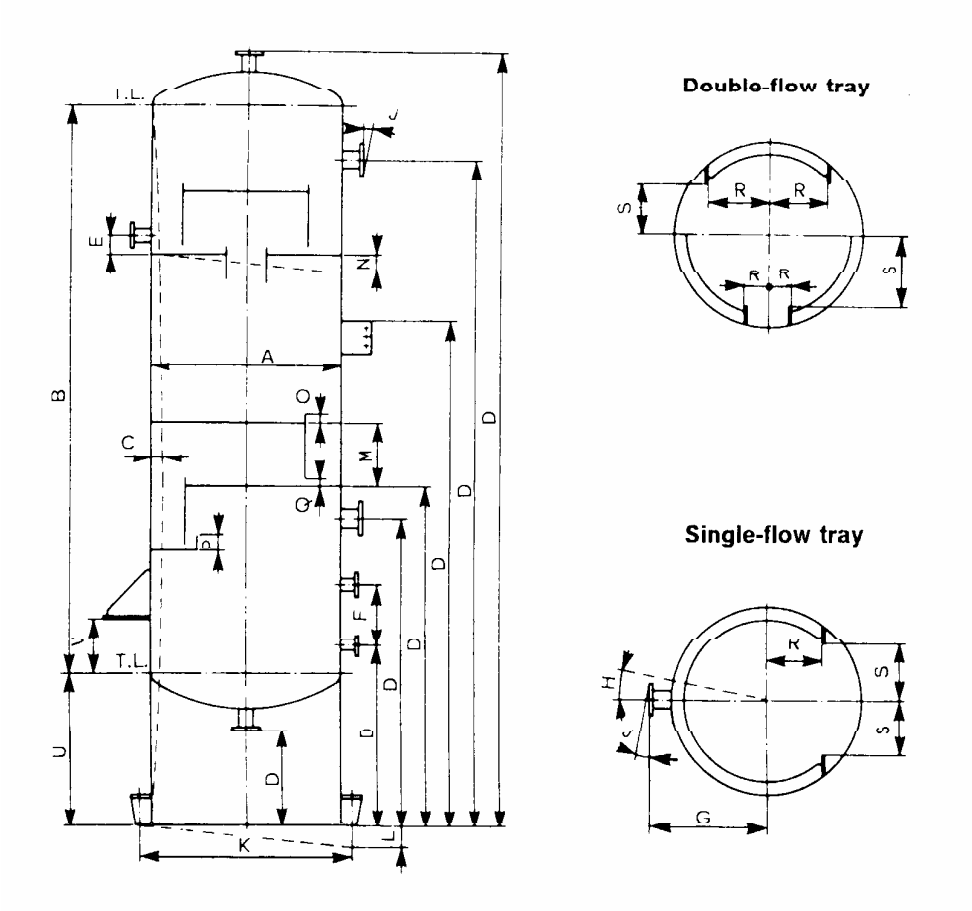


Figure 1.

3 Horizontal vessels

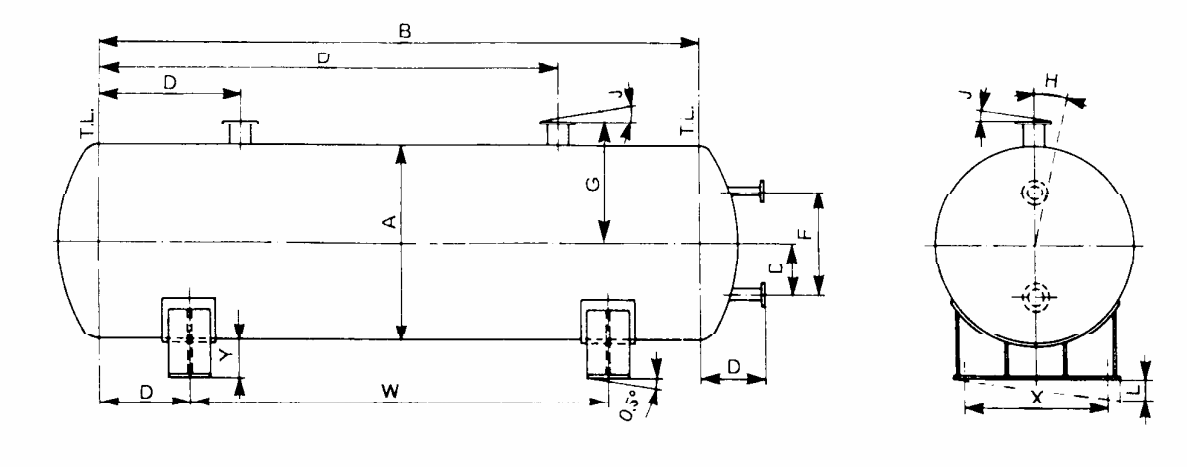


Figure 2.

Table 1. Dimensional tolerances

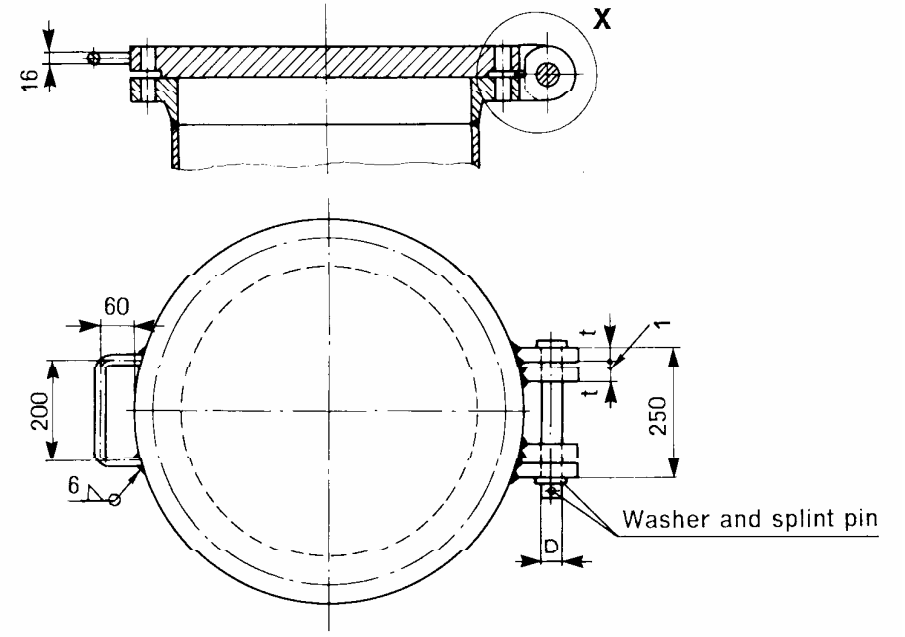
Code letter for permissible deviation	Description	Permissible deviation
A	Deviation of outside diameter from specified diameter, determined by measuring the circumference	± 0.5%
	Out-of-roundness (difference between max. and min. diameter as deviation from specified diameter)	1%, max. 30
B	Vessel length • deviation for any section of 3000 mm length • deviation for overall length	 ± 5 ± 50
C	Deviation from straight line • for any section of 3000 mm length • for each meter if overall length ≤ 15 m • in total if overall length > 15 m	 3 1 0.5/m + 8
D	Height from lower edge of base ring (for vertical vessels) or distance from tangent line (for horizontal vessels) • to nozzles, supports, supporting rings and internals • to manholes	 ± 6 ± 12
E	Spacing of nozzles referred to internals	± 3
F	Spacing of level gauge nozzles Flange faces shall be on exactly the same plane	± 1.5
G	Distance between nozzle flange face and vessel centerline Distance between manhole flange face and vessel centerline	± 5 ± 10
H	Angular deviation of nozzles / supports from reference centerline If determined by measuring the circumference (for exception refer to F)	0.5° 10
J	Angular deviation of nozzle flange face from specified position (for exception refer to F) Angular deviation of manhole flange face from specified position	0.5° 1°
K	Pitch circle diameter of base ring ≤ 2100 mm Pitch circle diameter of base ring > 2100 mm Hole spacing	± 3 ± 7 ± 5
L	Deviation of base ring / supporting brackets or saddle from the horizontal plan, for • pitch circle or shell diameter ≤ 1200 mm • pitch circle or shell diameter > 1200 mm ≤ 2100 mm • pitch circle or shell diameter > 2100 mm	 3 5 7
M	Spacing between adjacent supporting rings Distance measured across more than 5 successive supporting rings	± 3 ± 12
N	Deviation of upper edge of supporting ring from horizontal plan • measured across vessel diameter – diameter ≤ 1200 mm	 3

Code letter for permissible deviation	Description	Permissible deviation
	– diameter > 1200 mm ≤ 2500 mm	5
	– diameter > 2500 mm	6.5
	• measured across chord for any section of 300 mm length	0.8
O	Deviation of upper edge of welded weirs from horizontal plane, measured across overall length	
	• vessel diameter ≤ 1200 mm	3
	• vessel diameter > 1200 mm ≤ 2500 mm	5
	• vessel diameter > 2500 mm	6.5
P	Weir height	± 3
Q	Distance between upper edge of supporting ring and lower edge of drain plate	± 3
R	Distance between column centerline and inner edge of weir or drain plate	± 2
S	Distance between column centerline and front edge of drain plate	± 3
T	All other dimensions of weld-in parts required for installing trays	± 3
U	Distance between base ring and tangent line	– 10
V	Distance between bracket and tangent line	+ 5
W	Spacing between saddles	± 3
X	Hole spacing of saddle	± 3
Y	Distance between lower edge of saddle and vessel shell	– 5

Uhde	Vessels and equipment **HINGED MANHOLE COVERS**	**UN 2000-04 (M)** Page **1** of **1**

[Modified On: 29/08/2008]

Dimensions in mm



X (Dismantled condition)

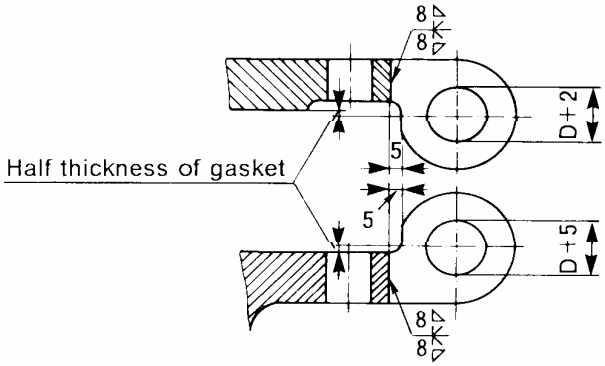


Table 1. **Hinge thickness and bolt diameter**

Nominal pressure PN bar	Hinge thickness t	Bolt diameter D at manhole - DN			
		400 resp. 16”	450 resp. 18”	500 resp. 20”	600 resp. 24”
10 / 16	20	16	16	16	16
25	24	20	20	22	22
40	28	24	24	26	26
63	32	30	30	32	32

Remarks

1. For the swivelling direction of the cover refer to the vessel drawing.
2. Material: Temperatures between -10°C and 250°C killed carbon steel, outside this range vessel material.

Uhde	Vessels and equipment SUPPORT SADDLES FOR HORIZONTAL STEEL VESSELS	UN 2000-05 Part 1 (M) Page 1 of 5

[Modified on: 29/08/2008]

Contents

Dimensions in mm

1 Scope

This standard applies to support saddles for horizontal steel vessels. This standard covers the design, material and erection requirements.

2 Support saddles for diameter range 219 to 508 mm (Type AV)

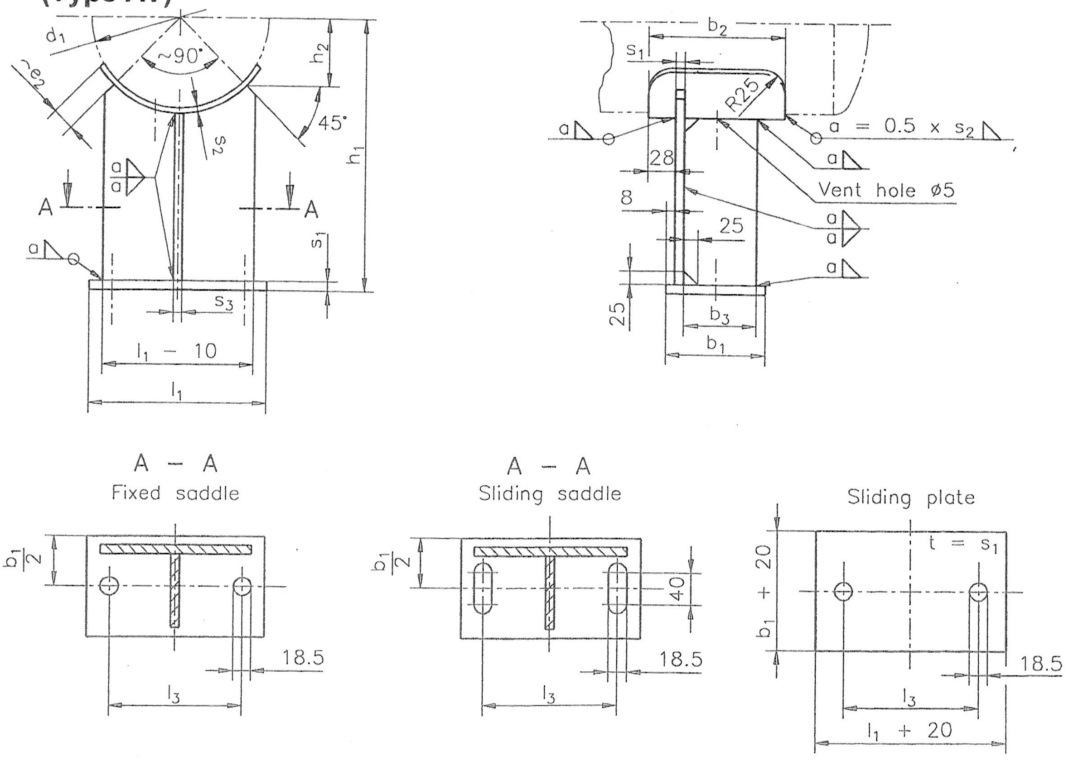


Figure 1.

Table 1.

Outside diameter d_1	Height h_1	Base plate or leg l_1	b_1	s_1	Reinforcing plate b_2	s_2	e_2	Arc lenght	Rib b_3	s_3	Height H_2	Anchor bolts Thread size	Pitch l_3	Fillet joint min. a	Weight per saddle support ~ in kg
219	310	200	120	8	160	6	25	227	96	8	82	M 16	150	3	6.5
273	335	240						269			101		190		8.0
324	360	280						309			119		230		9.0
356	380	300						334			130		250		10.0
406	405	350						374			148		300		11.0
508	455	420						454			184		350		13.0

3 Support saddles for diameter range 600 to 1000 mm (Type BV)

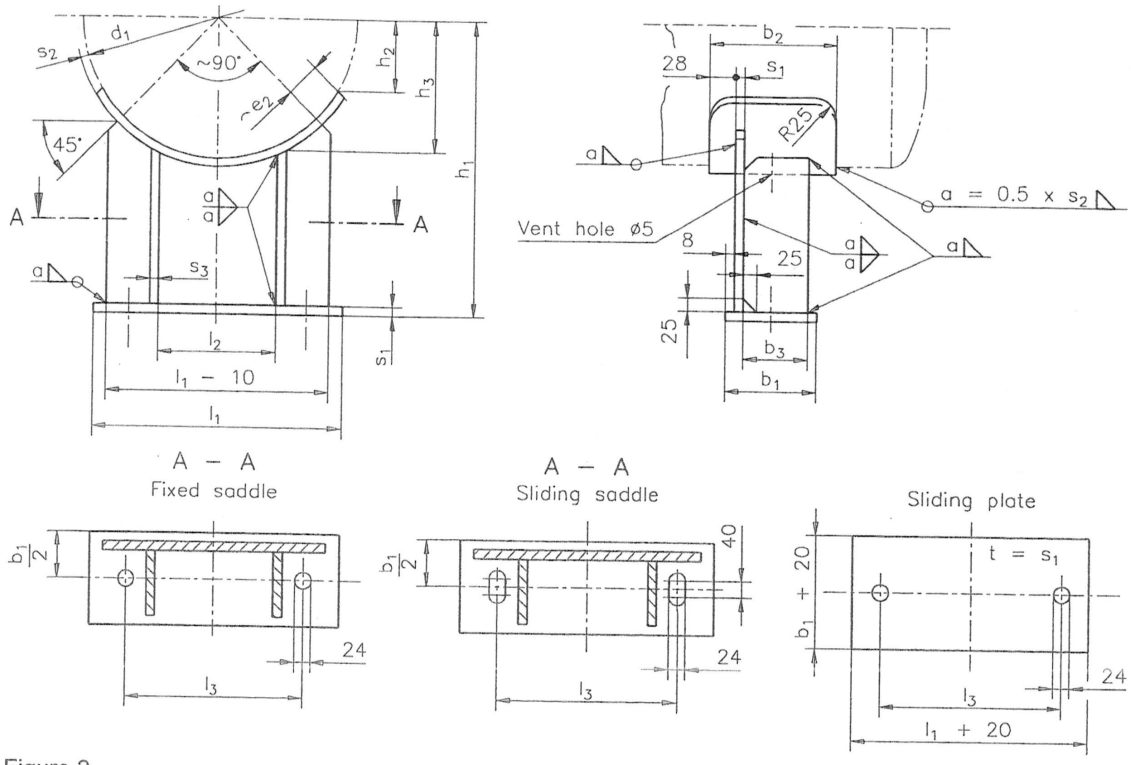


Figure 2.

Table 2.

Outside diameter d_1	Height h_1	Base plate or leg l_1	b_1	s_1	Reinforcing plate b_2	s_2	e_2	Arc length	Rib b_3	s_3	l_2	Height h_2	h_3	Anchor bolts Thread size	Pitch l_3	Fillet joint min. a	Weight per saddle support ~ in kg
600	500	500	120	8	160	6	35	546	96	8	250	216	280	M 20	350	3	18.0
700	550	600						624			350	256	310		450		20.0
800	600							703				287	367				21.0
900	650	750						782			500	322	382		600		26.0
1000	700							860				358	440				28.0

4 Support saddles for diameter range 1100 to 2000 mm (Type C)

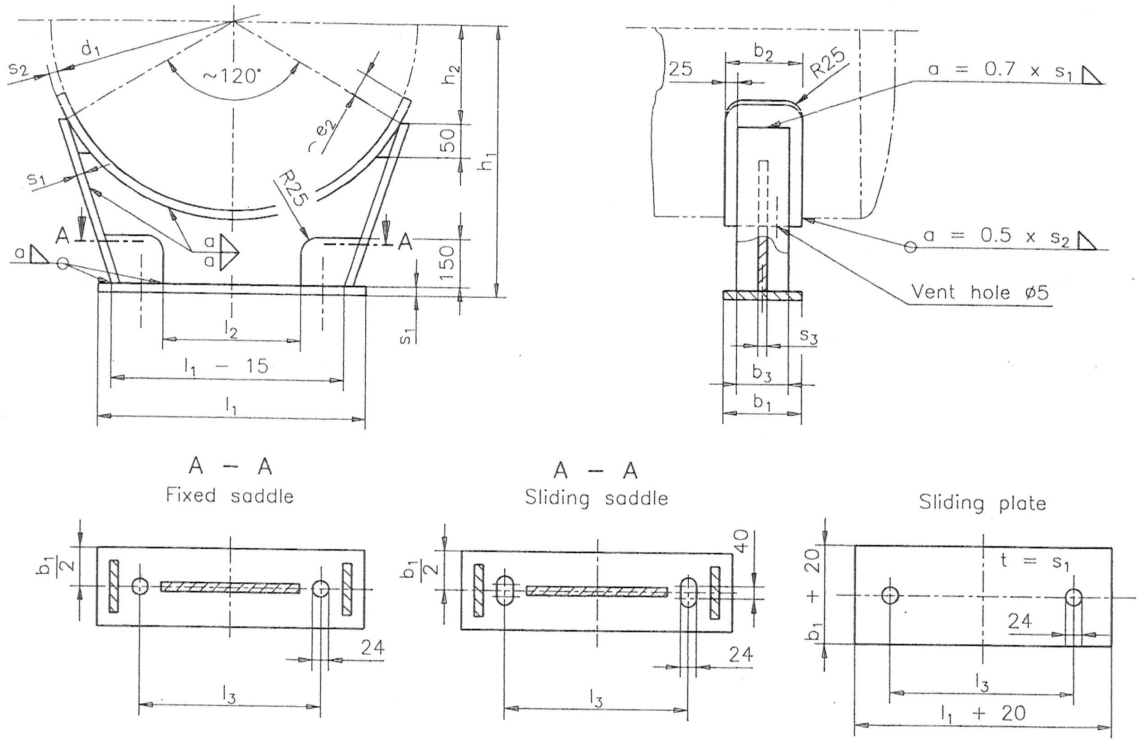


Figure 3.

Outside diameter d_1	Height h_1	Base plate l_1	b_1	s_1	Reinforcing plate b_2	s_2	e_2	Arc length	Leg b_3	l_2	s_3	Height h_2	Anchor bolts Thread size	Pitch l_3	Fillet joint min. a	Weight per saddle support ~ in kg
1100	750	900	160	10	200	6	45	1248	150	600	8	278	M 20	750	3	47.0
1200	800							1353				303				51.0
1400	900	1150	200	12	240		60	1592	190	850	10	353		1000	4	85.0
1600	1050							1802				405				95.0
1800	1150	1450		14		8	70	2033		1150	12	454		1300		140.0
2000	1250							2243				504				145.0

5 Support saddles for diameter range 2200 to 5000 mm (Type D)

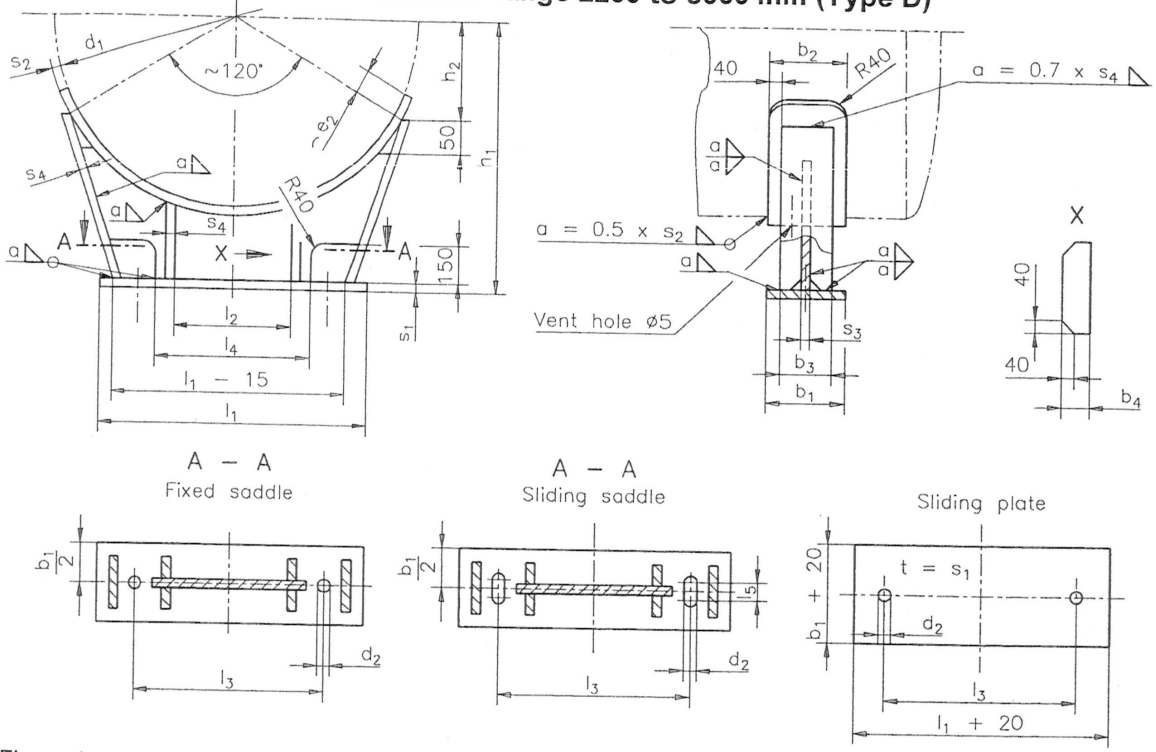


Figure 4.

Table 3.

Outside diameter	Height	Base plate			Reinforcing plate				Leg and ribs						Height	Anchor bolts				Fillet joint min.	Weight per saddle support
d_1	h_1	l_1	b_1	s_1	b_2	s_2	e_2	Arc length	b_3	b_4	l_2	l_4	s_3	s_4	h_2	Thred size	d_2	Pitch l_3	l_5	a	In kg
2200	1350	1750	240	14	300	10	85	2484	220	100	800	1350	10	14	555	M 20	24	1550	40	5	210
2400	1450							2694							605						220
2600	1550	2050	300		360	12	115	2965	280	130	1000	1600	12		656			1800			320
2800	1650							3175							706						330
3000	1750	2300	350	16	400			3384	320	150	1100	1850		16	756	M 24	28	2050	60		430
3200	1850							3594							806						440
3400	1950	2600	400		460	14	140	3855	380	180	1300	2100	14		857			2300		6	550
3600	2050							4065							907						620
3800	2150	2900		18				4274			1400	2400		18	957			2600			710
4000	2250							4483							1007						720
4200	2350	3200	450		500	16	180	4775	420	200	1600	2700	16		1058	M 30	35	2900	80		900
4400	2450							4984							1108						920
4600	2550	3500		20				5294			1700	3000		20	1158			3200			1030
4800	2650							5403							1208						1060
5000	2750	3800						5613			1900	3300			1258			3500			1130

6 Cold insulation

At operating temperatures below 0° C, the support saddles shall be provided with a cold insulation of synthetic resin- compressed wood or hard wood as per Uhde standard UN 5017-01 Part1 (M). For adequate installation of cold insulation on the sliding saddle, the base plate of the sliding saddle shall be provided with guide bars.

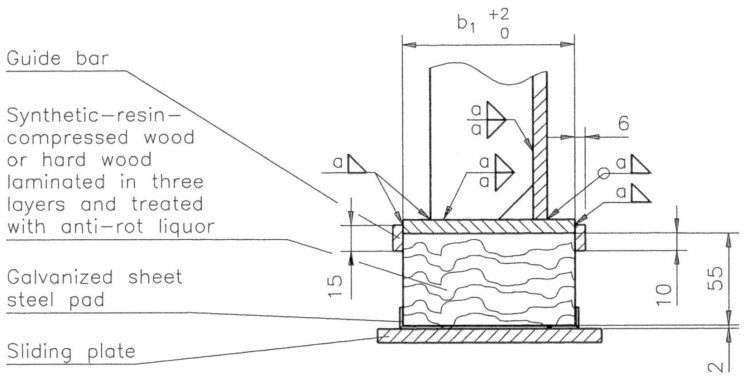


Figure 5.

7 Requirements

7.1 Design

The reference centrelines, the arrangement of the fixed and sliding saddles and the note "cold-insulated/not cold-insulated" shall be indicated in the equipment drawing.

Dimensional deviations shall be stated in the equipment specification. In the case of vessels with an outside diameter deviating from d1 (e.g. 1300 mm), the saddle with the next larger diameter d1 shall be used.

The length of the slots in the base plates of the sliding saddles shall be checked by the manufacturer for the correct saddle distances, materials and temperature variations. If required, the position of the slots shall be changed along the centreline of the vessels and stated in the drawing.

Unless otherwise specified, the saddles shall be supplied completely assembled (including sliding plate, with cold insulation, where applicable).

The reinforcing plates shall be welded to the vessel shell.

All welds shall have continuous fillet joints.

The manufacturer shall perform a stress analysis of the support saddles and vessel shell. If required, the reinforcing plate width shall be increased and the support saddles be reinforced, but the tie-in dimensions for the foundations shall not be modified. External forces shall be considered in the stress analysis.

The thickness of the reinforcing plate of high-alloy steel may be reduced if permissible according to stress analysis.

An earthing connection shall be welded to the fixed saddle in accordance with Uhde standard UN 2003-01 (M).

7.2 Steel vessel erection

Steel vessels shall be mounted by means of connection plates in accordance with Uhde standard UN 2000-15 (M). If this is not possible (e.g. galvanized steel structures), the bolt holes in the base plate shall not be placed on the reference centerlines. The position and size of said holes shall be stated in the drawing.

7.3 Materials

In the case of vessels of carbon steel and of low-alloy steel and at operating temperatures between -10°C and 250°C, all saddle components shall be made of carbon steel.

In the case of alloyed vessels and at operating temperatures below -10°C and above 250°C, the reinforcing plate shall be made of the vessel material and the other components of another suitable material.

Reference standards

Uhde standards:

UN 2000-15 (M)	Vessels and equipment; Connection plates for vessels in steel structures
UN 5017-01 Part1 (M)	Complementary material; Cold insulation for support saddles of horizontal steel vessels
UN 2003-01 (M)	Earthing connections for vessels and equipment

Uhde	Vessels and equipment SUPPORTS FOR VERTICAL STEEL VESSELS Skirt	UN 2000-05 Part 4 (M) Page 1 of 4

[Modified on: 29/08/2008]

Contents

Dimensions in mm

1 Scope

This standard applies to the design of skirts of columns and large vertical vessels.

2 General

The outside diameter of the skirt shall be equivalent to the outside diameter of the vessel shell. The skirt shall be attached to the vessel bottom and the base ring by circumferential welds. Butt joints shall be welded on both sides and fillet joints with a = 0.7 x smallest wall thickness. The skirt shall be provided with an inspection port and vents in accordance with Table 1. The anchor bolts shall be placed on both sides of the main centre-lines.

If agreed, a fire-proof insulation of min. 50 mm thickness shall be installed. For this purpose, square nuts M12 of good welding material shall be welded perpendicularly to the skirt shell at a spacing of 300 mm on the circumference.

The dimensions specified are approximate values and do not release the manufacturer from his responsiblity of performing a stress analysis.

For additional data applicable to the upper section of the skirts in the case of heat or cold insulation, refer to Uhde standard UN 2004-06 (M).

3 Skirt design

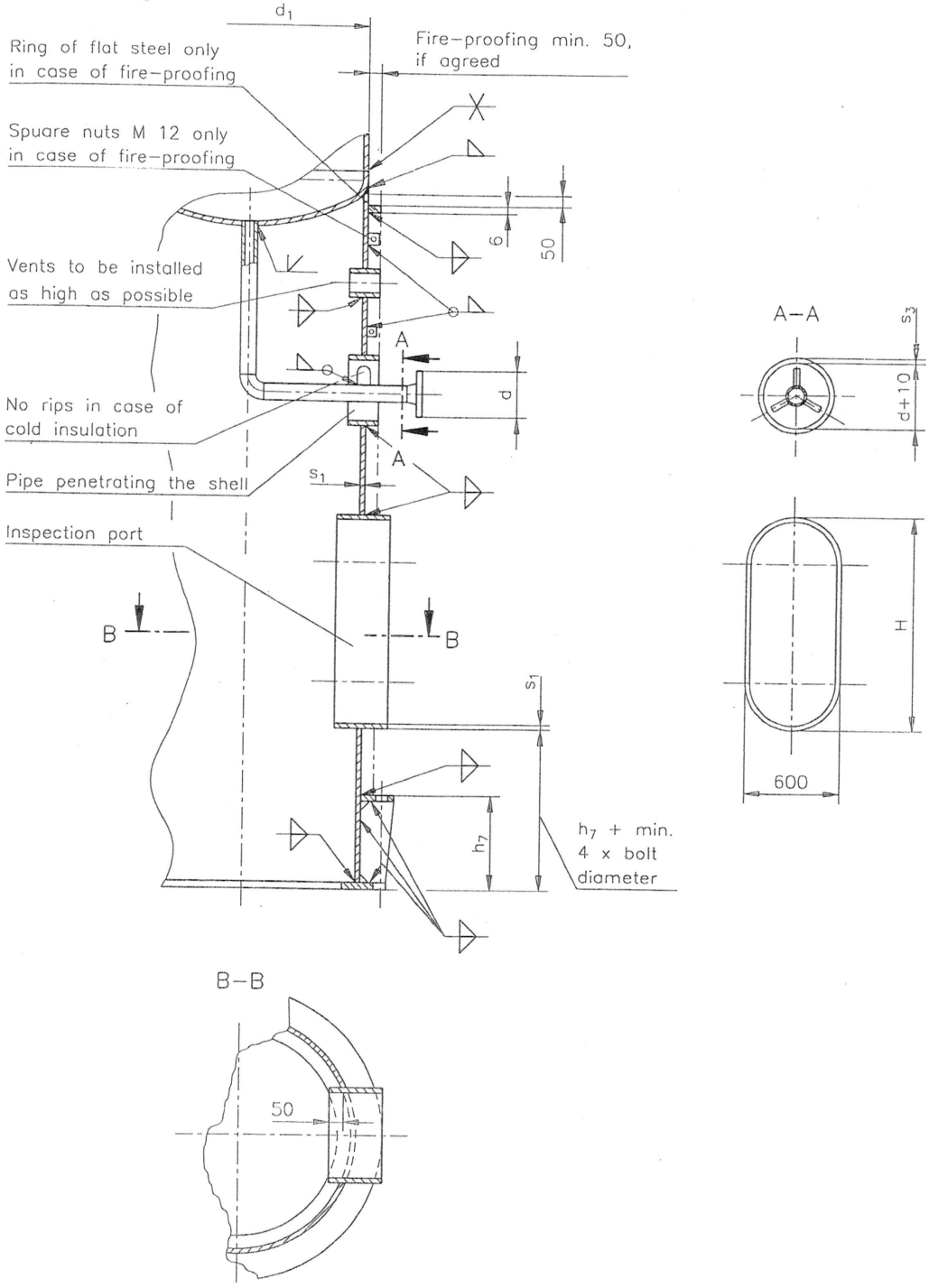


Figure 1.

Table 1

Outside diameter d_1	Vent	Inspection port
≤1000	2x DN 80	Size as agreed
> 1000	4x DN 100	Width: 600 Height H: 600 if skirt height < 2000 1200 if skirt height ≥ 2000

4 Base ring design

4.1 Stress analysis includes wind loads

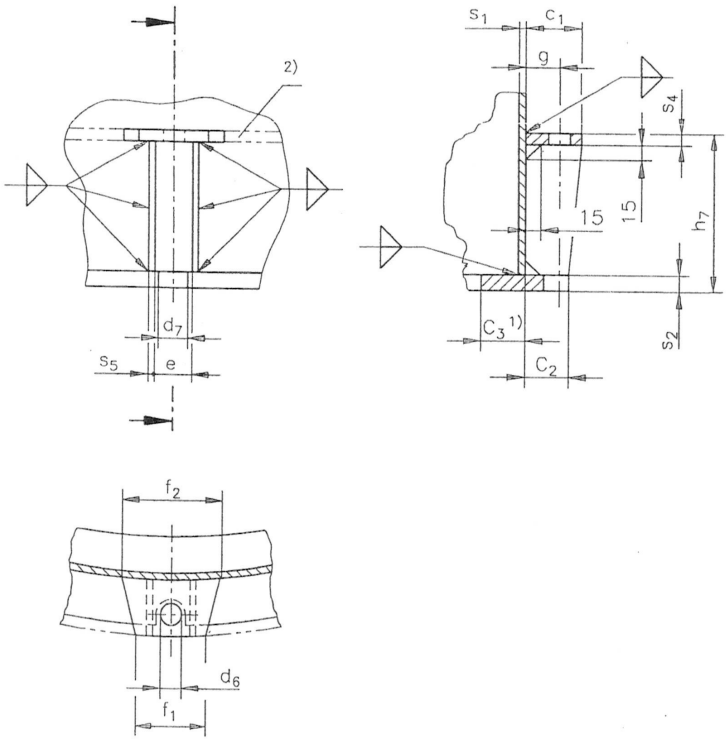


Figure 2.

Table 2.

Thread	Dimensions												
	c_1	c_2	d_6	d_7	e	f_1	f_2	g	h_7	s_1 1)	s_2 1)	s_4 1)	s_5
M 24	80	60	28	32	60	120	180	45	300	12 to 16.6	s_4 + 10	25	12
M 30	95	75	35	40	70	130	190	55					
M 36	110	85	42	48	80	160	220	65					16
M 42	125	100	48	54	90	170	250	75	400	14 to 20		30	
M 48	140	110	56	64	100	180	260	85					
M 56	155	125	66	76	120	220	300	95		15 to 23		35	20
M 64	175	140	74	84	130	230	330	105	500	17 to 26		10	
M 72 x 6	195	155	82	92	140	240	340	115		18 to 30		45	
M 80 x 6	215	165	91	106	160	280	380	125		20 to 30		50	25
M 90 x 6	235	180	101	116	170			135	600	22 to 36		55	
M 100 x 6	255	195	112	126	180			145	800	24 to 40		60	

1) s1, s2 and s4 are approximate values and shall be determinated by stress analysis.

1) $c_3 - c_2$ shall be determined by stress analysis
2) If the clearance between the brackets is reduced to 1.5 times the plate width f_2, a closed ring shall be provided

4.2 Stresses with no significant tilting moments

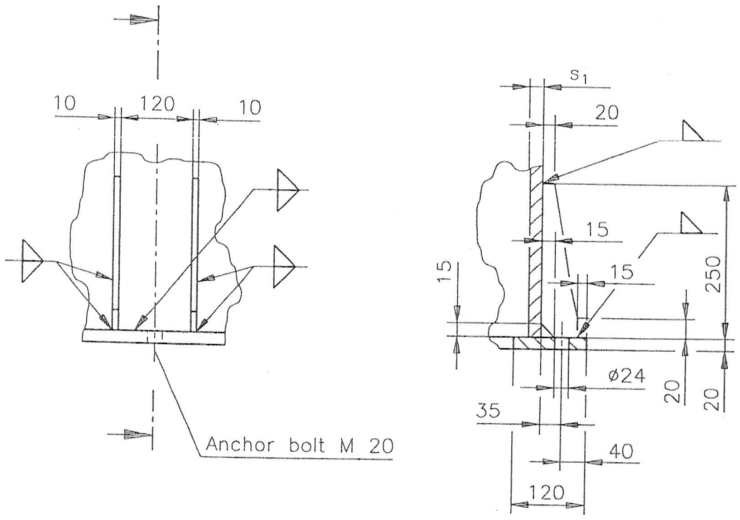


Figure 3.

5 Materials

The upper section of the skirt over a length of 0.5 m shall be made of vessel material and the other components of carbon steel.

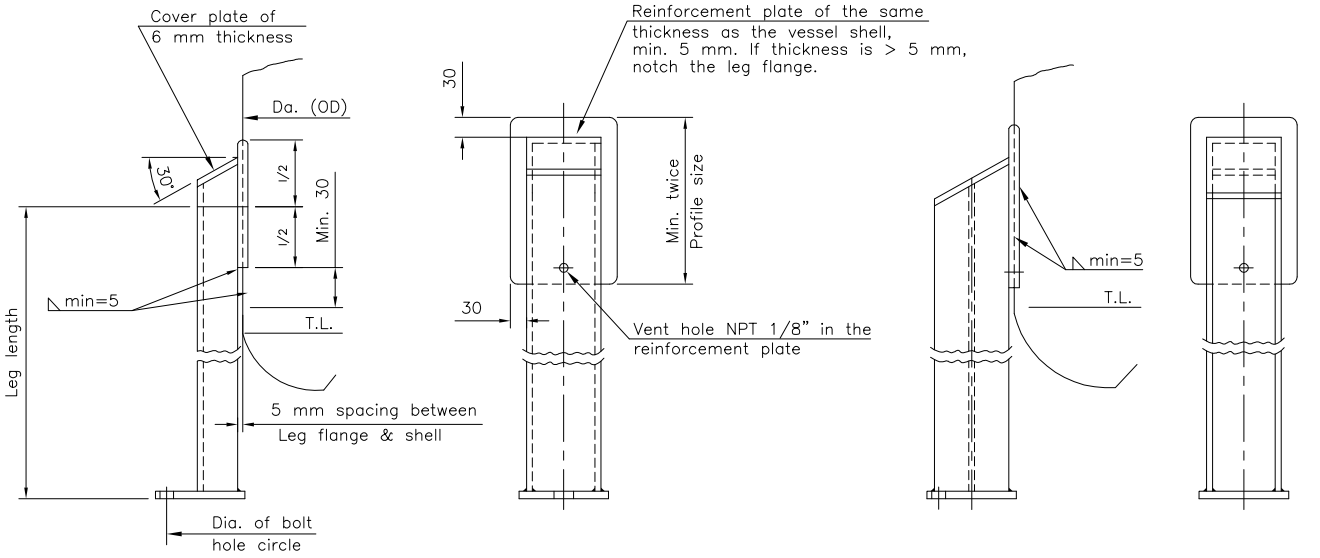
Reference standards

Uhde standards:

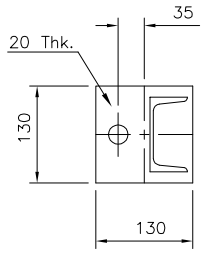
UN 2004-06 (M) Vessels and equipment; Insulation clips for vertical steel vessels.

Dimensions in mm

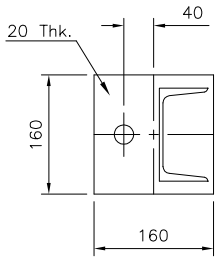
[MODIFIED ON : 29/08/2008]



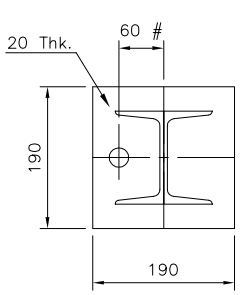
ISMC 100



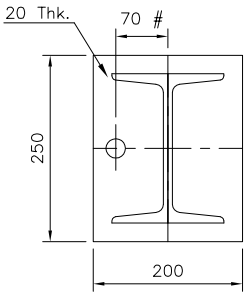
ISMC 125



ISMC 125*



ISMC 200*



Holes of 26 mm dia for M20 anchor bolts

* Two nos. of channels welded back to back are to be provided for each leg.

\# To be verified with actual Hole Circle Dia

Table 1 – Max. admissible loads for vessel legs

SECTION	TEMP °C	MAX. PERMISSIBLE LOAD ON LEG IN Kg.				
		1M	1.6M	1.9M	2M	3M
ISMC 100	20 250	1500 1050	960 680			
ISMC 125	20 250	2330 1660		1330 950		
ISMC 125*	20 250	6300 4400			4300 3050	2600 1850
ISMC 200*	20 250	12500 9000			10600 7600	7300 5200

VESSEL DIA (mm)	HOLE CIRCLE DIA = Da DIA + ... (mm) FOR SECTIONS			
	ISMC 100	ISMC 125	* ISMC 125	* ISMC 200
355.6	190	230		
406.4	190	230		
508	190	230		
600	190	230		
700	190	230		
800	190	230	280	
900	190	230	280	
1000	190	230	280	
1100	190	230	280	
1200	190	230	280	325

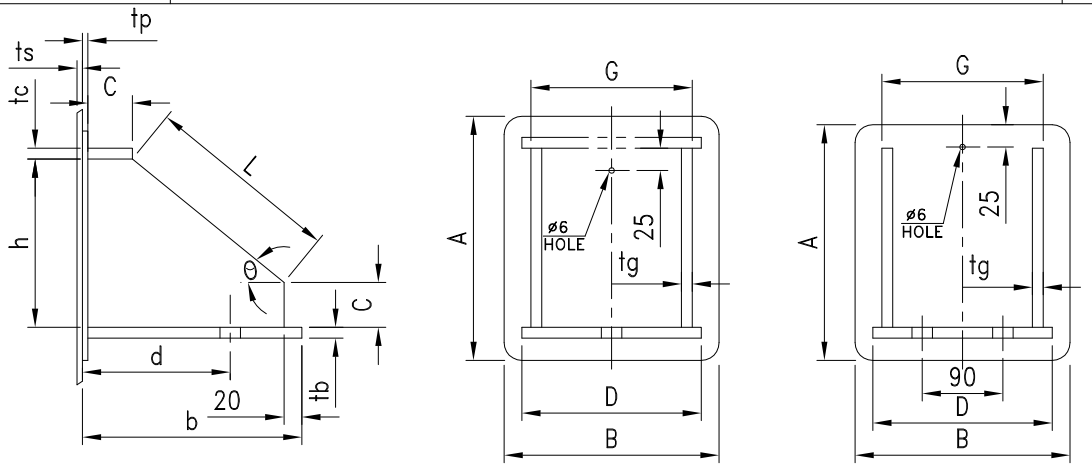
REMARKS :

1. Materials : Reinforcement plate – Shell material
   Legs – Carbon steel for opertaing temperatures from –10°C to 250°C.
   Special materials are required for temperatures below –10°C and above +250°C.
   Base plate – Carbon steel
2. Length and number of legs – Please refer the vessel drawing.
3. The manufacturer shall perform a stress analysis to determine the maximum admissible load. The maximum admissible load is the actual load + 10% in order to compensate for load variation.
   The loads in Table 1 are intended for the selection of adequate sizes and they apply to vertical loads only. Wind loads and other horizontal loads shall be considered additionally.
4. The vessel manufacturer shall perform a stress analysis to determine shell loads.

Uhde

Vessels and Equipment
SUPPORTS FOR VERTICAL VESSELS
BRACKETS (LUGS)

UN 2000-05 Part 6



LOAD/LUG Kg.	A mm	B mm	h mm	D mm	d mm	b mm	C mm	G mm	tb mm	tg mm	tc mm	WEIGHT OF 1 LUG EXCL. PAD Kg.
250	260	240	200	200	350	430	50	180	12	12	0	20
500	280	240	220	200	350	430	50	180	12	12	0	21
750	310	240	240	200	350	430	50	180	16	12	0	24
1000	340	250	270	210	400	480	50	180	16	12	0	29
1500	350	280	280	230	400	480	60	200	20	16	0	41
2000	370	280	300	230	400	480	60	200	20	16	0	42
2500	390	290	320	240	400	480	70	200	20	16	0	45
3000	420	310	330	250	400	480	70	210	20	16	20	49
4000	450	330	350	270	400	480	80	210	25	16	25	60
5000	480	350	380	290	400	480	80	210	25	16	25	64
6000	500	400	400	310	450	530	100	220	25	16	25	77
7000	520	430	420	330	450	530	100	220	25	16	25	81
8000	580	450	440	350	450	530	100	220	30	16	30	94
9000	600	470	460	370	450	530	110	230	30	20	30	112
10000	620	500	480	400	500	600	120	230	30	20	30	134
12500	650	550	500	450	500	600	120	280	32	20	32	150

NOTES:-

1) All dimensions are in mm.
2) Minimum 4 Nos. lugs recommended. But 2 Nos. can be used for Diameter <= 1000 mm.
3) 2 Nos. bolts per lug to be provided if the no. of lugs = 2.
4) MOC of pad shall be same as that of shell and tp >= ts.
5) If the total weight of the equipment is more than 50000 Kg. it is recommended to use continuous ring for top & base plates.
6) These dimensions are applicable for insulation thickness = 150 mm (Max.). P.C.D. of the equipment is to be confirmed by Piping Department. The dimension 'd' is recommended max. value. This value should be reduced to minimum possible during engineering.
   For load upto 3000 Kg/lug, d=insulation thk. + 65mm, (min. 125mm).
   For load above 3000 Kg/lug, d=insulation thk. + 140mm, (min. 200mm).
7) Size of anchor bolt = M20. MOC : IS 2062 Gr.A, Allowable Stress = 850 Kg/cm2.
8) Wind pressure = 200 Kg/m2 is considered. Seismic effect not considered.
9) Dimensions specified are guidlines only. Manufacturer to perform & submit stress analysis of bracket and shell.
10) Minimum weld size shall be 0.7 x smaller of the thickness of the parts being welded.

Technical Discipline: MQ

Uhde	Vessels and equipment **INSULATION CLIPS FOR VERTICAL STEEL VESSELS**	**UN 2004-06 (M)** Page **1** of **2**

[Modified On: 29/08/2008]

1 Scope

This Uhde standard applies for the design of insulation clips for vertical steel vessels.

2 Clips for heat insulation

All dimensions in mm

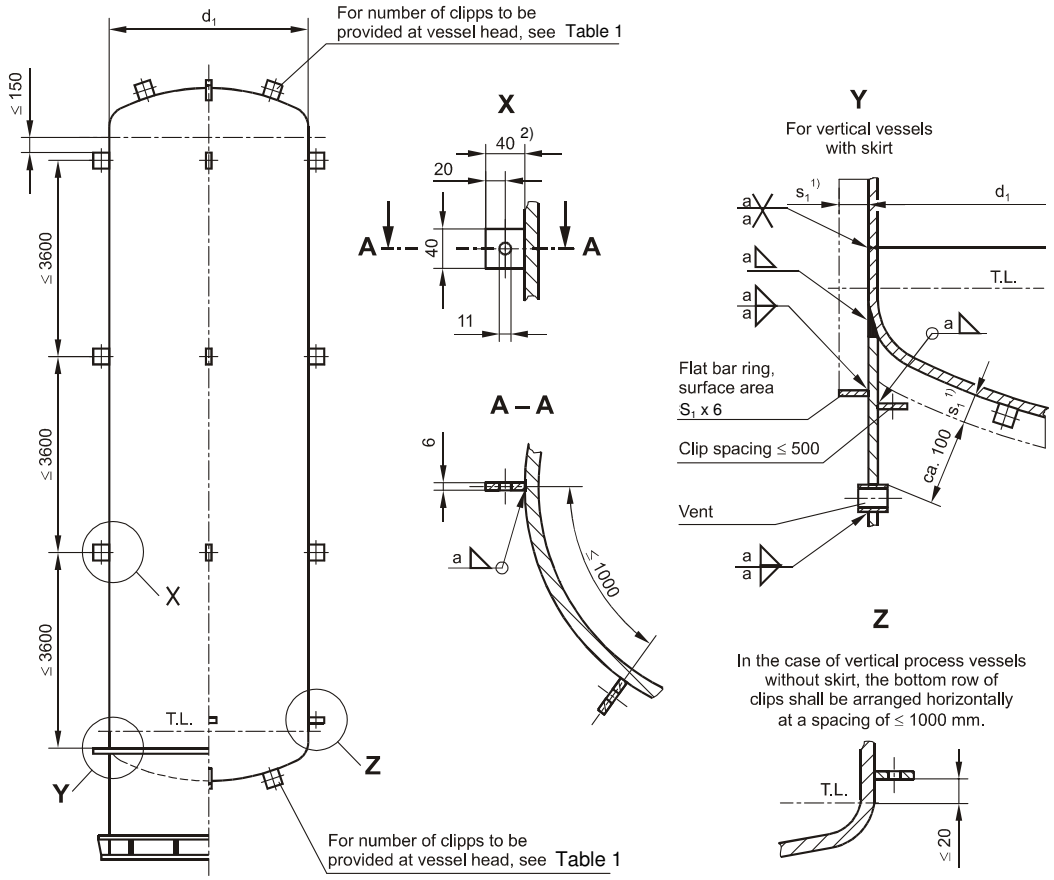


Figure 1.

1) s_1 = insulation thickness
2) For $s_1 \leq 40$, clip length $= s_1 - 5$

Table 1.

Outside diameter d_1 in mm	Number of clips
≤ 1000	4
> 1000 ≤ 2000	12
> 2000	Arranged in both directions, spacing ≤ 1000 mm
Special parts	**Arrangement of clips**
Hemispherical heads	Clips arranged on concentric circles with radial distance ≤950mm and ≤1000mm on circle
Conical sections	Distance ≤ 1000 mm circumferentially and ≤ 950mm longitudinally

Clip type and size, however, shall be in accordance with detail X and section A - A.