

Technical Specification

ST 10 MM0007 Technical Specification for unpressurized Steel Tanks

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Appendices

APPENDIX I – TOLERANCES, ERECTION OF TANKS AND EQUIPMENT

APPENDIX II – INSTRUCTION FOR LINING MILD STEEL TANKS

1 General

This specification shall be applied for Atmospheric Vessels having $P_d \leq 0,5$ bar(g).

The purpose of this specification is to define the design, manufacturing and inspection regulations for unpressurized steel tanks. In case of flammable substances and poisons/hazardous materials, national valid regulations shall be followed in addition to this standard. In case of contradictions, national regulation is prevailing.

Equipment shall be designed, manufactured, inspected, and delivered according to relevant local laws, applicable local government decrees, this specification, and Enquiry documents and, where applicable, Pressure Equipment Directive (PED) 2014/68/EU. The design, manufacturing and inspections shall be based on:

- EN 14015
- EN 1993-1-1
- EN ISO 14122 1...4
- EN 1991-1-3 + National Annex
- EN 1991-1-4 + National Annex
- EN 13445
- EN 1993-4-2, and
- This specification.

The laws and regulations issued by local authorities shall be followed. If discrepancies exist between this specification and the Purchaser's drawings or other specifications, the most stringent requirements shall be applied.

If the Supplier wants to modify any of the details, e.g. dimensions or materials, they shall submit their suggestions for the Purchaser's approval.

Specification MM0003 (Technical Specification for Pressure Vessel) shall be followed in heating coils and other equipment having $P_d > 0,5$ bar(g). Heating coil materials shall, however, be made of seamless pipes. Specification MM0001 "Technical specification for Piping" shall be followed for all piping.

2 Reference standards

ST 04 MG0001	General Mill Standards
ST 04 MG0002	Units to be used
ST 13 MM0001	Technical Specification for Piping
ST 50 MM0003	Technical Specification for Pressure Vessel
ST 16 MM0004	Technical Specification for Surface Treatment and Painting-Metallic Surfaces
ST 14 MM0005	Technical Specification for Thermal Insulation
PED 2014/68/EU	Pressure Equipment Directive
EN 1092-1	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Part 1: Steel flanges
EN 1991-1-3	Eurocode 1. Actions on structures. Part 1-3: General actions. Snow loads

EN 1991-1-4	Eurocode 1: Actions on structures. Part 1-4: General actions. Wind actions
EN 1993-1-1	Eurocode 3: Design of steel structures. Part 1-1: General rules and rules for buildings
EN 1993-4-2	Eurocode 3. Design of steel structures. Part 4-2: Tanks
EN 10204	Metallic products. Types of inspection documents
EN 13445	Unfired pressure vessels.
EN 14015	Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above
EN 17635:2016	Non-destructive testing of welds. General rules for metallic materials (ISO 17635:2016)
EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN ISO 14122	Safety of machinery. Permanent means of access to machinery. Parts 1-4.
EN ISO 4014	Hexagon head bolts. Product grades A and B
EN ISO 9001	Quality management systems. Requirements
EN ISO 9606	Qualification testing of welders - Fusion welding.
EN ISO 9712	Non-destructive testing. Qualification and certification of NDT personnel
EN ISO 14732	Welding personnel. Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials
EN ISO 15609	Specification and qualification of welding procedures for metallic materials. Welding procedure specification. Part 1: Arc welding
EN ISO 15614	Specification and qualification of welding procedures for metallic materials. Welding procedure test.
ASTM E562	Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count
GHS	Globally Harmonized System of Classification and Labelling of Chemicals

3 Technical requirements

3.1 Manufacturing Standards

All the tests and licenses required by the authorized inspection agency, product standard (EN 14015), this specification or enquiry documents shall be the Supplier's responsibility and all fees for these shall be at the Supplier's expense.

The stipulations indicated in the outline drawings of the Purchaser must be followed.

If the tolerances given in the standards and other documents differ, the most stringent requirements shall be applied.

3.2 Materials

The material shall conform to the specifications in the drawings and applicable design standards. The materials shall be allowed according to the design standard – if there are deviations from the standard, the Authorized Inspection Agency shall inspect the complete design and approve the deviations.

Unless otherwise agreed between the Purchaser and the Supplier, materials welded directly to the vessel (excluding lining plates) shall be of the same material group as the vessel.

Screws, nuts and washers shall be hot dip galvanized ($T \leq 300\text{ }^{\circ}\text{C}$). Minimum strength class of bolts 8.8 or 25CrMo4 according to the design temperature.

The impact strength properties of the materials used in tanks and steel structures to be located outdoors shall be taken into account when required.

The tank delivery shall include all necessary bolts, nuts, gaskets, fittings, insulation rods and insulation fixing construction, if required, etc.

All materials shall be new and unused. Material should be chosen so that the design lifetime of the tank will be at least 30 years.

Requirements for carbon steel tank are covered in EN 14015. Additional requirements for other materials are presented in the following chapters.

3.2.1 Stainless Steel

Stainless material must be kept separately from carbon steel. Plastic or other harmful materials shall not be used to prevent contamination or corrosion damages. During handling and transportation, stainless steel may be placed on or come into contact only with surfaces of stainless steel, PE plastic, pure wood, etc.

All tools, clips, lugs or temporaries must be of stainless steel or the contact surface must be plated with stainless steel. The stainless-steel components must be protected by appropriate shielding whenever grinding and cutting work is done in their vicinity.

3.2.2 Material Certificates

Material certificates for plates, fittings, all welding fillers and other structural components shall be according to EN 10204 3.1, and the material manufacturer shall have an EN ISO 9001 certificate accredited within the European Community.

Material certificates shall be according to EN 10204 2.2 for the following materials/components:

- Supports, excluding parts welded directly to tank structure
- Internals, excluding parts welded directly to tank structure and / or if any exposure to critical media can occur.
- Gaskets
- Bolts, studs, and nuts

3.3 Design

Atmospheric tanks shall be designed according to EN 14015, EN 13445 (pressure equipment as part of the tank), EN 1993-4-2 and EN 1993-1-1.

Besides the hydrostatic load of the tank's content, the following shall be considered (but not limited to) in the stress calculations:

- possible internal and external pressure and vacuum conditions
- natural forces (wind, snow, etc.)
- loads caused by insulation and insulation cladding sheet
- loads from inside lining, if applied
- loads caused by platforms, piping, ladders, equipment attached etc.
- loads appearing during erection, operation (vacuum, inlet of a fluid, vibrations, the surrounding of the mixer inlet shall be strengthened well), maintenance or inspection
- requirements of chemical law
- injection of bottom
- Tightness/Pressure test medium
- Reinforcement requirements of Equipment Suppliers
- seismic loads, tailored to the area of seismic activity for the specific region

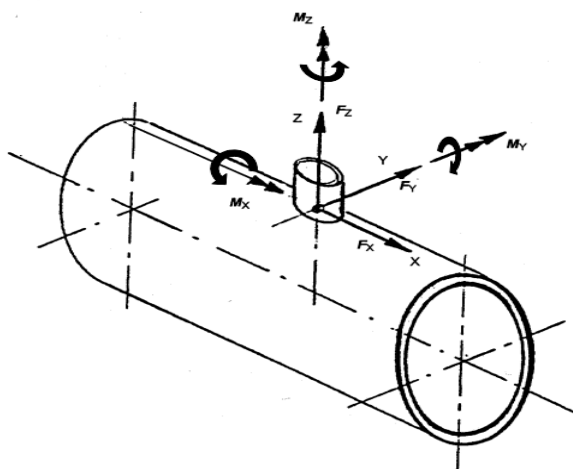
Snow and wind loads shall be according to local National requirements and specification MG0001, General Mill Specification.

The corrosion allowance of carbon steel tanks shall not be less than 2 mm. If the structure is in contact with a liquid on both sides (e.g. a partition wall in the tank), the corrosion allowance shall be doubled. The corrosion allowance shall be shown in the drawings.

If not especially required, stainless steel tanks need no corrosion allowance.

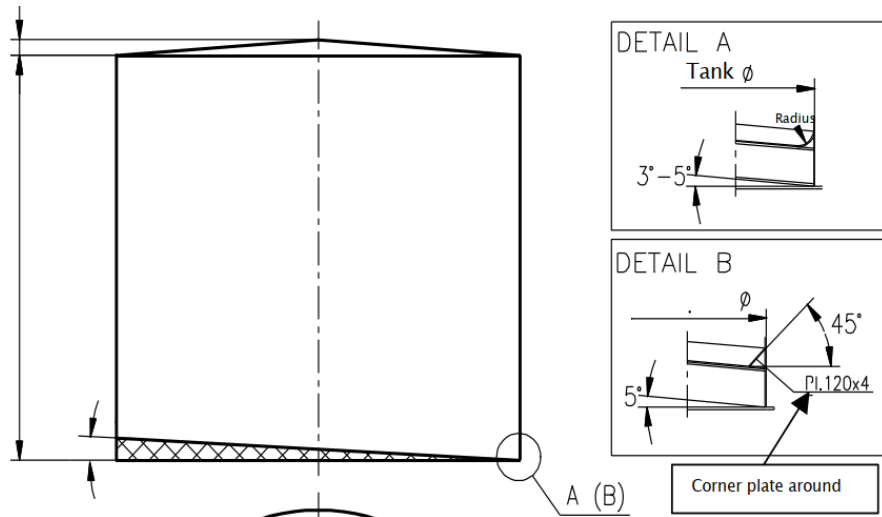
Nozzles shall be designed to carry external loads specified in the Table below, if not otherwise specified or agreed. The indications of F (kN) and M (kNm) are shown in the sketch below the table.

DN	PN 10/PN16		PN25		PN40	
	$F_x = F_y = F_z$ (kN)	$M_x = M_y = M_z$ (kNm)	$F_x = F_y = F_z$ (kN)	$M_x = M_y = M_z$ (kNm)	$F_x = F_y = F_z$ (kN)	$M_x = M_y = M_z$ (kNm)
80	2,62	1,14	2,88	1,16	3,32	1,20
100	3,43	1,77	3,77	1,81	4,33	1,89
125	4,48	2,67	4,92	2,75	5,66	2,89
150	5,58	3,69	6,13	3,82	7,05	4,05
200	7,88	6,05	8,66	6,34	9,95	6,83
250	10,30	8,81	11,31	9,35	13,01	10,24
300	12,81	11,96	14,08	12,84	16,19	14,30
350	15,42	15,51	16,94	16,84	19,48	19,06
400	18,10	19,45	19,89	21,36	22,87	24,54
450	20,84	23,80	22,91	26,42	26,34	30,80
500	23,65	28,56	25,99	32,04	29,89	37,86
550	26,52	33,74	29,14	38,25	33,51	45,77
600	29,44	39,36	32,35	45,06	37,20	54,57
650	32,41	45,42	35,61	52,50	40,95	64,31
700	35,42	51,95	38,93	60,60	44,76	75,01
750	38,48	58,94	42,28	69,36	48,63	86,73
800	41,58	66,42	45,69	78,83	52,54	99,50
850	44,71	74,40	49,14	89,02	56,51	113,37
900	47,89	82,90	52,62	99,95	60,52	128,36
1000	54,34	101,47	59,72	124,13	68,67	161,90



If the bottom slope is not otherwise defined, following principles shall be followed:

- the slope 3-5 ° will be in tank of a diameter up to 3000 mm – R 50
- the slope 3-5 ° will be in tank of a diameter from 3000 mm – R 80

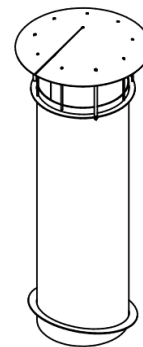
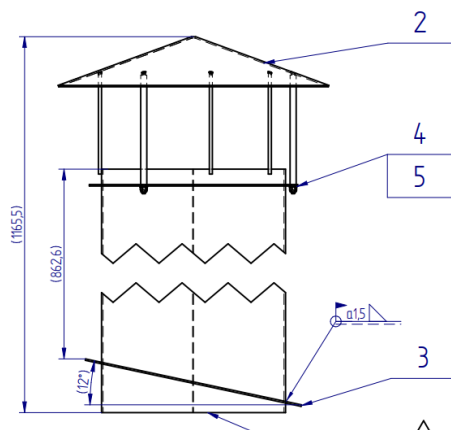


If frangible roof is required because of the process or tank contents, the requirements of EN 14015 appendix K shall be applied and roof plates shall not be attached to the internal roof-supporting structures.

Vacuum strength shall be min. 200 mm WC, if not required more in project documents. Ventilation pipe of tank venting to air shall be sized according to EN 14015 Appendix L. Vent piping shall be protected in a way that the outside particles do not block the piping.

Pulp storage towers are recommended to be manufactured and inspected in accordance with the procedures specified in PED for category III. (corresponding to PED module G). Design review and product verification for pulp towers are recommended to be performed by the authorized inspection agency. Pulp towers are recommended to be calculated using FEM – analysis program.

Minimally one ventilation opening of the tank venting to air shall be designed according the drawing below.



PERFORM THE ASSEMBLY WELD DURING FINAL ASSEMBLY ON THE ROOF

Dimensions and number of ventilation openings are stated by the tank's Supplier. Minimum are two openings. All opening shall be accessible from a platform for a permeability inspection. Every of the openings shall be sized to cover the max. plus 50% reserve of the calculated air vent flow. Minimal dimension is DN250. As a second air ventilation opening could be stated the stored medium overflow or other opening if mechanically secured against closure to level lower than max. plus 50% reserve of the calculated air vent flow. Vent openings shall be protected by blocking of inside or outside structures (eg. insulation, gratings etc.).

Vent openings shall be remarked at the Supplier's documentation (drawings and operation and maintenance manuals).

3.4 Welding

All welders and welding operators shall be qualified according to EN ISO 9606 and EN ISO 14732, respectively.

The Manufacturer shall use Welding Procedure Specifications (WPS) according to EN ISO 15609 on all welding. The WPS shall be qualified by a welding procedure qualification records (WPQR) according to EN ISO 15614.

Butt welds shall be full penetration welds if not otherwise agreed. The shell's end joints and the weld joints where the shell and the roof/bottom of the tank meet shall be welded on both sides.

The weld grooves shall be suitable for the material thickness and welding process.

The tank shell plates shall be installed so that the tank's inside surface is smooth and level.

The bottom and roof joints shall be according to EN 14015 and the wall thicknesses according to EN 14015. If Annular ring is applicable (>12.5m tank diameter) shall be welded with butt welds and backing strips. Table below defines minimum bottom wall thicknesses (EN14015, Table 13).

Material	Lap welded bottoms	Butt welded bottoms
C and C Mn steels	6 mm	5 mm
Stainless steels	5 mm	3 mm

Welds shall not coincide with nozzles, manholes, supports, reinforcement plates etc. Minimum distance between welds is 50 mm.

Welds must not form a cross in the corner of plates, but plates shall be arranged so that welds form a T-joint.

Welding shall be performed in suitable environment considering the welding process. Equipment related to welding shall be serviced, validated, inspected and measurement devices calibrated yearly. Latest validating date shall be attached to the equipment (e.g. by a sticker). These actions shall be documented such that the action date and servicing instance can be identified for each piece of equipment. The welders shall have the WPS related to the job when performing the welding.

The Manufacturer shall have equipment required to supervise that the welding is performed according to the WPS. The Manufacturer shall make verifiable supervision for the welding. The supervision shall include ensuring, that the welding parameters and conditions (e.g. supervision of measuring of interpass temperatures) are according to the WPS. When the

interpass temperature is limited, it shall be measured with a contact thermometer after each pass.

Stainless steels shall be protected from contamination (being in contact with carbon steels or other low alloyed steels). Tools, grinding discs etc. shall be compatible with stainless steels, and may not have been used with carbon or low alloyed steels before. Stainless steels shall be protected, when work performed on carbon or low-alloyed steels causes a contamination risk by welding splatter or sparks. Blasting medium used previously for low alloyed materials may not be reused for stainless materials.

Welds of stainless materials shall be cleaned mechanically or by pickling and passivating. Field welds shall be cleaned mechanically. The welds shall be free of oxidation, discolouration and slag after the cleaning.

Stainless materials shall be welded with root shielding gas. Use of backing paste is not allowed.

The manufacturer shall keep welding log and welding maps or use other methods which enable traceability of materials and welders.

Interpass temperatures shall not exceed the following:

- Austenitic stainless steels: 150 °C
- Highly alloyed austenitic stainless steels: 120 °C
- Austenitic-ferritic stainless steels ("duplex"): 150 °C
- Highly alloyed austenitic-ferritic stainless steels ("super duplex"): 120 °C.

On all WPQRs used in welding of austenitic-ferritic stainless steels (duplex steels), ferrite content shall have been measured by a metallographic method on weld metal and HAZ on all passes. Ferrite content of the WPQR shall be within a range of 35 % to 65 %. ASTM E562 or other reliable optical methods can be used in the determination.

3.5 Finishing

EN 14015 Annex R shall be followed for finishing.

The inside welds of tanks shall be made smooth with the inside surface of the tank, and welds in corners shall be rounded by grinding.

Surface roughness shall be taken into account especially in the tanks of the short circulation of the drying machine, in short circulation piping of the drying machine as well as in cooling water piping where humus is possibly accumulated.

No welding, heating or deforming work shall be made to tanks after the start of lining work.

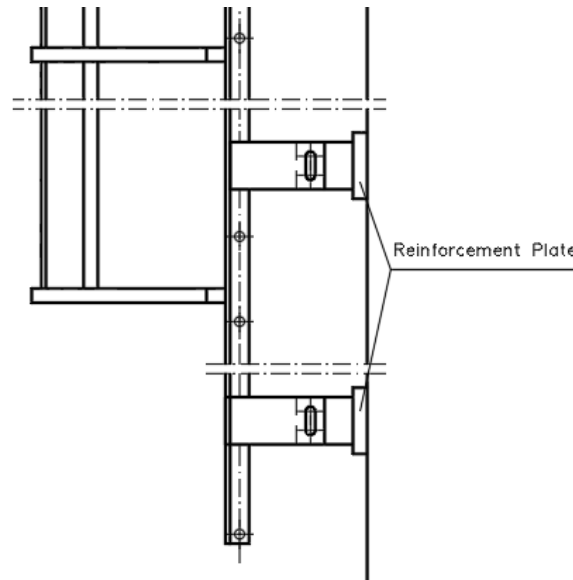
Materials shall be marked with a code indicating the manufacturing lot. Materials shall be traceable.

The Supplier shall hand over a drawing showing the manufacturing lot codes and the used and measured plate thicknesses.

Erection supports shall not be removed by breaking. Their removal shall be made by gas cutting or with an abrasive wheel. Attachment points shall be inspected with VT, and they shall be surface inspected if needed (MT/PT). Any damages to the plate surfaces shall be repaired.

All holes made by gas cutting shall be ground.

Heavy size ($>DN50$) pipe supports, consoles, steel platform supports, etc. must not be welded directly to the tank shell. A reinforcement plate shall be welded to the shell (see sketch), and the support structure shall be fastened on this plate. Reinforcement plates shall be equipped with a M6 threaded telltale holes.



3.6 Nozzles

Flange connections shall be used. Flanges shall be according to EN 1092-1, and shall have a minimum pressure class of at least PN 10, even if the design pressure of the equipment is lower.

Gaskets shall be according to project specifications. Hexagon screws and nuts shall be of the metric series, with standard ISO threads, and comply with the standards EN ISO 4014.

Small nozzles ($DN \leq 50$) shall be supported from two directions.

Tank separation from the process by blind plates for safe working inside the tank shall be possible.

Reinforcement plates shall be equipped with M6 threaded telltale holes. Telltale holes shall be plugged after testing the tightness of reinforcement plates.

Manhole covers shall allow manipulation (open/close) by one person, shall be hanged or connected by hinges to the covers of the tank. Inside diameters of manholes shall not be smaller than DN 600. Roof manholes shall be equipped with safety grid.

3.7 Draining

Following principles shall be followed:

- drain piping shall be sized so that the draining time is reasonable and EN14015 requirements for drain piping, venting and pressure balance shall be followed
- design of drain piping to the channel shall take safety aspects into account
 - e.g. by leading the pipe to the floor channel
- chemical tank shall be designed to allow complete draining

- Draining pipe and accessories material shall correspond to the material of the tank

3.8 Overflow

Water lock is required if tank vent is collected.

Water lock location is inside the tank at the top of the overflow.

Tank roof manhole shall be located so that overflow can be visually inspected from the manhole.

Overflow shall be led to channels. Safe location of overflow on the channel shall be ensured, and if needed, the channel shall be covered.

3.8.1 Dimensions

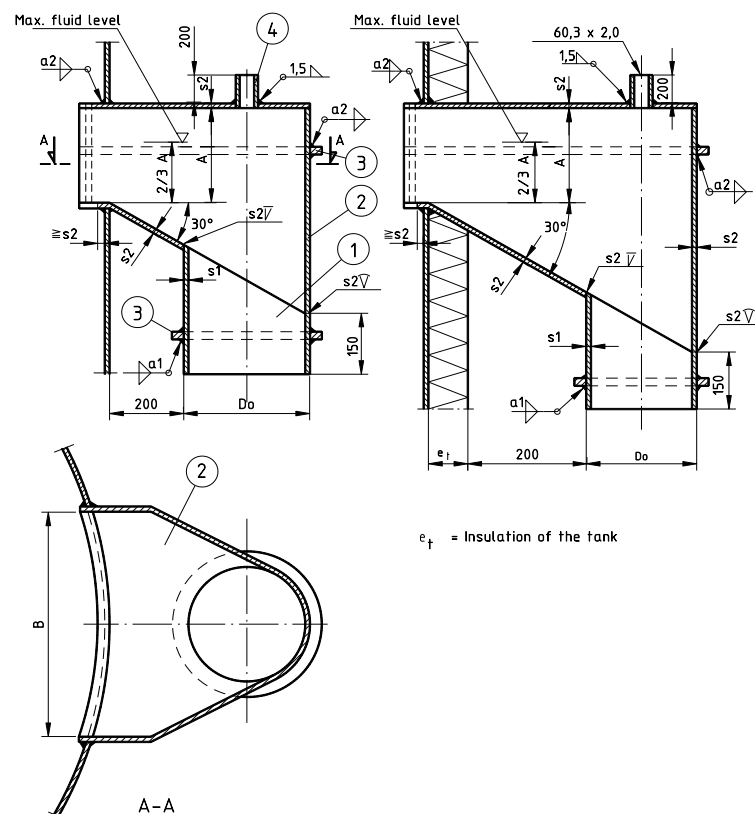


Figure1.

4	Pipe DN50	Material shall correspond to the material of the tank.
3	Flat bar 80 X 6 Note 1)	Material shall correspond to the material of the tank.
2	Plate	Material shall correspond to the

		material of the tank.
1	Pipe, See Table 1	Material shall correspond to the material of the tank.
Part		Material
<p>Notes:</p> <p>1) Reinforcement bars (part 3) shall be welded on the connection when DN > 400.</p>		

Table 1.

Max. overflow l/s 1)	Dimensions (mm)							
	DN	Do	A	B	s ₁ 2)	s ₂ 2)	a ₁ 3)	a ₂ 3)
41	200	219.1	175	400	3.0	5	1.5	3.5
60	250	273.0	200	500	3.0	5	1.5	3.5
105	300	323.9	250	600	3.0	5	2.0	3.5
111	350	355.6	250	700	4.0	5	2.0	3.5
166	400	406.4	300	800	4.0	6	2.0	4.0
256	500	508.0	350	1000	4.0	6	2.0	4.0
370	600	610.0	400	1200	5.0	6	2.0	5.5
500	700	711.0	450	1500	5.0	6	2.0	5.5
650	800	813.0	500	1800	5.0	6	2.0	5.5

Notes:

- 1) The flow rate has been calculated for water.
- 2) The dimensions are minimum values. The manufacturer is responsible for checking the strength case by case.
- 3) Welding details shall be considered as minimum requirement. Design code shall be followed when applicable.

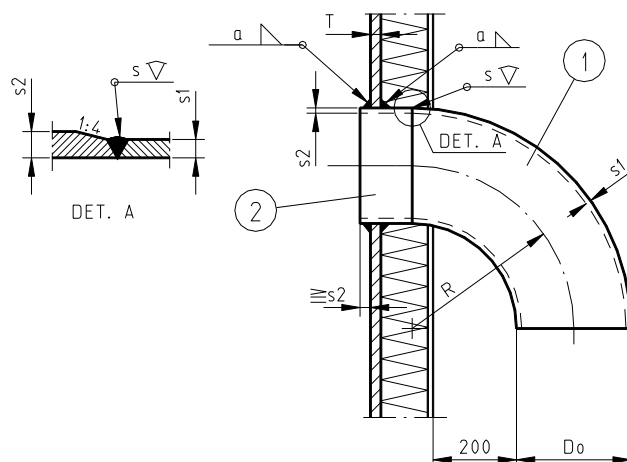


Figure 2.

2	Pipe, See Table 2	Material shall correspond to the material of the tank.
1	Bend 90°	Material shall correspond to the material of the tank.
Part	Description	Material

Table 2.

DN	Max. overflow l/s 1)	Dimensions (mm)				
		Do	Min. s ₁ , 2)	Min. s ₂ , 2)	a 3)	R
100	6	114.3	2.5	2.5	2.0	152
150	16	168.3	2.6	4.0	3.0	229
200	30	219.1	2.6	4.0	3.0	305
250	56	273.1	3.2	4.0	3.0	381
300	87	323.9	3.2	5.0	3.5	457

Notes:

- 1) The flow rate has been calculated for water.
- 2) The dimensions are minimum values. The manufacturer is responsible for checking the strength case by case.
- 3) Welding details shall be considered as minimum requirement. Design code shall be followed when applicable.

3.9 Vortex Breaker

Vortex breaker shall be used in order to prevent vortex formation, when draining the liquid from the tank.

Vortex breaker type A (Figure 3) is used for nozzles with internal pipe. Vortex breaker type B (Figure 3) is used for nozzles with shell or head. Material shall correspond to the material of the tank.

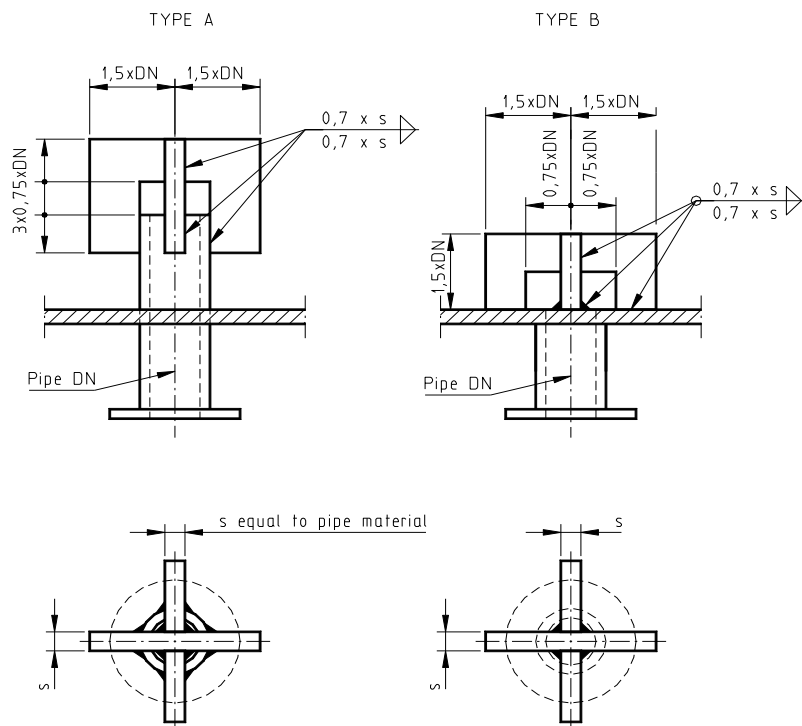


Figure 3.

3.10 Tank Foundation

3.10.1 Foundation Instruction for Chemical Tanks

Chemical tank foundation shall be of leak-proof construction.

The foundation of the tank shall be about 3° inclined towards draining and draining connection shall be left space into the foundation.

Insert plates (at least 4 pcs) shall be installed to the primary concrete at anchoring points.

The foundation base shall be smoothed and carefully cleaned. The foundation shall be lined with epoxy.

The tank shall be installed according to layout drawing and fixing anchors shall be welded to the inserts.

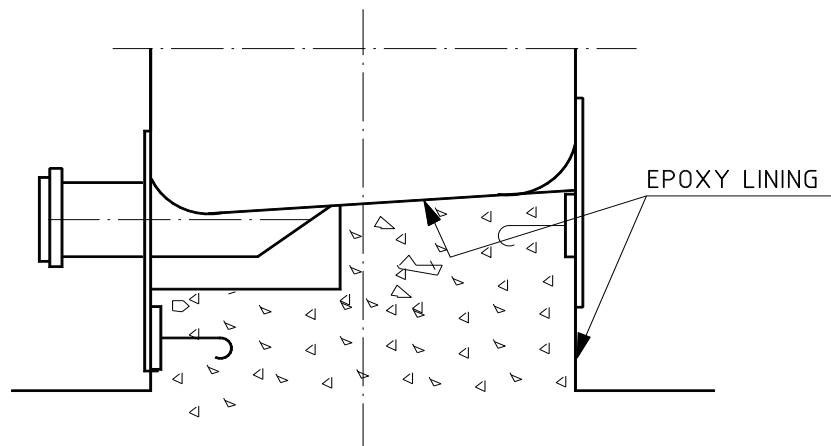


Figure 4.

3.10.2 Steel Tank Bases and Injection

This part gives guidance on bottom injection, for the supporting and corrosion protection of steel tank base, installed on concrete, by filling the space between the tank bottom and concrete with injection mass, using an injection pump. Also, the standards PSK 3015 and EN 13670 shall be followed. Also, this part gives guidance of the actions preceding and the performance of the work.

Tank concrete foundation shall be made so even that injection is not required due to inaccuracy of the foundation.

The loads of injection shall be taken into account in the fastening of tank and in the bottom construction. The tank shall be fastened at minimum 1.5 m interval.

Necessary pipe connection for injection, their connecting and pipe connections for air outlets are included in the delivery. The removal of pipes and plugging of holes are also included in the delivery.

3.10.2.1 Preparation work

Before starting the injection it shall be made sure that the tank has been supported against injection pressure.

In order to prevent the leakage of injection grout, any holes between the edge of the tank and concrete foundation shall be packed before starting the injection.

The bottom of the tank shall have R 1 external threaded connections for injection and air venting as shown in Figure 5.

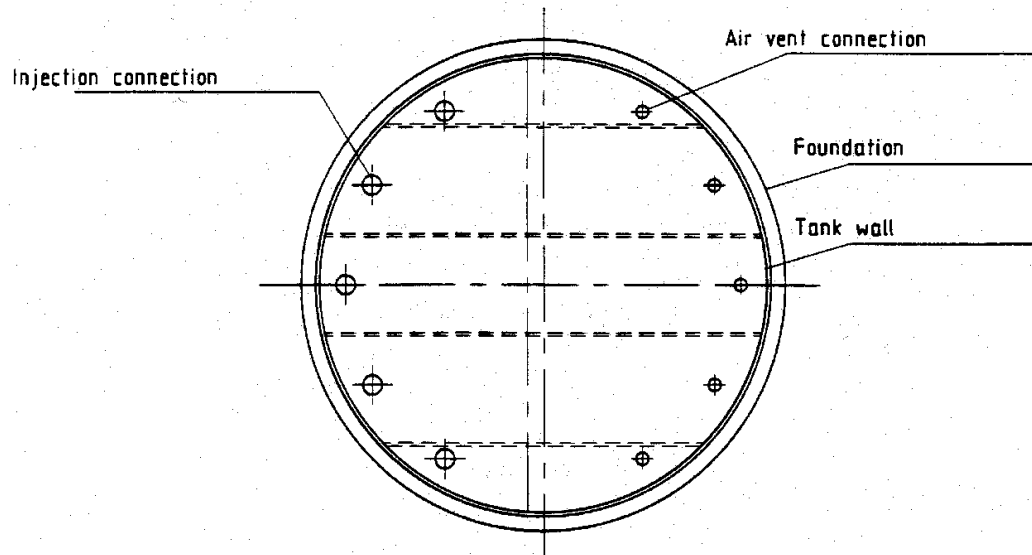


Figure 5. Example of the location of air vent and injection nozzles.

There shall be one connection for each 2 m² of the bottom area of the tank.

The highest point of this space to be injected shall have additionally one R 1 external threaded connection for air venting.

3.10.2.2 Injection

The materials and working methods used in injection work shall conform to the instructions and orders for concrete works in Local Building Code and the instructions given in this standard.

Injection grout is a mixture of water and concrete or water, concrete and additive. Filler and sand can be used in injection grout as base material only in sufficiently large injection spaces. The consistency of the grout shall correspond to the working method to be used.

The granularity curve of a base stone material used shall be located within the recommended area shown in Figure 6 and it shall be regularly continuous.

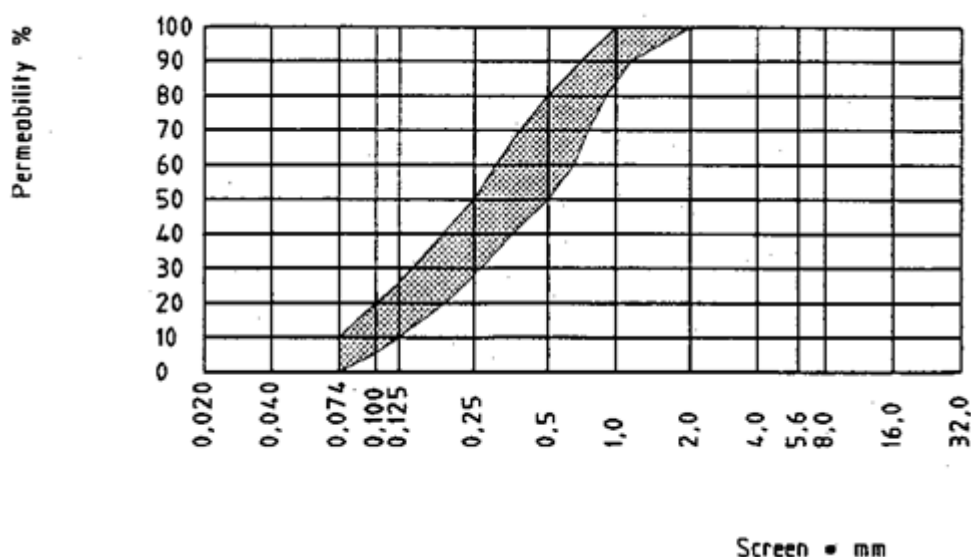


Figure 6. Recommended range for the granularity curve of the stone material.

The ratio of water-concrete mass $w \approx 0,45$. In order to improve the injection characteristics, additives approved by an accepted testing institute can be used.

The injection sequence shall be selected so that no air pockets remain between the tank bottom and the concrete base. When injecting inclined spaces, the work shall be performed from bottom upwards.

Injection shall be performed at a pressure, which will not cause any damage to the tank. The spreading of the injection grout can be improved by vibrating the bottom of the tank lightly. The spreading of the injection grout can be followed by observation of the injection connections, by watching the changes in the form of the tank bottom and by tapping the tank bottom.

If needed, more injection and vent connections shall be added and the packing between the tank edge and concrete base shall be improved.

After injection, the connections shall be removed and their holes shall be closed.

3.11 Lining, Insulation and Surface Treatment

The type of lining, insulation and surface treatment shall be indicated in the drawings.

The lining shall be made according to Appendix II.

The insulation shall be made according to specification MM0005 "Technical specification for Thermal Insulation", considering the following additional regulations.

Carbon steel tanks shall be insulated against the condensation when needed.

If the tanks are to be lined and insulated, the insulation clips/pins shall be welded before the erection lining work.

The surface treatment shall be carried out according to the specification MM0004 "Technical Specification for Surface Treatment and Painting-Metallic Surfaces".

3.12 Earthing

Tanks shall be earthed by connecting them to the earth network by earth cables following instructions in EN 60204-1 "Safety of Machinery. Electrical equipment of machines. Part 1: General requirements".

Earthing connections shall be erected after tank erection according to electrical site supervision. Requirements in MEIA0013, Earthing and Lightning Protection Standard, shall be followed.

3.12.1 Dimensions and Material

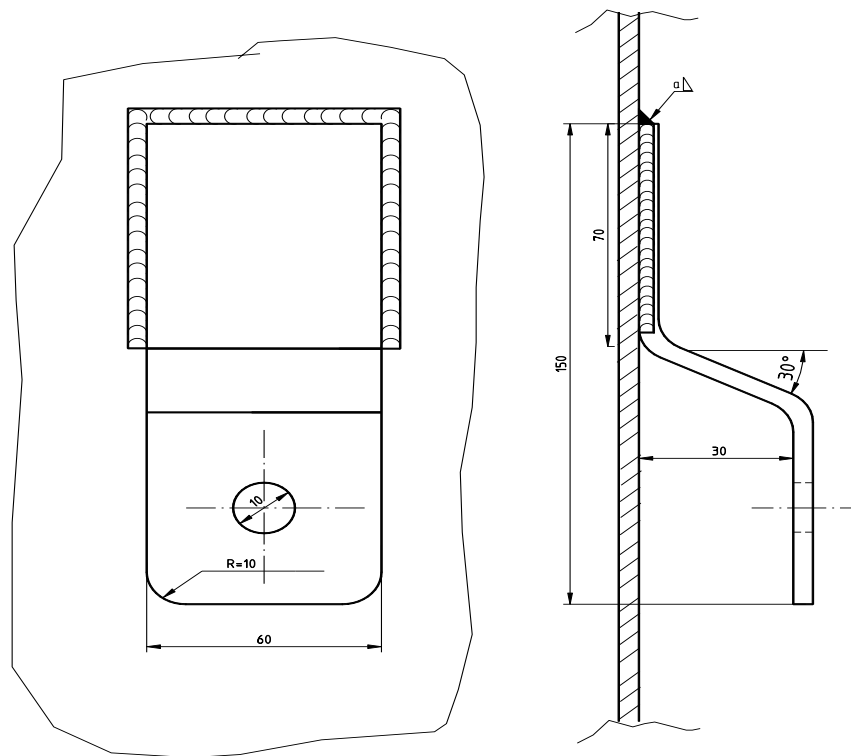


Figure 7.

Material of the earthing connection corresponds to the material of the tank. Welding work shall comply with the tank manufacturer's instructions.

3.13 Steel Structures, Stairs, Ladders, Platforms

Stairs, platforms and walkways shall be designed and manufactured according to standard EN ISO 14122. Safety requirements in EN ISO 14122 and requirements in Technical Standard MG0001 shall be considered. Self-closing doors and anti-slip steps shall be used.

3.14 Marking

3.14.1 Nameplate

Name plate information shall be according to EN 14015:2015 point 20.2

Tanks containing hazardous chemicals shall be labelled with the contents and their hazard symbols according to the GHS (Globally Harmonized System of Classification and Labelling of Chemicals).

Tank nameplate shall be according to Purchaser's mill specific regulations, see standard ST13.01.04.

Fixing of the name plate shall be performed by a name plate brackets. The brackets of insulated tanks shall extend over the insulation.

4 Inspections

Manufacturer shall perform all inspections required by the standards, PED (e.g. heating coils), local laws, Authorized Inspection Agency, this specification, or the Enquiry documents at their own cost.

Inspections and testing shall be performed according to requirements of EN 14015 and authorized inspection agency.

On request, the Supplier shall arrange free access to the Purchaser to all manufacturing, warehousing and erection areas, and the Purchaser shall present all quality, manufacturing and inspection/testing documentation to the inspector of the Purchaser. The Purchaser has the right to visit these areas to supervise progress, quality, inspections and tests, and also has the right to have extra tests performed. The Supplier shall ensure these rights are extended towards any sub-suppliers.

Before start of manufacturing, inspection and testing plan (ITP) shall be delivered to the Purchaser.

Tests and document reviews/approvals do not release the Supplier from their responsibility of quality and schedule.

The Supplier shall clarify the adequacy of supervision of their sub-suppliers and shall get acceptance of the Purchaser for it. The sub-suppliers shall be approved by the Purchaser.

Inner and outer surfaces of the tank shall be cleaned of slag, paint, oil, grease, etc. before inspections or hydrostatic test (water fill test). Inspection procedure during water fill test of pulp towers shall be agreed on separately with the Purchaser.

The Purchaser has the right to demand changing of the gaskets after inspections and tests without extra charges.

The Supplier is responsible for making preparations for the inspections and tests at their own charge.

The Purchaser shall be notified of the tests two weeks in advance.

All re-tests and inspections shall be paid for by the Supplier. Re-testing shall be performed, until an acceptable result has been obtained after repairs.

4.1 Non-Destructive Testing (NDT)

NDT reports and certificates shall be signed by the inspector.

All NDT shall be performed before the hydrostatic test.

The Supplier shall notify the Purchaser of planned inspections and tests at least two weeks in advance.

NDT personnel shall be qualified according to EN ISO 9712 level 2. The inspection agency shall have an audited quality system.

Ferrite content of duplex welds shall be measured with Ferritescope for 5 % of the welds.

This specification uses abbreviations of EN 17635:2016 Table 1 for NDT methods.

MT shall be used for ferritic materials in surface inspections.

Inspection scopes of both EN 14015 and this specification shall be fulfilled. Acceptance criteria shall be according to EN 14015.

100 % VT shall be performed for all welds. 100 % MT/PT shall be performed for bottom T-cross welds.

The extent of pulp tower's welding seams (additional requirements) shall be inspected as follows:

- welds at both ends of conical part shall be 100 % UT/RT
- all crossing T-joints 100 % UT/RT
- other welds 10 % UT/RT
 - inspections shall be divided:
 - 2/3 to the lower cylindrical part, conical part and two courses of the upper cylindrical part
 - 1/3 to the rest of the upper cylindrical part

4.2 Positive Material Identification (PMI)

Positive material identification (PMI) shall be performed for metals having nominal alloying maximum of chrome, nickel or molybdenum greater than 1 wt.% in the material standard, or when the metallic material is not ferritic steel. PMI shall be performed on portable X-ray fluorescence or laser based devices. Records shall be kept of PMI testing.

Testing scope shall be 5 % of the delivery.

4.3 Lining Leak Test

To perform the lining leak test, compressed air shall be fed through the leakage detection pipes and a soap solution shall be applied on the seams at lining joints to find out possible leaks.

4.4 Hydrostatic Test (Water Test)

For hydrostatic test procedure see EN 14015 Chapter 19.

Gaskets of nozzles (including manhole) shall not be reused if they are opened after installation.

4.5 Acceptance Inspection

Other objects to be tested and inspected in connection with the acceptance test are:

- the correct fastening of the tank to the foundation
- ladders, platforms, manholes, etc.
- the correct fastening of piping and steel platform supports
- surface treatment inspection (film thickness measurement)
- correct installation of tank insulation

The Supplier and the Purchaser shall together draw up a report of each inspection. These inspection reports shall be signed by both parties.

5 Documentation

Documents acc. to EN 14015 point 20.

Appendix I

APPENDIX I – TOLERANCES, ERECTION OF TANKS AND EQUIPMENT

1. GENERAL

The tolerances of this standard are an attempt to coordinate equipment of different contractors and to enable prefabrication.

The tighter tolerances in this standard or in the standard EN14015 / chapter 16 shall be used.

2. BINDING

This standard is to be complied with in the erection of tanks and equipment unless otherwise stated on drawings or in contract documents.

3. VERTICAL TANKS

3.1. Location

Location in horizontal direction is to be measured from measuring points or measuring lines to the centerlines of the tank.

3.2. Elevation

Elevation of the tank is to be measured from the given ground level to the down level of feet or supporting beam.

Tolerance shall be ± 3 mm.

3.3. Verticality

Verticality shall be measured with a suitable method. The lower value of the following shall be used as acceptance criteria:

Deviation: max. 50 mm, or

Deviation is at most:

Tank diameter

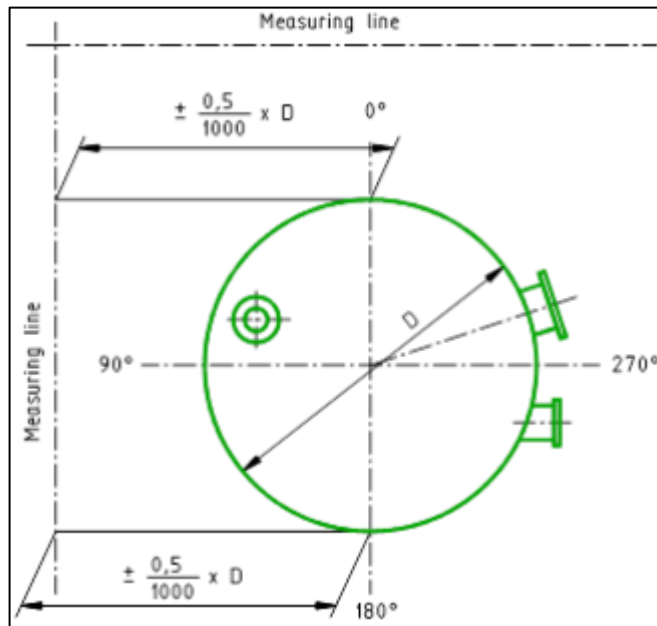
$D \leq 10$ m

$10 \text{ m} < D \leq 30 \text{ m}$

Deviation

$2.5/1000 \times H [\text{m}] = [\text{mm}]$

$2.8/1000 \times H [\text{m}] = [\text{mm}]$



The measuring is to be done from measuring points or measuring lines.

Maximum tolerance between the tank center line and the theoretical center line is ± 3 mm.

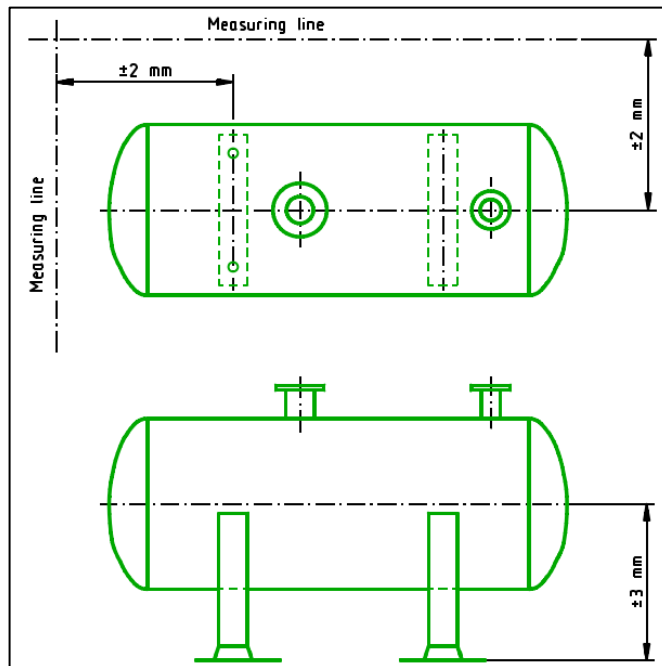
4. HORIZONTAL TANKS

4.1. Location

The location of the tank is measured from the measuring point or lines.

Location in the length direction is measured from the anchoring support.

Location in the cross direction is to be measured from the tank center line.



4.2. Elevation

Tank elevation is measured from the base level to the tank center line.

Tolerance $\pm 3 \text{ mm}$.

4.3. Mounting Direction

The mounting direction of the tank is to be determined according to the tank length axis (center line) when viewed from the top. The parallel deviation can be $\pm 2 \text{ mm/m}$ at the highest.

Appendix II

APPENDIX II – INSTRUCTION FOR LINING MILD STEEL TANKS

1. GENERAL

This standard is intended to define the method for lining carbon steel tanks (e.g. S235JRG2) with austenitic stainless-steel plate (1.4307 or 1.4432).

2. SIZE AND SHAPE OF LINING PLATES

Tank bottom and the cylinder shall be lined with steel plate of $s \times 500 \times L$ mm. L = length of the plate. The lining plate thickness is min 2 mm for the upper cylinder, or more, if required according to static calculation of tank supplier. Lower cylinder and the conical part the lining plate thickness is min 4 mm or more, if required according to static calculation of tank supplier.

The tank provided with mixers $s_{\min} = 4$ mm. In the influence area of mixer, the maximum sizes of the plates are $4 \times 500 \times L$.

To prevent three plates from overlapping, the corner of one plate shall be removed (see Figure 1).

The plates shall be moulded to fit tightly against the tank base plate.

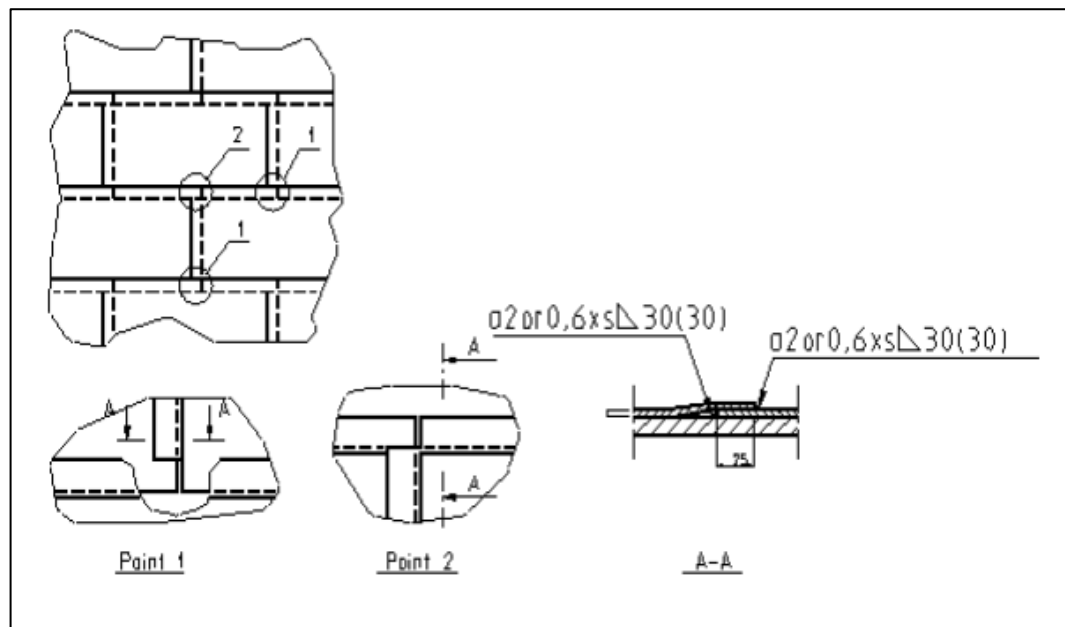


Figure 1. Bending and cutting of lining plates.

3. WORK SEQUENCE

Before starting the lining work, it is important to make sure that welding seams on the inside of the tank have been ground down flush with the plate surface.

All irregularities (as weld splatter) must be removed and 40 mm on both sides of the joining weld stainless to mild steel plate must be ground or steel brushed to a clear metal surface.

The tank shell lining shall start from the top. The height of the lining zone must not exceed 3000 mm. The transition welding between stainless steel and carbon steel must be welded with a continuous fillet weld on the lining zone limits.

The leakage detection pipes (2 pieces per circumference) shall be fitted at the lower edge of each lining zone (see Figure 2). Pipe nozzle length $L = 30 \text{ mm} + s + \text{insulation thickness of the tank}$.

Ends of the leakage detection pipes shall be marked with the zone identification codes in a permanent manner. The zone codes shall be presented in the zone map.

The cone shall be lined with horizontal plates.

Tank corners shall be lined with curved steel plates as shown in Figure 2.

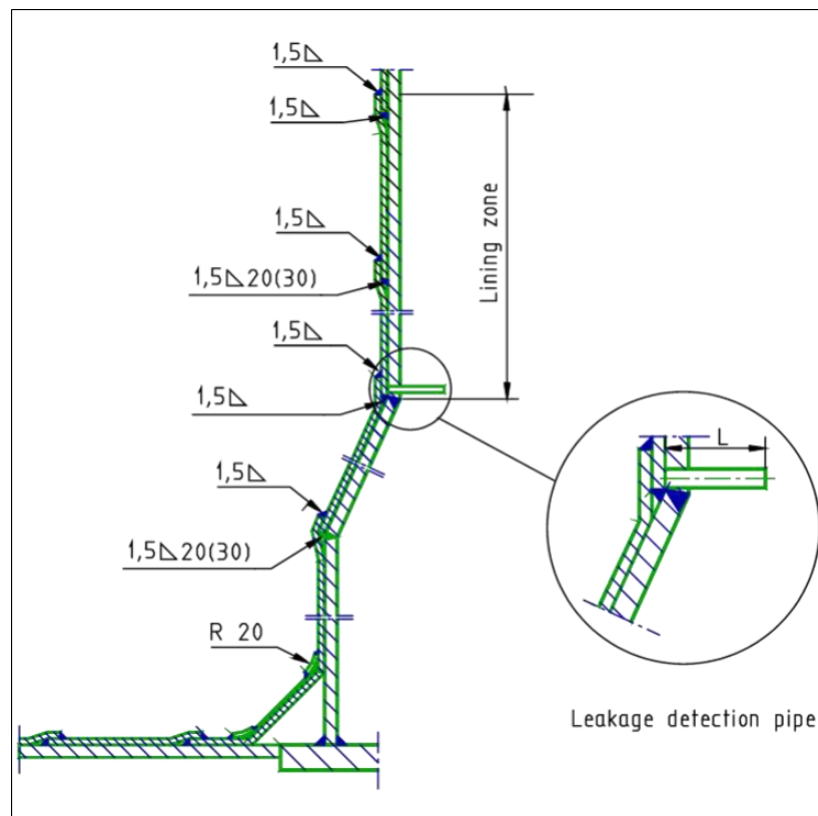


Figure 2. Fitting of curved steel lining plates.

4. INSPECTION

Inspection shall be carried out according to tank drawings and this specification.