

ST 13 MM0001 Technical Specification for Piping

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Contents

1	General.....	4
1.1	Codes and Standards.....	4
2	Reference Standards.....	5
3	Materials and Dimensions	7
3.1	Ferritic Steel Piping	8
3.2	Austenitic Stainless Steel Piping	8
3.2.1	CrNi-steel.....	8
3.2.2	Austenitic stainless CrNiMo-steel	8
3.2.3	High alloyed austenitic stainless steels.....	8
3.3	Austenitic-Ferritic Steel Piping.....	9
3.4	Precision Steel Piping.....	9
4	Nominal Pressure Classes	9
4.1	Nominal Pressure for Pipe Classes	9
4.2	Nominal Pressure for Flanges.....	9
4.3	Nominal Pressure for Valves	9
5	Design and Installation.....	9
5.1	Connection Types.....	9
5.2	Piping Supports	10
5.3	Work Allowances.....	10
5.4	Insulation	10
5.5	Surface treatment.....	10
5.6	Marking of Pipelines and Fittings	11
5.7	Allowed flow Velocities.....	11
5.7.1	Airs	11
5.7.2	Water and pumped condensates.....	11
5.7.3	Steams	12
5.7.4	Acids	12
5.7.5	Alkalis	12
5.7.6	Pulp	13
6	Welding	13
6.1	Welding Procedures.....	14
6.2	Welding Conditions.....	14
6.3	Welding Plan	14
6.4	Welding Personnel.....	14
6.5	Welding Processes.....	15

6.6	Welding Filler Materials	15
6.7	Shielding Gas	15
6.8	Welding of Stainless Materials.....	15
6.9	Grounding.....	16
6.10	Quality of Welding and Acceptance Levels.....	16
6.11	Heat Treatments / Post Weld Heat Treatments	16
7	Inspections, Testing, and Quality Control	17
7.1	Inspection Personnel	19
7.2	Inspection Scope	19
7.2.1	PED Classified Piping.....	19
7.2.2	Piping according PED article 4 chapter 3 ("4.3")	19
7.2.3	Piping with Hazardous Contents (Chemical Piping).....	19
7.3	Piping Components Not According to Pipe Classes	20
7.4	Inspection Diagram	20
8	Documentation.....	20
8.1	Piping Isometrics	21
8.2	Welding Log	22
8.3	Documentation of Valves and Other Pressure Accessories	22
8.4	Material Certificates.....	23
8.4.1	Piping Components.....	23
8.4.2	Bolt, Studs and Nuts.....	23
8.4.3	Gaskets	23
8.4.4	Valves and Other Pressure Accessories	23
8.4.5	Safety Accessories.....	23
8.4.6	Welding Fillers	24
8.4.7	Primary Supports	24

Appendices

Appendix I: First page and contents of the quality control book

1 General

The purpose of this specification is to facilitate the piping and mechanical design and to ensure uniform practices. The term "shall" indicates a mandatory requirement. Where the drawings, specifications, standards and installation instruction contradict, the most stringent requirements shall be followed.

All standards within this specification refer to the latest harmonized revisions, unless the revision has been specifically defined.

The Supplier is the Manufacturer of the pressure equipment and pressure equipment assemblies of their delivery, as described in the Pressure Equipment Directive **2014/68/EU (PED)**.

The Supplier is responsible for their delivery as the Manufacturer regardless of any approvals of methods, designs, procedures, materials or other documents made by the Supplier.

All deviations to norms, standards or this specification requires a written approval of the Purchaser.

1.1 Codes and Standards

All piping shall follow the laws, rules, regulations and standards given by the local authorities.

Piping shall fulfil requirements of the pressure equipment directive 219/2016 Sb. ("Nařízení vlády o posuzování shody tlakových zařízení při jejich dodávání na trh", czech implementation of **2014/68/EU**, of the local authorities/regulations, local pressure equipment legislation and chemical legislation, and of this specification.

The following standards and regulations shall be commonly applied:

EN	European Committee for Standardization (CEN)
ISO	International Organization for Standardization
DIN	Deutsches Institut für Normung, German Standards

The piping shall be delivered according to **EN 13480** (all parts are applicable). Requirements of EN 15001, EN12732 and local norms shall be fulfilled when applicable. Piping components which are not according to harmonized EN standards shall be dimensioned and their calculations documented and delivered to the Purchaser. The components shall follow the requirements of **EN 13480**. The designs shall be approved by the Notified Body at least in PED categories II and III.

The Supplier shall ensure all pressure equipment assemblies or piping under their scope are CE marked as per the requirements of **PED**. The pipelines/assemblies having design pressure ≤ 0.5 bar (g), and pipelines/assemblies falling under PED article 4 section 3 (which are constructed according sound engineering practice = SEP) shall not be separately CE-marked. Such piping is later referred to as "4.3 piping".

Local conditions, such as snow, wind and earthquake loads and possible environment temperatures shall be adequately taken into account in the designs when appropriate.

Piping within the scope of NV 191/2022 Sb. („Nařízení vlády o vyhrazených plynových zařízeních a požadavcích na zajištění jejich bezpečnosti“) these piping must meet the requirements of this regulation and the requirements of the ČSN 38 6405.

2 Reference Standards

Standards

EN 1090-2	Execution of steel structures and aluminium structures. Part 2: Technical requirements for steel structures.
EN 1515-1...4	Flanges and their joints
EN 10204	Metallic products. Types of inspection documents.
EN 13480-1...8	Metallic industrial piping.
EN 15001-1...2	Gas infrastructure. Gas installation pipework with an operating pressure greater than 0,5 bar for industrial installations and greater than 5 bar for industrial and non-industrial installations.
EN ISO 9001	Quality management systems. Requirements.
EN ISO 898-1...4	Mechanical properties of fasteners made of carbon steel and alloy steel.
EN ISO 3834-2	Quality requirements for fusion welding of metallic materials. Part 2: Comprehensive quality requirements
EN ISO 4014	Hexagon head bolts – product grades A and B
EN ISO 4126-1...7	Safety devices for protection against excessive pressure.
EN ISO 5817	Welding. Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded). Quality levels for imperfections.
EN ISO 9606-1...5	Qualification test of welders. Fusion welding.
EN ISO 9712	Non-destructive testing – qualification and certification of ndt personnel
EN ISO 10675-1...2	Non-destructive testing. Acceptance levels for radiographic testing.
EN ISO 11666	Non-destructive testing of welds. Ultrasonic testing. Acceptance levels.
EN ISO 14731	Welding coordination. Tasks and responsibilities
EN ISO 14732	Welding personnel. Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials.
EN 15608	Welding. Guidelines for a metallic material grouping system

EN ISO 15609-1...6	Specification and qualification of welding procedures for metallic materials. Welding procedure specification.
EN ISO 15613	Specification and qualification of welding procedures for metallic materials. Qualification based on pre-production welding test.
EN ISO 15614-1...14	Specification and qualification of welding procedures for metallic materials. Welding procedure test.
EN ISO 17635	Non-destructive testing of welds. General rules for metallic materials.
EN ISO 23277	Non-destructive testing of welds. Penetrant testing. Acceptance levels.
FORCE Technology	Reference charts – for purity of purging gas in stainless Report 93.34 steel tubes
ISO 4200	Plain end steel tubes, welded and seamless – general tables of dimensions and masses per unit length
ISO 5208	Industrial valves – pressure testing of metallic valves.

Technical Specification

ST 13 MM0002	Piping Standards
ST 16 MM0004	Specification for Painting
ST 14 MM0005	Specification for Insulation

Regulations

250/2021 Sb.	"Zákon o bezpečnosti práce v souvislosti s provozem vyhrazených technických zařízení a o změně souvisejících zákonů"
NV 219/2016 Sb.	"Nařízení vlády o posuzování shody tlakových zařízení při jejich dodávání na trh"
NV 191/2022 Sb.	"Nařízení vlády o vyhrazených technických plynových zařízeních a požadavcích na zajištění jejich bezpečnosti"
NV 192/2022 Sb.	"Nařízení vlády o vyhrazených technických tlakových zařízeních a požadavcích na zajištění jejich bezpečnosti"
246/2001 Sb.	"Vyhláška Ministerstva vnitra o stanovení podmínek požární bezpečnosti a výkonu státního požárního dozoru (vyhláška o požární prevenci)"
2014/68/EU	Pressure Equipment Directive
2014/68/EU	Guidelines Pressure Equipment Directive Guidelines

2014/34/EU

ATEX directive

Regulation (EC) 1272/2008

Regulation (EC) on classification, labelling and packaging of substances and mixtures

3 Materials and Dimensions

The following nominal sizes and outer diameters based on **ISO 4200**, Series 1 are to be used in austenitic and carbon steel piping:

Stainless Steel Piping ISO 4200 S1		Carbon Steel Piping ISO 4200 S1		PE, PVC Piping	FPR Piping	Precision Steel Piping
DN	Do	DN	Do	DN=Do	DN=Di	DN=Do
6	10.2	6	10.2	10	(10)	(6)
8	13.5	8	13.5	16	(15)	8
10	17.2	10	17.2	25	(20)	10
15	21.3	15	21.3	(32)	(25)	12
20	26.9	20	26.9	40	(32)	16
25	33.7	25	33.7	(50)	(40)	(18)
32	42.4	32	42.4	63	50	20
40	48.3	40	48.3	(75)	65	(22)
50	60.3	50	60.3	(90)	80	25
65	76.1	65	76.1	110	100	(28)
80	88.9	80	88.9	(125)	125	30
100	114.3	100	114.3	140	150	38
125	139.7	125	139.7	160	200	42
				(180)	250	50
150	168.3	150	168.3	(200)	300	
200	219.1	200	219.1	225	400	
250	273.0	250	273.0	250	500	
300	323.9	300	323.9	(280)	600	
350	355.6	350	355.6	315	(700)	
400	406.4	400	406.4	(355)	(900)	
450	457.0	450	457.0	400	1000	
500	508.0	500	508.0	(450)	1200	
600	610.0	600	610.0	560	1400	
700	711.0	700	711.0	630		
800	813.0	800	813.0	710		
900	914.0	900	914.0	800		
1000	1016.0	1000	1016.0			
1200	1220.0	1200	1220.0			

Pipe sizes in brackets should be avoided.

Compatibility of parts according to this standard with existing piping dimension system of the plant has to be ensured in planning phase and confirmed by Purchaser in case of rebuilds at existing plants.

3.1 Ferritic Steel Piping

P235GH, P265GH seamless pipes shall be according to EN 10216-2 and welded pipes according to EN 10217-2 or EN 10217-5 (only SAWL is allowed).

16Mo3, 13CrMo4-5, 10CrMo9-10 and X10CrMoVNb9-1 piping shall be according to EN 10216-2 (seamless).

Pipe fittings (elbows, T pieces, reducers, caps) shall be according to EN 10253-2.

Flanges EN1092-1 shall be used in ferritic steel piping.

A corrosion allowance of at least 1 mm shall be applied.

3.2 Austenitic Stainless Steel Piping

Pipe fittings (elbows, T pieces, reducers, caps) shall be according to EN 10253-4.

Flanges (EN1092-1) shall be used in austenitic stainless steel piping.

Minimum wall thickness

DN	Wall thickness (mm)
15-250	2,0
300-350	2,6
400	3,2
450-700	4,0
800-900	5,0
1000	6,3
1200	8

3.2.1 CrNi-steel

EN 1.4307 (304L) seamless pipes according to EN 10216-5 and welded pipes according to EN 10217-7.

3.2.2 Austenitic stainless CrNiMo-steel

EN 1.4432 or EN 1.4404 (316L) seamless pipes according to EN 10216-5 and welded pipes according to 10217-7.

3.2.3 High alloyed austenitic stainless steels

EN 1.4539 (904L) and EN 1.4547 (254 SMO) seamless pipes according to EN 10216-5 and welded pipes according to 10217-7.

3.3 Austenitic-Ferritic Steel Piping

Austenitic-ferritic EN 1.4462 (X2CrNiMoN22-5-3) seamless pipes according to EN 10216-5 and welded pipes shall be according to 10217-7.

Pipe fittings (elbows, T pieces, reducers, caps) shall be according to EN 10253-4.

Flanges EN1092-1 shall be used in ferritic steel piping.

Minimum wall thicknesses in point **Chyba! Nenalezen zdroj odkazů.** is applicable also to austenitic-ferritic steel piping.

3.4 Precision Steel Piping

Precision steel pipes shall be according to EN 10305.

Hydraulic piping below DN35 shall be manufactured of CrNi stainless steel (EN 1.4307) and CrNiMo stainless steel (EN 1.4404) according to EN 10216-5. Above DN35 EN 10305-4 carbon steel pipes shall be used, painted outside if otherwise not agreed.

Fittings shall be non-soldered taper bush according to standard DIN 2353 or pre- approved manufacturer's catalogues.

4 Nominal Pressure Classes

4.1 Nominal Pressure for Pipe Classes

Nominal pressures to be used in pipe class designation are PN 10, 16, 25, 40, 63, Use of other (lower or higher) pressure classes shall be accepted by the Purchaser. In such cases separate calculation shall be done.

4.2 Nominal Pressure for Flanges

All flange connections shall be at minimum PN 10 according to EN1092-1.

4.3 Nominal Pressure for Valves

Flange drilling must be according to minimum PN 10, or the valve assembly between minimum PN 10 flanges with a wafer connection shall be possible.

5 Design and Installation

5.1 Connection Types

Welded connections shall be used as much as possible. Flange connections shall be used in applications where they are required due to installation, maintenance, cleaning etc. purposes. Tightening of the flange connections shall be performed in correct order with a calibrated torque wrench, to a proper torque depending on bolt and gasket material. Assemblers of the flange connections shall have certificate according EN 1591-4. Need for flange protection shall be assessed during detail engineering based on the results of risk analysis.

Valves with welding ends may not be welded directly to each other. In such cases, an intermediate pipe of length of at least 50 mm shall be used. Long enough distance between handwheels shall be ensured as well.

Threaded connections shall be avoided and only used in $DN \leq 50$. If threaded connections are used, the piping shall be equipped with a sufficient number of tapered couplings to make the removal of valves and equipment possible. Threaded connections shall be sealed with a material having suitable sealing properties and chemical resistance to the flow medium.

Drain connections shall be supported according MM0002 Piping Standards 320-012. Branch connections shall be supported against cyclic and dynamic loads.

5.2 Piping Supports

The piping supports shall be according to the **MM0002** "*Piping Standards*".

The primary support parts that are connected to the pipe (for example clamp) shall be same material grade as the pipe. Body of primary supports shall be painted carbon steel.

Secondary steel material shall be similar as the material of steel structure in which the secondary steel is connected.

Surface treatment shall be done according to the MM0004 "*Technical Specification for Surface Treatment and Painting-Metallic Surfaces*"

Piping shall be supported so that the pipes do not break or dislocate in any design or operation conditions or during hydrostatic pressure testing.

It is not allowed to weld supports on pipes. Stoppers on fix points can however be welded on the pipe, but the stoppers shall be the same material as the pipe.

Piping shall be supported so that when $DN \geq 150$ flanged valves or other flanged $DN \geq 150$ armatures are removed, the pipes do not have to be supported separately.

Piping shall be supported so that flanges of pumps, valves and other equipment are not significantly loaded due to piping.

Inspections of supports shall be documented.

5.3 Work Allowances

Taking required working allowances into account (e.g. installation tolerances of connecting equipment) is responsibility of the piping contractor.

5.4 Insulation

Piping insulation shall be implemented in compliance with the specification **MM0005**.

5.5 Surface treatment

Surface treatment of the metallic surfaces (including primary and secondary supports) shall be performed according to the specification **MM0004**.

5.6 Marking of Pipelines and Fittings

Valves and other pipe fittings shall be marked with stainless steel equipment position plate.

Pipelines shall be marked with pipeline codes, flow direction arrows, and colour codes.

Specific description how to mark pipelines, valves and other pipe fittings should follow the local mill instructions and specifications.

5.7 Allowed flow Velocities

5.7.1 Airs

	DN size	Velocity, m/s
Mill air	25 ... 200	10 ... 15
Instrument air	10 ... 25	5 ... 10
Instrument air	32 ... 200	10 ... 15
Conveying air	25 ... 200	5 ... 30
Vacuum air		10 ... 20

5.7.2 Water and pumped condensates

DN	≤25	40	50	65	80	100	125	150	200
v (m/s)	0.8	1.0	1.4	1.5	1.6	1.7	2.0	2.5	2.8
v_{max} (m/s)	2.0	2.0	2.5	2.5	2.5	3.0	3.0	3.5	3.8

DN	250	300	350	400	450	500	600	700	800	1000	1200
v (m/s)	3.2	3.4	3.6	3.8	4.0	4.2	4.2	4.7	5.0	5.0	5.2
v_{max} (m/s)	4.0	4.0	4.5	4.5	4.5	5.0	5.0	5.5	5.5	5.8	5.8

In cases where the pressure loss is not determinant such as short branch pipe lines that do not have an effect on the dimensioning of a pump head, velocities up to v_{max} values given in Table above can be used.

Lower velocities than presented in Table above are usually used for pumped condensates. In normal cases the velocities are about 70 % of the velocity given in the Table above. For longer pipelines the pipe sizes shall be designed case by case to avoid flashing in condensate pipelines.

Bigger DN sizes shall be designed case by case taking into account the actual flow conditions, geometry of piping etc.

5.7.3 Steams

Steam / DN	25	40	50	65	80	100	125	150	200	250
Saturated low pressure steam, p<5 bar	15	20	22	25	28	30	30	30	30	30
Saturated medium pressure steam, p=5...16 bar	15	20	22	25	28	30	30	30	30	35
Saturated high pressure steam, p>40 bar	15	20	22	25	28	30	30	30	35	35

Steam / DN	300	350	400	450	500	600	700	800	1000	1200
Saturated low pressure steam, p<5 bar	30	35	35	35	35	35	35	35	40	40
Saturated medium pressure steam, p=5...16 bar	35	35	35	35	35	35	40	40	45	
Saturated high pressure steam, p>40 bar	40	40	45	50	50	55	55	55	60	

5.7.4 Acids

The recommended flow velocities for acids in general are 1...2 m/s, except for Sulphuric acid the velocity shall be < 1.5 m/s and for Hydrochloric acid 1...1.5 m/s.

5.7.5 Alkalis

Sodium hydroxide	0.5...1.2 m/s
White liquor	0.5...1 m/s
Green liquor	2.5...3.0 m/s
Weak black liquor	1.0...2.0 m/s
Intermediate black liquor	1.0...1.5 m/s
Strong black liquor	0.8...1.2 m/s
Soft soap	0.5...0.8 m/s
Lime mud, lime filtrate, scrubber dregs, green liquor dregs, sodium sulphate	1.0...1.5 m/s

5.7.6 Pulp

Pulp consistency / DN	50	65	80	100	125	150	200	250	300	350	400	450	500	600	700	800	1000
c=1%																	
v	1.0	1.1	1.4	1.7	1.8	2.3	2.5	2.8	3.0	3.2	3.2	3.5	3.7	3.9	4.0	4.0	4.2
v _{max}	2.5	2.5	2.5	3.0	3.0	3.0	3.5	3.5	4.0	4.0	4.0	4.5	4.5	5.0	5.0	5.5	5.5
c=1.5%																	
v	1.0	1.1	1.2	1.6	1.7	2.0	2.5	2.8	3.0	3.1	3.2	3.4	3.5	3.7	3.9	4.0	4.0
v _{max}	2.5	2.5	2.5	3.0	3.0	3.0	3.5	3.5	3.5	3.5	4.0	4.0	4.0	4.5	4.5	5.0	5.1
c=2.0%																	
v	0.8	1.0	1.1	1.2	1.4	1.7	2.0	2.5	3.8	3.0	3.0	3.2	3.2	3.5	3.6	3.8	3.8
c=2.5%																	
v	0.8	0.8	1.0	1.0	1.1	1.2	1.7	2.0	2.5	2.8	2.8	3.0	3.0	3.0	3.4	3.5	3.6
c=3.0%																	
v	0.8	0.8	0.8	1.0	1.0	1.2	1.3	1.5	1.8	2.0	2.2	2.3	2.5	2.8	3.0	3.4	3.4
c=3.5%																	
v	0.7	0.7	0.7	0.8	0.9	1.0	1.0	1.2	1.4	1.6	1.8	2.0	2.3	2.5	2.8	3.0	3.2
c=4.0%																	
v		0.6	0.7	0.7	0.7	0.8	1.0	1.0	1.2	1.5	1.6	1.7	2.0	2.2	2.2	2.5	2.6
c=5.0%																	
v			0.5	0.5	0.6	0.7	0.7	0.8	1.0	1.2	1.5	1.5	1.7	2.0	2.0	2.2	2.3
c=6.0%																	
v				0.5	0.5	0.6	0.6	0.7	0.8	1.0	1.2	1.5	1.5	1.7	2.0	2.0	2.1
c=7.0%																	
v					0.5	0.6	0.6	0.7	0.7	0.8	0.8	1.0	1.0	1.2	1.5	1.5	1.7
c=8.0%																	
v						0.4	0.5	0.6	0.6	0.7	0.7	0.8	0.8	1.0	1.0	1.2	1.2

6 Welding

This section shall be applied on all welding of metallic piping and primary supports.

Temporary attachments shall be of the same material as the material they are welded to. Temporary attachments shall be removed by grinding (tear off and bending out are forbidden) after welding and the surface shall be ground smooth. For non-austenitic materials (including austenitic-ferritic stainless steels) the ground sections shall be surface inspected (MT/PT).

The Manufacturer shall have an accredited quality system covering the manufacturing according to **EN ISO 3834-2**.

The Manufacturer shall supervise all welding activities. Intermittent welds are not permitted, unless they have been defined in the drawings, and all welds shall be marked according to applicable standards. Minimum requirement of the certification of the welding coordinator shall be EWT/IWT.

The welders shall mark their identification codes beside the welds in a permanent manner.

Parts that can be damaged during welding (such as seals of valves) shall be removed or protected according to the manufacturer instructions before welding. The imperfections found in weld inspections shall be handled according to EN 13480-5 chapter 8.1.3. In addition to this, the Supplier maximum failure rate, calculated as percentage of all volumetrically tested welds per system completion, shall be 10%. The maximum failure rate per welder is 7%. The Supplier is responsible for following and documenting the failure rate of all welds, by batch

and by welder. If the welder exceeds the maximum failure rate the welder is not allowed to continue work. Penalty for exceeding the Supplier maximum failure rate is subject to commercial Contract.

6.1 Welding Procedures

Welding procedure specifications (WPS) according to **EN ISO 15609** shall be used in all welding, and they shall be qualified with applicable **EN ISO 15614** welding procedure qualification records (WPQR). EN ISO 15614-1, Level 2 is only acceptable.

When pulse welding is used, manufacturer of the welding equipment and waveform control method shall be recorded to the WPQR together with other relevant information.

6.2 Welding Conditions

Welding shall be performed in a suitable environment considering the welding process. Equipment related to welding shall be serviced, inspected and measurement devices calibrated yearly. The latest validation date shall be attached to the machine (e.g. by a sticker). These actions shall be documented so 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 with them when performing welding. The Supplier shall have equipment required to supervise that the welding is performed according to the WPS. The Supplier shall make verifiable supervision for the welding. The supervision shall include ensuring, that the welding parameters and conditions (e.g. interpass temperatures) are according to the WPS. Measurements of interpass temperatures shall be performed with a contact thermometer.

6.3 Welding Plan

The Supplier shall deliver a detailed welding plan to the Purchaser, including details about location of the welds, groove shapes, base materials, filler materials and protective gases (including backing gas when applicable), WPS, and pre heating and post weld heat treatments. The welding plan shall be reviewed by the Purchaser but reviewing does not relieve the Manufacturer or the Supplier of any of their responsibility of the welding.

6.4 Welding Personnel

Welding personnel for main items shall have the following qualifications and welders shall be approved by the Notified Body (when required by PED):

- welders according EN ISO 9606
- welding operators according to EN ISO 14732
- welding co-ordinators according to EN ISO 14731

The manufacturer shall hand over a list of welders to the Purchaser with the following information:

- welder's name and identification sign
- welding process
- welding positions
- base material and dimensions
- range of approval for the welder
- expiration date of the qualification test

If a welder cannot perform the work with the required quality, the Purchaser has the right to stop his work. In such case, the Supplier is responsible of replacing the welder with a proficient one.

6.5 Welding Processes

Welding processes shall be suitable for the base material. Root welds of stainless steels shall be reasonably flush and join smoothly to the base material.

Welding process 141 (TIG/GTAW) shall be used on:

- welding of thin austenitic materials (wall thickness less than 3 mm)
 - use of welding process 142 is also allowed
- root passes of all welds

6.6 Welding Filler Materials

Welding fillers shall be marked clearly. All welding fillers that cannot be identified, shall be disposed of immediately. Welding consumables shall be stored in a dry place, and the welders shall have the equipment required for drying the fillers, or for keeping them dry. Temperature and moisture shall be measured of the welding filler warehousing area twice a day. The results shall be recorded. A record shall be kept of the handed over welding fillers. The handing over record shall contain the filler heat number, welder name, date and the handed over amount.

Welding electrodes shall be warehoused in temperatures and humidity conditions according to the instruction's manufacturer of the electrodes. Suitability of the environment shall be supervised. The welders shall have access to drying equipment for pre drying the electrodes in their daily work.

All fillers shall be according to qualified WPSs and be suitable to the base material. The mechanical properties shall be at least equivalent to the base material.

Suitable over-alloyed or nickel-based fillers shall be used in dissimilar metal welds.

Welding fillers shall be type approved. The material certificates shall be according to Section 8.4.

6.7 Shielding Gas

The shielding gases and backing gases shall be according to the WPSs. The flow of the gases shall be defined in the WPS.

Using of root gas for stainless materials is defined in Section 6.8.

6.8 Welding of Stainless Materials

Following shall be followed on welding of stainless materials:

- Parameters of WPS shall be chosen to minimize heat input (risk of sensitization or, on highly alloyed variants, risk of embrittling phases)
- Interpass temperature shall be less than 150 °C on austenitic stainless steels
- Interpass temperature shall be less than 120 °C on highly alloyed austenitic stainless steels
- Interpass temperature shall be less than 150 °C on austenitic-ferritic ("duplex") stainless steels

- Interpass temperature shall be less than 120 °C on highly alloyed austenitic-ferritic ("super duplex") stainless steels
- Phase content determination on WPQR's when material is duplex or super duplex. Ferrite content shall be 35-65 %.
- Preheating is not allowed
- Oversized electrodes are not allowed

Amount of repair welds is limited on stainless steels. Two repair welds are allowed. If more repairs are required, at least the weld material, heat affected zones (HAZ) and 20 mm of the pipe shall be removed to both directions.

Stainless steels shall be protected from contamination (being touched by carbon- 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 after welding mechanically and/or by pickling. The welds shall be free of oxidation, discolouration and slag after the cleaning.

All stainless materials shall be welded with internal root gas purge. Dams (rubber or collapsible disc barriers) shall be used to ensure root gas protects the root weld adequately. Use of backing paste is not allowed.

The purging gas shall be used to rinse the pipe with a volume of at least ten times the delimited pipe volume before welding. The O₂ level within the piping component shall be at maximum 35 ppm for Argon root gas, and 100 ppm for N₂ root gas. **FORCE Technology report 94.34 "Reference charts – for purity of purging gas in stainless steel tubes"** can be used to estimate the sufficiency of the purging.

6.9 Grounding

Grounding shall be done with clamps connected directly to the welding piece. The current may not run through machines or pressure accessories such as valves. The Supplier is responsible for damages caused by welding current, when grounding is connected improperly.

6.10 Quality of Welding and Acceptance Levels

All pressure bearing welds shall have full penetration, and no undercut is allowed. Welding quality level shall be at least according to **EN ISO 5817** level B, unless this specification, enquiry documents or manufacturing standard requires more stringent criteria. If the weld does not fulfil the requirements, it shall be repaired and re-inspected at the cost of Supplier, and additional inspections made as required by **EN 13480-5** and Purchaser specifications.

6.11 Heat Treatments / Post Weld Heat Treatments

Heat treatments shall be performed, when required by **EN 13480-4**, a qualified WPS, this specification or other enquiry documents. The heat treatments shall be performed following **EN 13480-4**, the qualified WPS and an approved heat treatment procedure.

Only electronic heating devices are accepted. Flame heating of materials is not allowed.

Temperature of the welds shall be monitored during the heat treatments with instruments having a recording function. The instruments shall be based on thermocouples. The time-temperature curves shall be provided also in electronic form. Scanned pdf files are acceptable as electronic form for instruments equipped with a paper plotter.

Pre heating shall be applied, when it is defined in the WPS, and pre heating temperature shall also be monitored. When nominal maximum composition of chrome of a ferritic material is over 1 %, the monitoring shall be performed with thermocouples.

When interpass temperature is limited, the temperature shall be measured after each pass with a contact thermometer or thermocouples.

Outdoors and indoors in unheated environment, all welding grooves shall be dried prior to the welding with proper equipment. When interpass temperature is limited, the temperature shall be measured with a contact thermometer after each pass.

All instruments and heat treatment equipment shall have been calibrated within the last year.

7 Inspections, Testing, and Quality Control

All inspections and testing shall fulfil both the requirements of **EN 13480-5** and additional requirements of this specification. The Supplier shall be responsible of all Notified Body (NoBo) approvals and inspections of their delivery at their own cost. The Supplier shall also be responsible of all inspections and tests required by manufacturing standards, this specification and enquiry documents.

The inspection scope, if more stringent requirements are not specified within the enquiry specification or enquiry documents, shall be according to **EN 13480-5**. Minimum inspection and testing scope of 4.3 piping containing hazardous chemicals shall be equivalent to the scope of PED category I piping.

Acceptance criteria for non-destructive testing shall be according to welding class by applying standard **EN ISO 17635**.

The Supplier is responsible for the quality control of their delivery, including inspections. The Supplier shall arrange free access for the Purchaser or their representative to the production and warehousing sites for Supplier's own quality control purposes and for witnessing of inspections, and the Purchaser shall have access to manufacturing, inspection and QA/QC documentation. The Purchaser reserves the right to, at their own cost, have extra inspections performed on the parts of the delivery in Supplier's premises, and to verify results previously performed. The Supplier is responsible of repairing defects exceeding the acceptance criteria that are found in additional inspections, without additional expense to the Purchaser.

In the delivery schedule, the Supplier shall present the date of inspections, and shall inform the Purchaser 7 working days for final inspection and 5 working days for NDT volumetric inspections or hold / witness points. The Supplier shall present an inspection and testing plan (ITP) and a quality plan to the Purchaser for approval before start of the pre-fabrication or assembly. The participation of the Purchaser and Notified Body shall be agreed on and marked on their respective columns within the ITP at each stage of the manufacturing (witness & hold points).

If disassembly of a finished construction is required to reveal a defect, and a defect is found after disassembly, the Supplier is responsible for all costs caused by the disassembly.

No action explained in this specification will relieve the Supplier of their responsibility of fulfilling requirements related to quality and time schedule.

Inspections shall be performed after heat treatments, if heat treatments are required. All inspection reports shall be included in the final documentation.

The inspection methods are abbreviated in this specification according to **EN 17635:2016** Table 1.

Acceptance criteria are listed in the following Table:

Method	Visual Inspection (VT)	Penetrant Testing (PT)	Magnetic Particle Testing (MT)	Radiographic Testing (RT)	Ultrasonic Testing (UT)	Time of flight diffraction Technique (TOFD)	Phased array ultrasonic technique (PAUT)
Inspection procedure	EN 17637	EN ISO 3452-1	EN ISO 17638	-	-	-	-
Acceptance criteria	EN ISO 5817 Quality level B	EN ISO 23277 Acceptance level 2X.	EN ISO 23278 Acceptance level 2X.	EN ISO 10675-1 Acceptance level 1, Quality Level B per ISO 5817	EN ISO 11666 Acceptance level 2 for Quality Level B	EN ISO 15626 Acceptance level 1 for Quality Level B	EN ISO 19285 Acceptance level 2 for Quality Level B
Radiographic techniques	-	-	-	EN ISO 17636-1 – Class B:	-	-	-
Testing technique and level	-	-	-	-	EN ISO 17640	EN ISO 10863	EN ISO 13588

					at least B for Quality Level B	C for Quality Level B	B for Quality Level B
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7.1 Inspection Personnel

NDT personnel (excluding VT personnel) shall be qualified according to **EN ISO 9712**, minimum level 2. VT personnel shall be qualified according to EN ISO 9712, minimum level 1. The inspection agency shall have an accredited quality system.

7.2 Inspection Scope

Minimum requirements of **EN 13480-5** for inspections and tests shall be fulfilled.

The percentages defined in this specification correspond to the number of welds required to be inspected. All welds within the inspection scope shall be inspected completely.

Inspection scopes shall be defined separately for prefabrications and field welds.

The inspected welds shall be random and shall represent a weld group. A weld group is a group of welds having the same welder/welding operator and a specific WPS.

Hydrostatic pressure test shall be done according to EN 13480-5. Replacement of a hydrostatic pressure test requires a written permission of the Purchaser.

Pneumatic pressure test shall be avoided due to safety reasons, if needed anyway the application of pneumatic pressure test must be signed by in written form at least Mondi Safety manager, Mondi Welding or NDT manager and supplier Project manager.

7.2.1 PED Classified Piping

This section applies to PED Category I-III piping.

Inspection scope:

- the minimum scope of EN 13480-5 shall be fulfilled
- pressure test according to requirements of PED

7.2.2 Piping according PED article 4 chapter 3 ("4.3")

Non-chemical piping falling under PED article 4 section 3 (constructed according to sound engineering practice), unless otherwise separately defined, shall be inspected as follows:

- RT minimum scope is 2 %
- the minimum scope of EN 13480-5 for category 0 ("4.3 piping") shall be fulfilled
- a hydrostatic pressure test shall be performed according to requirements of EN 13480-5
- a tightness test with operating pressure is not an acceptable replacement for the hydrostatic pressure test without a written permission of the Purchaser

7.2.3 Piping with Hazardous Contents (Chemical Piping)

PED category I-III chemical piping shall fulfil the inspection and testing requirements set for the PED category in **EN 13480-5**.

4.3 chemical piping shall fulfil the requirements set for PED category I in **EN 13480-5**. A hydrostatic pressure test shall be performed for chemical piping as for PED category I piping.

7.3 Piping Components Not According to Pipe Classes

If there is a need to deviate from the specified standards and their components, at least the following requirements shall be followed:

- materials of harmonized material standards for pressure purposes shall be used. Material thickness shall not be less than the thickness defined for the specified pipe class
- requirements of **EN 13480** shall always be fulfilled
- welding requirements and instructions in section 6 shall be applied
- root pass shall always be made with the welding process 141 (TIG/GTAW)
- the welding procedure specifications and qualification record shall be according to the standards series **EN ISO 15609** and **EN ISO 15614**
- the welders and welding operators shall be qualified according to standards **EN ISO 9606** (applicable part) and **EN ISO 14732**, respectively.
NDT requirements:
 - qualification requirements of personnel according to section 7.1
 - 10% RT/UT including any weld intersections (longitudinal welds of header and branch pipes in T-pieces always 100% RT/UT),
 - 100% PT/MT and 100% VT.
 - the acceptance levels are VT: **EN ISO 5817** level C, PT: **EN ISO 23277** level 2x, RT: **EN ISO 10675** level 2, UT: **EN ISO 11666** level 3
 - heat treatments required after forming according to **EN 13480-4**.
 - dimensions and tolerances according to the component standard in the pipe class. The actual dimensions shall be reported.
 - possible adjustments and repairs must be approved beforehand by the client.
 - all documentation shall be according to PED **2014/68/EU Guideline G-19** - documentation shall be as if the component was minimum PED I, or actual PED class if it is higher. Material certificates shall be according to section 8.4
 - all components shall be designated showing the pipeline number, component number and the pipe class for identification.

7.4 Inspection Diagram

Performed NDT shall be traceable with the welding log and welding map.

8 Documentation

The documentation is an essential part of the supply. The Supplier is responsible of ensuring all documentation is correct and included. The supplied documents may also be reviewed by the Purchaser.

The document language shall be English or local language, unless otherwise agreed. The units shall be according to the SI system. Operation-, maintenance and training documentation shall be delivered in local language.

The manufacturing documentation, WPQRs, WPSs and material certificates shall be available two weeks before start of manufacturing. These documents shall be delivered to the Purchaser at latest at that time. Possible particular material appraisals (PMA) shall be included but use of non-harmonized materials requires separate approval of the Purchaser.

Manufacturing documentation to be included in the final documentation shall include (but is not limited to):

- basis of design
- general description of pressure equipment
- manufacturing drawings
- pipeline list
- material lists
- material certificates according to section 8.4.
- design inspection certificates when required
- design calculations
- stress analysis
- EC-design review documents
- manufacturing information, WPSs, WPQRs, and heat treatment certificates
- Inspection and testing plans
- inspection and NDT reports and inspection diagrams
- heat treatment certificates and heat treatment equipment calibration certificates
- pressure test certificates (for pressure accessories)
- instructions for pressure test
- EU declaration of conformity (complete CE marked piping and CE-marked accessories and equipment)
- certificate of conformity when required
- manufacturer's declaration of conformity for 4.3 piping
- declarations of conformities of sub-suppliers for their scopes
- welding log
- marking requirements
- risk assessments when required
- training documentation
- installation, operating and service manuals

The documentation shall be provided as a physical set of quality control book with cardboard dividers. Additionally, the quality control book shall be delivered as an electronic file in .pdf format, which includes electronic bookmarks for each main section described before. Also local mill requirements for documentation shall be taken into account and editable format e.g. Word, Excel shall be delivered when required. The final documentation shall also contain the drawings in native formats. The index page and arrangement of the folders in the piping quality control book shall follow Appendix I of this specification.

8.1 Piping Isometrics

At least the following information shall be included in the piping isometrics in the design phase:

- Line address (from – to)
- Content
- Pipe class
- PED/chemical group
- PED category
- Insulation class
- Design parameters (pressure / temperature)
- Operation parameters (pressure / temperature)
- Pipe line parts with dimensions
- Applied quality and dimensional standards
- Quantities
- Structural materials
- Requested scope of NDT
- Pressure test parameters

8.2 Welding Log

The Supplier shall ensure, that a welding log is kept up to date during manufacturing. Welding log shall contain at least used WPS & WPQR, welder's identification, weld number, visual testing acceptance, and NDT results (and possible re-examinations, and number of resulting penalty inspections), and heat numbers of piping components.

The welding log shall contain at least the following information:

- Row No.:
- Weld No.:
- Pipeline No.:
- Isometric. No.:
- Sheet no.:
- Weld type:
- Diameter:
- Wall Thickness:
- Material type no.1
- Heat number:
- Material certificate number:
- Material type no.2
- Heat number:
- Material certificate number:
- Welding Process
- WPQR
- WPS
- Welding Consumable
- Welder:
- Welding Date:
- Inspection Report no.:
 - o VT
 - o PT
 - o RT
 - o UT
- Inspection result: [Acc / Rej]
- Defect length:
- Notes:

8.3 Documentation of Valves and Other Pressure Accessories

The Supplier shall provide information of the pressure accessories separately for each line. The information shall contain at least:

- Position number
- Nominal diameter (DN)
- Nominal pressure (PN)
- Manufacturer's type code
- Rated values (pressure & temperature)
- structural material standards and grades
- identification numbers of material certificates
- pressure / tightness test certificate numbers

The following shall also be supplied for pressure accessories

- EU declaration of conformity (CE marked pressurized accessories)
- Installation, operation and maintenance manuals
- Material certificates according to section 8.3
- ATEX certification in accordance with directive 2014/34/EU for electric appliances in

- ATEX areas
- A declaration that the accessory is suitable for service in ATEX environment, if the accessory is used in such environment (e.g. valves)
- Fire-safe certification if required by the service

8.4 Material Certificates

The requirements of this section apply to both CE marked and non-CE marked piping, and to their parts if other way haven't specified in piping standard or purchasing documentation. Certificate **EN ISO 9001** is mandatory for material manufacturers..

A higher material certificate (e.g. **EN 10204** type **3.1** instead of type **2.2**) is acceptable.

8.4.1 Piping Components

Main pressure bearing components shall have material certificates according to **EN 10204** type **3.1**. Non main pressure bearing metallic parts of the piping shall have material certificates according to **EN 10204** type **2.2**.

8.4.2 Bolt, Studs and Nuts

Material certificates of metallic seals, studs, nuts, and bolts shall be according to **EN 10204** type **2.2**.

8.4.3 Gaskets

Material certificates of metallic gaskets shall be according to **EN 10204** type **2.2**. **EN 10204** type **2.1** certificates shall be provided for non-metallic parts and gaskets.

8.4.4 Valves and Other Pressure Accessories

Main pressure bearing components of piping accessories shall have material certificates according to **EN 10204** type **3.1**. Main pressure bearing components of piping accessories in **PED** categories 0 (SEP) and I shall have material certificates according to at least **EN 10204** type **2.2**.

Material certificates of metallic seals, studs, nuts, bolts, obturator and stem shall be according to **EN 10204** type **2.2**. **EN 10204** type **2.1** certificates shall be provided for non-metallic parts and gaskets.

8.4.5 Safety Accessories

Valves classified as safety accessories (e.g. pressure relieve valves) shall fulfil requirements of PED (including essential safety requirements), and be CE marked. Safety relieve valves and other safety accessories shall fulfil the requirements of **EN ISO 4126** (applicable part). Safety devices shall have material certificates according to **EN 10204** type **3.1** for main pressure bearing parts.

Material certificates of metallic seals, studs, nuts, bolts, obturator, spring and stem shall be according to **EN 10204** type **2.2**. **EN 10204** type **2.1** certificates shall be provided for non-metallic parts and gaskets.

8.4.6 Welding Fillers

Material certificates of welding fillers shall be according to **EN 10204** type **3.1**.

8.4.7 Primary Supports

Material certificates of primary supports shall be according to requirements of **EN 13480-3** Appendix N Table N.1.