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04-Piping
Mechanical Piping and Fittings

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This standard technical description is subject to change without prior notice. The most current issue will at all times be located on the Norðurál web site, www.nordural.is.

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1 Responsibility

This Standard Technical Specification (STS) is of responsibility of the Owner. The revision and date of issue is on the front page.

All deviations from the specifications must be approved in writing by the Owner.

2 Scope and field of application

2.1 Scope Definition

This Standard Technical Specification details the minimum technical requirements including but not limited to, the design, material quality and workmanship, installation, testing, inspection and identification of piping made for black steel, stainless steel, HDPE, and chlorinated high density polyvinyl.

The provision of this Standard Technical Specification applies to the production area of Norðurál aluminum smelter.

2.2 Document Conflicts

Any conflicts between the referenced documents shall be brought to the attention of the Owner without delay and in writing for resolution.

3 References and Definitions

3.1 References

All equipment, materials, workmanship, design calculation and tests shall be performed in compliance and read in conjunction with the NA-00-ST5001, *General Standard Technical Specification* and other relevant standards.

The relevance order of standards shall be according to NA-00-ST5001.

Norðurál Standard Technical Specifications can be accessed on Norðurál website, www.nordural.is/islenska/fyrirtaekid/innkaup/stadlar.

The following referenced documents should be considered for the application of this document. For dated references, only the edition cited applies. For all references, dated and undated, the latest edition of the referenced document (including any amendments) applies.

Standard Reference	Name/Subject
Directive: 2014/68/EU	Pressure Equipment
EN 13480:2012, Metallic industrial piping	Part 1: General
	Part 2: Materials
	Part 3: Design and calculation
	Part 4: Fabrication and installation
	Part 5: Inspection and testing
	Part 6: Additional requirements for buried piping
	Part 7: Guidance on the use of conformity assessment procedures
	Part 8: Additional requirements for aluminum and aluminum alloy piping
NA-03-ST5001	Surface treatment and painting
NA-06-ST5002	Specification for LOTOV
IST EN ISO 5817:2003	Welding. Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded). Quality levels for imperfections
ÍST EN ISO 12100:2010	Safety of machinery – General principles for design, risk assessment and risk reduction
ÍST EN ISO 13849, Safety of machinery Safety-related parts of control systems	Part 1: General principles for design and 2 Safety of Machinery – Safety-related parts of control systems: 2015, Part 2: Validation: 2012
ÍST EN 10204: 2004	Metallic Products – Types of inspection documents

ÍST EN 558:2017	Industrial valves - Face-to-face and center-to-face dimensions of metal valves for use in flanged pipe systems - PN and Class designated valves
ÍST EN 10220:2002	Seamless and welded steel tubes – Dimension and masses per unit length
ÍST EN 764-1:2014	Pressure equipment – Part 1: Terminology – Pressure, temperature, volume, nominal size
ÍST EN 1092-1:2007+A1:2013	Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 1: Steel flanges
NFPA 30:2018	Flammable and Combustible Code (2015 edition)
NFPA 77:2014	Recommended Practice of Static Electricity (2014 edition)
ÍST EN ISO 3834-3:2005	Quality requirements for fusion welding of metallic materials - Part 3: Standard quality requirements
ÍST EN ISO 9606-1:2013	Qualification testing of welders - Fusion welding - Part 1: Steels
IEC 62395-2:2013 ÍST EN 62395-2:2013	Electrical resistance trace heating systems for industrial and commercial applications - Part 2: Application guide for system design, installation and maintenance
IEC 60079-0:2011 ÍST EN 60079-0:2012	Explosive atmospheres – All parts
ÍST EN 10216:2013 – Seamless steel tubes for pressure purposes - Technical delivery conditions	Part 1: Non-alloy steel tubes with specified room temperature properties
	Part 2: Non-alloy and alloy steels tubes with specified elevated temperature properties
	Part 3: Alloy fine grain steel tubes
	Part 4: Non-alloy and alloy steel tubes with specified low temperature properties
	Part 5: Stainless steel tubes
ÍST EN 10217 – Welded steel tubes for pressure purposes - Technical delivery conditions	Part 1: Non-alloy steel tubes with specified room temperature properties
	Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties.
	Part 3: Alloy fine grain steel tubes.
	Part 4: Electric welded non-alloy and alloy steel tubes with specified low temperature properties
	Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties.
	Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties.
	Part 7: Stainless steel tubes.
IST EN 10084:2008	Case hardening steels - Technical delivery conditions
ÍST EN 10224:2002	Non-alloy steel tubes and fittings for the conveyance of water and other aqueous liquids - Technical delivery conditions
ÍST EN 10255:2004+A1:2007	Non-Alloy steel tubes suitable for welding and threading - Technical delivery conditions.
ÍST EN 10210-1:2006	Hot finished structural hollow sections of non-alloy and fine grain steels - Part 1: Technical delivery conditions
ÍST EN 10253-1:1999	Butt-welding pipe fittings - Part 1: Wrought carbon steel for general use and without specific inspection requirements
ÍST EN 10253-2:2007	Butt-welding pipe fittings - Part 2: Non-alloy and ferritic alloy steels with specific inspection requirements
ÍST EN 10256:2000	Non-destructive testing of steel tubes - Qualification and competence of levels 1 and 2 non-destructive testing personnel
ÍST EN 10294-1:2005	Hollow bars for machining - Technical delivery conditions - Part 1: Non-alloy and alloy steels
ÍST EN 10297-1:2003	Seamless circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 1: Non-alloy and alloy steel tubes
IST EN 10253-2:2008-09	Butt-welding pipe fittings - Part 2: Non-alloy and ferritic alloy steels with specific inspection requirements
DIN EN 10253-4:2008-06	Butt-welding pipe fittings - Part 4: Wrought austenitic and austenitic-ferritic (duplex) stainless steels with specific inspection requirements.
BS EN ISO 17637:2011	Non-destructive testing of welds. Visual testing of fusion-welded joints.
ÍST IEC 60079-30-2:2007	Explosive atmospheres - Part 30-2: Electrical resistance trace heating - Application guide for design, installation and maintenance
ÍST IEC 62395	Electrical resistance trace heating systems for industrial and commercial applications - Part 1: General and testing requirements
IST 200:2006	Electrical Installation of Buildings

EN 89/655/EEC	Council Directive Concerning the minimum safety and health requirements for the use of work equipment by workers at work
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3.2 Abbreviations

- AKS Aluminum Kennzeichen System
- EN European Norm (CEN)

3.3 CE Marking

Pressure equipment, including pipes of certain dimension and assemblies should, generally, bear the CE marking. General principles governing the CE marking and its relationship to other markings are set out in Regulation (EC) No 765/2008, Article 30.

The Vendor shall investigate the requirement for CE marking for design, manufacture and conformity assessment when maximum allowable pressure exceeds 0,5 bar.

NA-00-ST5001 General Standard Technical Specification

3.4 Permits

The Vendor shall obtain all permits and inspections required by building ordinances and any legal body having jurisdiction.

4 Piping - Design, Fabrication and Installation Requirements

4.1 General requirements

Refer to ÍST EN 13840-4:2012, Chapter 5.

4.2 Pipes Identification

All piped services shall be permanently identified by means of painted bands and letters. Where the pipe diameter is not sufficient to allow the printing to be fully visible, tags shall be used. The colour chosen for each pipeline shall be in accordance with Standard Technical Specification for NA-03-ST5001- *Surface treatment and painting*.

Identification bands shall be applied adjacent to all valves, at intervals of not more than 15 m along all pipe runs and on both sides of each wall or partition.

4.3 Valve Tags

Provide all valves with permanent 50 mm brass or stainless steel identity tags attached with rings.

Stencil valve identification on tags with 10 mm stencils.

Identify all valves with its service (fluid) designation. Add valve numbers in the special cases where such numbers are shown on the drawings.

Date, together with any other information that will assist future maintenance and the purchase of spare parts. Labels shall be attached to the valve handle or stem.

The numbers on the valve labels shall refer to those on the record "As fitted" drawings and the valve charts.

VALVE SIZE	LABEL SIZE	LETTERING
15 mm (1/2") to 50 mm (2")	35 mm (1 3/8") x 70 mm (2 3/4")	5 mm (3/16")
80 mm (3") to 100 mm (4")	57 mm (2 1/4") x 114 mm (4 1/2")	10 mm (3/8")
150 mm (6") & above	76 mm (3") x 152 mm (6")	13 mm (1/2")

4.4 Paint and Corrosion Protection

Consult Standard Technical Specification, NA-03-ST500 - Surface Treatment and Painting

4.5 Connections to Existing Equipment – Tie-In

When connections must be made to existing piping systems of an operating plant, prior explicit approval from the Owner shall be obtained.

4.6 Field Run Piping

Shall be field run according to ÍST EN 13480-4, Chapter 8.2. Pipes which are field run shall typically not be larger than DN50.

4.7 Pipe Clearances and Safety Clearances

Piping around pumps, heat exchangers and other process equipment shall be laid out according to IST EN 349:1993+A1:2008 and IST EN ISO 13857:2008-06. Clear passage shall never be less than 760 mm.

Minimum clearance between adjacent underground piping, including insulation cladding, shall be according to IST EN 13480-6: but never less than 100 mm.

Underground pipes shall not be closer than 400 mm to foundation and sewage piping shall always be lower than adjacent piping.

4.8 Accessibility

Appurtenances shall be designed so that valve wheels and bolted flanges and connections are freely accessible. Where needed fixed platform shall be installed to access valves. If dismantling adjacent parts is necessary to access these parts and components is necessary, the accessibility will be deemed inadequate and shall be subject to disapproval from the Owner.

4.9 Drawing requirements – preparation and submittals

Refer to Norðurál's standard: NA-00-ST5002

4.10 Installation and Marking and Final Documentation

For installation, refer to ÍST EN ISO 13480-4:2012, Chapter 8.

After design, fabrication and install, final documentation shall be compiled in accordance with ÍST EN 13480-5:2012, 9.5.

4.11 Cleaning

Refer to ÍST EN 13480-4:2012, Chapter 12.1

4.12 Inspection and Testing

In general, the requirements of ÍST EN 13480-5 shall be laid down as basis for inspection and testing.

4.13 Anchor Bolts - Fixing

Refer to ÍST EN 13480-3, Chapter 13.5.6, Annex K, and Annex M.

4.14 Foundations

Refer to Norðurál's standard: NA-02-ST5002 "Concrete Work".

4.15 Material records

The Vendor, whence material certificate is sourced shall produce and submit as a minimum a

type 3.1 Certificate, according to ÍST EN 10204, Chapter 4.

4.16 Valves – General

Valves must be adequately supported with pipe hangers, etc. to prevent additional loading on the valve body as per IST EN 13480-3. Follow the recommendations in the following tables:

4.16.1 Valves for process fluids

VALVE SIZE DN	PRESSURE RATING	CONNECTION
15 (½") to 40 (1½")	40 bar	Screwed
50 (2") to 250 (6")	16 bar	Flanged

4.16.2 Valves for Compressed air piping:

VALVE SIZE DN	PRESSURE RATING	TYPE	CONNECTION
15 to 40	40 bar	Ball valve	Screwed
50 to 250	16 bar	Gate valve	Flanged

Ball valves shall be 3-piece, forged carbon steel body, stainless steel (316) ball and trim, glass reinforced PTFE seats.

4.16.3 Valves for Potable water piping:

VALVE SIZE DN	PRESSURE RATING	TYPE	CONNECTION
15 to 40	40 bar	Ball valve	Screwed
50 to 200	16 bar	Gate valve	Flanged

4.16.4 Valves for Diesel Fuel and Fuel gas piping:

VALVE SIZE DN	PRESSURE RATING	TYPE	OPERATION	CONNECTION
15 to 40	40 bar	Ball valve	Wrench	Screwed
50 to 150	16 bar	Ball valve	Wrench	Flanged
200 to 250	16 bar	Ball valve	Gear	Flanged

4.16.5 LOTO requirements

Valves shall be fitted with Lock Out Tag Out (LOTO) devices to fulfill the requirements of EN 89/655/EEC, *Concerning the minimum safety and health requirements for the use of work equipment by workers at work*. EN 1037, Safety of machinery — Prevention of unexpected start-up.

4.16.6 Face-to-Face dimensions

Face-to-Face dimensions shall be according to ÍST EN 558:2017.

4.16.7 High point vents and drains

Piping for fluid media shall, as minimum, have DN15 high point vent and DN25 low point drain. Such connections shall be fitted with valves and safety plugs.

4.16.8 Pipe sizes

Pipe sizes shall be selected from IST EN 10220:2002

4.16.9 Odd Pipe Sizes

Do not use the following, steel pipe sizes, unless specifically called for on drawings or equipment connection size makes it necessary:

- DN32 (Ø42,16 mm or 1-1/4")
- DN45 (Ø51, 54 and 57 mm or 1-3/4")

- DN65 (Ø76,1 mm or 2-1/2")
- DN90 (Ø101,6 mm or 3-1/2")
- DN125 (Ø139,7 mm or 5")

Odd pipe sizes shall only be acceptable as an exception; and, providing there are no valves in the lines. Such pipes shall; however, be approved by the Engineer prior to installation.

5 Components of Pipes

5.1 Reducers

Reducers, eccentric and concentric, shall be according to IST EN 10253-2 and used for changes in pipe diameter. Whenever liquid will remain in drained pipes if concentric reducers would be installed eccentric reducers shall be used.

5.2 Elbows

Elbows shall be long radius (1,5xR or more if the fluid dynamics so requires) and according to EN 10253-2. Field bends shall not be accepted.

5.3 Flanges and Flange Connections.

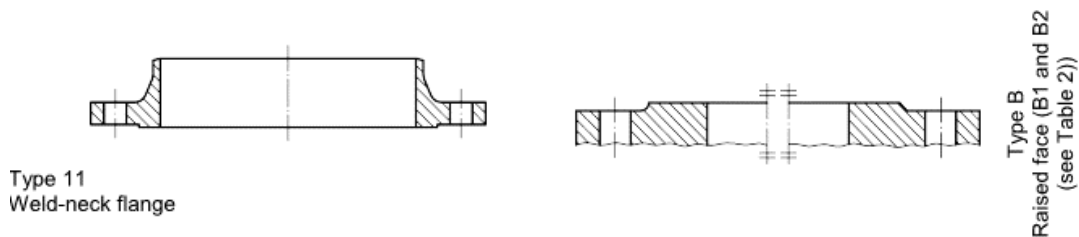
Allowable rating for flanges are:

- PN 6 - max pressure 6 bar
- PN 10 - max pressure 10 bar
- PN 16 - max pressure 16 bar

Material shall be forged steel according to EN 10025

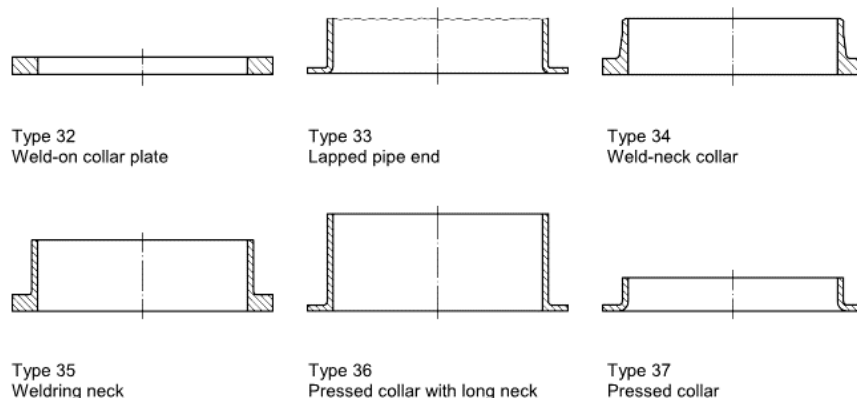
Pipes that are larger than DN50 shall be flanged. Flanges shall preferably be type ÍST EN 1092, Type 11, raised face (B).

Welded-neck rased face flange: IST EN 1092, type 11, rased face type B1



Type 11
Weld-neck flange

Two piece flanges (Flange and lose-flange): IST EN 1092, type 02, collar type 33, 34, 35, 36 or 37



Type 35
Weldring neck

Type 36
Pressed collar with long neck

Type 37
Pressed collar

NOTE These sketches are diagrammatic only.

Slip-on (Weld-on) flanges, IST EN 1092-1, type 32 (slip-on) may be used, subject to the approval of the Engineer. They are not preferred.

5.3.1 BOLTS FOR FLANGED CONNECTIONS

Bolts are carbon steel bolts to:

- ISO 898-1 minimum Class 8.8
- EN ISO 4017:2017, class 8.8

Nuts to:

- ISO 898-2 Class 8.
- EN ISO 4032, class 8

The bolts and nuts shall be corrosion protected to suite the environment they will be used in. Refer to ÍST EN 1591

5.3.2 GASKETS

Without exceptions, gaskets shall be **ASBESTOS FREE FIBER**.

Whenever electrical insulated connections are required, pre-manufactured electrical gasket are required and design approval of the Owner shall be sought. Maloney type (or equivalent) may be proposed.

5.4 Pipe Support Installation

Pipe support shall adhere to the requirements of ÍST EN 13480, Chapter 13 and Annex Q, Table Q1. In addition, vertical pipes shall be plumb and all lines in the same direction shall be parallel to each other.

During installation of all piping services, great care shall be taken to prevent any foreign matter entering the pipes. All open ends shall be temporarily capped or plugged with the appropriate pipefittings until the installation is completed. Wooden plugs and the like shall not be used.

5.5 Butt Welded Fittings

Bends, branches and reducers, 50 mm and larger for welding:

- Material P 195 TR1 to EN 10216-1
- Dimensions to IST EN 10253-2:2008-09
- Wall thickness, class 4 as per IST EN 10253-2, table 14.

5.6 Steel Threaded Fittings

All threaded steel fittings shall be according to EN 10241. Cast iron or malleable fittings is not allowed for the Engineering Services. Threads shall be according to ISO 7 (IST EN 10226-1).

5.7 Thread fittings

In general, thread fittings shall not be used, unless approved by the Owner. Only British Standard Parallel (BSPT) thread shall be used. Never should a NPT and BSPT be mixed as they will not seal properly.

5.8 Grounding and potential energy

Bond and grounding shall be provided for all pipes and piping carrying flammable or combustible materials.

NFPA 30, the Flammable and Combustible Code, 2015 edition and NFPA 77, Recommended Practice on Static Electricity may be laid down as basis for bonding and grounding design. However, Icelandic, laws, rules and regulations shall predominate the NFPA codes.

Careful consideration shall be given to pipes such as vacuum pipes which may build up static

electricity. These shall be full electrically grounded according to ÍST 200 (IEC 60364).

6 Testing

6.1 General

In general tests shall fulfill the requirements as specified in ÍST EN 13480-5:2002.

The Vendor shall furnish equipment such as: pumps, gauges, and material necessary for a conclusive test.

All tests shall be made in the presence of the Owner. And the Vendor shall notify the Owner within predetermined notification period; however, never shorter period than a one work week (seven days).

Note: Regulations may require officials to witness tests. Whence approval is sought from officials, they shall be notified with at least two working week notice.

The Vendor shall notify the Owner and government officials, when applicable, when any work is completed and ready for inspection and final test. On the satisfactory completion and final test of a completed system, a certificate of approval, signed by the witnessing parties, shall be issued to the Owner.

6.2 Reports

Reference is made to ÍST EN 13480-5, Chapter 8,5.

Once applicable tests as prescribed in ÍST EN 13480-5, Chapter 7 to 9. The manufacturer shall carry out a review of the manufacturing documents to verify that all applicable examinations and tests specified in clauses 7 to 9 have been satisfactorily performed and reported.

6.3 When validation is not required

Where the design of parts has already been validated in accordance with this European Standard, and where an appropriate certificate or assessment report is available, a further design validation shall not be required.

6.4 Preparation of System

The following items shall be isolated from the system prior to execution of tests:

- Expansion joints;
- Safety and relief valves (except those used to relieve thermal expansion of the testing (fluid)).
- Refer to ÍST EN 13480-5:2002, paragraph 9.3.2.1.8, NOTE 2
- Instruments;
- Control valves;
- Connected equipment.

Prior to tests:

- Lines shall be thoroughly cleaned internally then flushed, blown out
- Temporary strainers shall be installed downstream of test sections to protect downstream components
- Underground lines shall be tested before covering joints.
- Piping shall be tested prior to insulating. Where pre-insulated pipes are used, joints shall not be covered or insulated until after testing.
- Install blanks with equal or larger PN class, all according to ÍST EN 13480-3.
- Test pressure reading shall be located at the lowest point of the line or system of lines being tested.

During tests:

- The maximum permissible pressures shall not exceed definitions in ÍST EN 13480-5, Chapter 9.3.2.2.1
- When conditions require that a pressure test be maintained for a period during which the testing medium in the systems would be subject to thermal expansion, provision shall be made for relief of excess pressure
- The temperature of the test fluid shall not exceed 25°C.

Additional requirements include:

- Where a short section must be removed from a line to apply a test, these pieces shall be tested separately
- Lines requiring repaired shall be retested at pressures originally specified for the test
- Where the specified test procedures differ from those set out by the Authorities. The more stringent procedure of the two shall be followed.

After satisfactory completion of all tests:

- Lines shall be completely drained of the test fluid or gas.
- Insulation and painting may and shall then be completed;

7 Welding

7.1 Welding Standards, Welders and Welding Consumables

The welding of pipe shall conform to the requirements of the following standards ÍST EN ISO 3834-2, or ÍST EN ISO 3834-3 depending on the level of quality requirements.

Technical delivery conditions for welding consumables shall conform to ÍST EN 12074:2000 and EN 13479:2004 and welding procedure approvals shall conform to EN13480-4. Welding consumables shall be marked according to IST EN ISO 2560 and be approved by approved body such as: Lloyd's Register, Bureau Veritas, TÜV, etc.

Welders shall be qualified in accordance with ÍST EN ISO 9606-1:2013 and their certificate correspond to types of weld they intend to perform. Only approved welding procedures shall be used.

Welding shall fulfill the requirements of ÍST EN 1011 and be in accordance with drawing, specifications and installation instructions.

Limits of imperfections for each type of welds shall better the following quality levels, all according to IST EN ISO 5817:2014:

- Fixtures and pipe support: Quality Level B
- Pipe welds: Quality Level C or better

Welding symbols on drawings shall be according to IST EN 2553:2013.

7.2 Welding Inspection

The Owner shall have continuous access for inspection of the work. No weld shall be covered or ground and no insulation applied before the inspection has been carried out.

One or more of the following defects shall be cause for rejecting of a weld:

- Failure to meet x-ray requirements or other code tests – IST EN ISO 17636-2:2013 and IST EN ISO 17636-1:2013
- Suspect ground welds
- Welding performed by unqualified person
- Welds not reasonably uniform in appearance – IST EN ISO 17637
- Evidence of penning – IST EN ISO 17637

- Cracks, pinholes – IST EN ISO 17637
- Oxidation around welds – IST ISO 5817
- Lack of fusion and/or incomplete penetration – IST ISO 5817
- Presence of porosity, slag inclusion or overlaps – IST EN 5817
- Undercutting adjacent to completed welds or evidence of undercutting by grinding – IST ISO 5817
- Any other fault at the discretion of the x-ray specialist

The following standards shall be laid down as basis of the work for fusion and gas welding of steel.

Grouping of materials	CEN USO/TR 15606, 20172, 20173, 20714
Qualification of Welders	EN ISO 9606-1
WPS	EN ISO 15609-1
Welding procedure qualification	EN ISO 15607, 15610, 15611, 15612, 15613
Welding operator qualification	EN ISO 14732
Non-destructive testing – Qualification and certification of NDT personnel	EN ISO 9712
Inspection and testing during welding	EN ISO 13916, EN 1011-2 & -3, CEN ISO/TR 17844
Inspection and testing after welding	
- NDT General rules	EN ISO 17635
- Visual inspection	EN ISO 17637
- Radiographic testing	EN 1011-2 & -3
- Ultra-sonic testing	EN ISO 17640, 10863, 13588, 22825
- Magnetic particle testing	EN ISO 17638
- Penetrant testing	EN ISO 17662
Post weld heat treatment	EN ISO 17663
Welding consumables – Technical delivery conditions	EN ISO 554
Acceptance tests	
- Radiography	EN ISO 10675-1 & -2
- Ultrasonic	EN ISO 11666, 15626, 22825, 23279
- Magnetic Particle	EN ISO 23278
- Penetrant	EN ISO 23277
- Imperfections in general	EN ISO 5817.
Note: WPS. Welding Procedure Specification, consult IST EN ISO 15609-1:2004	

X-rays shall be interpreted by the same firm and/or by the Owner. The X-rays shall be the full circumferences of the weld and in accordance with standards as per above table and IST EN 13480-5, Chapter 7 to the extent applicable to piping.

The Owner reserves the right to request the X-raying of any welded joint and will bear the cost of this if the joint is sound. However, the cost of X-raying and repair of joint shall be borne by the Vendor for any defective joints. Should a defect be found, additional X-rays shall be taken until repair and sound welding has been established. Cost of such rectifications shall be borne by the Vendor.

If more than 5% of the total number of welds X-rayed fail to meet the requirements, tests shall be extended to include all welds at Vendor's expense. All the work, which shall be redone because of rejected welds, shall be at the Vendor's expense.

The X-raying company will decide on the soundness of the welds and the type of repair required and their decision will be binding for Vendor. Cost of the final x ray of the joint shall also be at the Vendor's expense.

7.3 Cost of Welding Inspections – General rule

The Vendor shall propose the type and quantity of the weld tests which the Vendor finds necessary for successful project. However, before installation the Vendor shall request a agreement from the Owners.

If the Owner so wishes he can demand further test, both in type and quantity. This will be called the First Extra Test (FET). If the results of the FET are acceptable the Owner shall bear the total cost of the activity. The Owner can later initiate another FET at his discretion. However, if the FET indicate faults or other defect which need repair the Vendor shall bear the cost of the FET. The Vendor shall also bear the cost of Subsequent Extra Tests, SET, necessary to reestablish conformance with the Vendors initial weld procedure. The quantity and quality of SETs shall be the judgement of an independent firm specialized in the field and shall be binding for both parties.

8 Thermal Insulation

8.1 Insulating Materials

Insulating materials shall be one of the following:

- Resin Bonded Long Fibred Mineral Wool, with a minimum weight of 100 kg/m³.
- Resin Bonded Glass Fiber with a minimum weight of 100 kg/m³.
- Rigid foamed Polyurethane Block, with a nominal density of 30 kg/m³ (for anti-sweat prevention only).

Insulating materials shall be suitable for the intended function. The material shall be non-flammable and free from any substance, which might lead to spontaneous combustion. It shall be non-corrosive, wet or dry, odorless at operating temperatures and shall not contain substances which initiate the growth of molds or support vermin. It shall not suffer permanent deterioration because of contact with moisture.

Pre-formed moulded sections shall be used whenever practical on pipes and fittings. Moulded sections shall be mechanically robust and capable of being transported and handled without undue breakage, and shall fit snugly with the surface to be insulated. Plastic insulation shall only be used where the smallness or intricacy of the unit makes the use of moulded sections impractical, and for seam jointing. This material shall have the same insulating properties as the moulded material.

All indoor pipe work shall be finished with 0,6 mm plain aluminium jacketing. The aluminium jacketing shall be applied to all straight runs, bends, elbows, tees and other fittings.

Pipe work located outdoors shall be finished with 0,9 mm plain, or 0,6 corrugated aluminium jacketing. The aluminium jacketing shall be applied to all straight runs, bends, elbows, tees and other fittings. Suitable means of draining off condensation shall be incorporated.

All aluminum jacketing is to be fixed by the use of pop rivets or equal, and finished work shall present neat and workmanlike appearance.

All joints in the outdoor aluminium jacketing shall be permanently sealed for weather protection by the use of an aluminium coloured vapour barrier sealer.

8.2 Heat Tracing

ÍST IEC 60079-30-2:2015, ÍST IEC 62395-1:2013 and ÍST 200:2006 shall be laid down as basis for heat tracing.

9 Piping Materials

9.1 General

In this document tube and pipe is used interchangeably. It shall remain the task of the Vendor to define construction and material included in his design and fabrication. However, it shall be the task of the Owner to accept design.

Tubes may be of seamless or welded construction according to the dimensional standard ÍST EN 10220. Sizes DN15 through DN40 shall be, seamless, suitable for screwing as per IST EN 10255 (DIN 2440) and material fit for purpose. Sizes above DN50 shall be heavy wall seamless or welded, suitable for welding and material fit for purpose as per ÍST EN 10216 and ÍST EN 10217, all parts.

9.2 Corrosion Resistance

Steels shall fulfill at least the requirement of ÍST EN 10088-2, Chapter 3.2

9.3 Abbreviations

The following abbreviations shall be commonly used to describe properties of the pipe system:

BE	Beveled Ends
BS	Bell and Spigot
BF	Butterfly Valve
BV	Ball Valve
BW	Butt Weld
CD	Cold Drawn
CE	CE Marking
CS	Carbon Steel
CK	Check Valve
DP	Diaphragm Valve
ERW	Electric Resistance Weld
FF	Flat Face
FS	Forged Steel
Galv	Galvanized
GA	Gate Valve
GJ	Ground Joint
GL	Globe Valve
IS	Integral Seat
MI	Malleable Iron
MJ	Mechanical Joint
NAD	National Application Document
NV	Needle Valve
NRS	Non-rising Steam
OS&Y	Outside Screw & Yoke
PE	Plain Ends
PI	Pinch Valve
PV	Plug Valve
RF	Raised Face
RS	Rising Stem
SO	Slip ON
SOFF	Slip On-Flat Face
SORF	Slip On-Raised Face
SE	Screwed Ends
SMLS	Seamless
SJ	Solder Joints
SCWD	Screwed
SW	Socket Weld
SCH	Schedule
STR	Strainer
THK	Thickness
WN	Weld Neck
WNRF	Weld Neck-Raised Face
WNFF	Weld Neck-Flat Face

9.4 Protection of Piping Underground

These requirements apply to: Compressed Air, Water, and Gas, steel piping buried underground, or in sleeves, piping in concrete and that laid in concrete trenches that are to be subsequently sand filled.

- PRIMER Protecto Wrap No.1170 or approved equivalent
- WRAPPING Protecto Wrap No.200 AGT or approved equivalent

9.5 Seamless and welded tubes, PN6, PN10, PN16 - black and stainless

9.5.1 Design

Preferred pressure rating is PN16. However, if circumstance allow, PN10 may be used throughout isolated system segments which will operate at a pressure between 6 and 9 bar gauge.

9.5.2 Applicable standards

- Dimensional standards: ÍST EN 10220
- Threaded: IST EN 10255 (DIN 2440)
- Technical delivery conditions (material): ÍST EN 10216 and ÍST EN 10217, all parts.

9.5.3 Test

Hydrostatic, according to EN 13480-5, Chapter 9.3.2.2.1

9.5.4 Minimum Wall Thickness and Type Requirements

If other conditions do not prescribe differently, Tube wall thickness shall be according to the table below:

Table 9.1-1. Minimum wall thicknesses for pipe dimension DN6 to DN150

Nominal (DN)	Based on EN 10226-1 (DIN 2999)	Outer dimension (mm)	Wall thickness EN 10255 (DIN 2440) (mm)	Connection method TH = threaded WD = Welded SL = Seamless SM = Seamed
6	1/8"	10,2	2,00	TH & SL
8	1/4"	13,5	2,35	TH & SL
10	3/8"	17,2	2,35	TH & SL
15	1/2"	21,3	2,65	TH & SL
20	3/4"	26,9	2,65	TH & SL
25	1"	33,7	3,25	TH & SL
32	DO NOT UES	DO NOT UES	DO NOT UES	DO NOT UES
40	1 1/2"	48,3	3,25	TH & SL or SM
50	2"	60,3	3,65	WD or TH & SL or SM
65	DO NOT UES	DO NOT UES	DO NOT UES	DO NOT UES
80	3"	88,9	4,05	WD & SL or SM
100	4"	114,3	4,50	WD & SL or SM
125	DO NOT UES	DO NOT UES	DO NOT UES	DO NOT UES
150	6"	165,1	4,85	WD & SL or SM

9.5.5 Technical delivery conditions for fittings and appurtenances

DESIGNATION	NOMINAL SIZE	DESCRIPTION	WALL THICK. OR RATING.
FITTINGS	DN15 TO DN50	CS, ERW, IST EN 10253-2, TYPE B, P235TR2,	PN10 – PN16
UNION	DN15 TO DN50	BLINDS, TYPE 05, P235GH, PRESSURE RATING OF THE MATING FLANGE.	
	DN50 TO DN150	DO NOT USE	
FLANGES	DN15 TO DN150	RF, IST EN 1092-1, TYPE 11 (WELD-NECK), TYPE 11 (HUBBED SLIP-ON), FACING TYPE B1, S235JR.	MATING FLANGE
BLINDS	DN200 TO DN600	RF,IST EN 1092-2	PN10

GASKETS	DN15 TO DN50	IST EN 13480-3:2012.	PN10
VALVES AND ACCESSORIES	DN65 TO DN150	RF, IST EN1092-2, FACE-TO-FACE IST EN 558-1	PN16
BALL VALVE	DN200 TO DN600	RF, IST EN 1092-2, OS & Y, BOLT.BONNET, SOL. WEDGE DISC, CI BODY, RS, RENEWABLE BRONZE SEAT RINGS, FACE -TO-FACE IST EN 558-1.	PN6
CHECK VALVE	DN15 TO DN50	IST EN 10226-1, IST EN 5352	PN10
	DN65 TO DN150	RF EN 1092-2, IST EN13709	PN16

9.5.6 Notes

- Pipe elbows shall be long radius, Type 3D, per EN 10253-2:2007
- SLIP-ON flanges, subject to approval of Owner, may be used on straight pipe runs; however, Welding Nek flanges at valves & fittings.

9.5.7 Cleaning and Inspection

Pipe lines shall be thoroughly flushed with clear, clean water at a sufficient velocity to remove all foreign matter. During flushing operation, all welds shall be hammered. After flushing, valves shall be inspected for dirt and proper functioning. If valves are dirty, they shall be repacked.

9.5.8 Sterilizing of Potable Water

After cleaning and flushing, sterilize all potable water piping in accordance with Health Authorities requirements. Do not use system during sterilization period. Drain carefully and flush completely at a sufficient velocity with clean potable water.

9.6 Chlorinated polyvinyl chloride pipes

9.6.1 Design

For specific piping system as per below table, chlorinated polyvinyl chloride, pipe material may be used. Maximum pressure rating depends on applications, but shall not exceed 12 bar,g.

9.6.2 Test

Hydrostatic, according to EN 13480-5, Chapter 9.3.2.2.1

9.6.3 Technical delivery conditions

The material definition is chlorinated polyvinyl chloride, CPVC or PVC-C, thermoplastic material. Other names for the same material is Polychloroethylene, CAS Number, 68648-82-8.

The following table indicates CPVC pipes from one manufacturer, GIRPI. Other manufacturers who base their systems on the same piping material may be suggested by the Vendor.

Application	Boundaries	GIRPI SYSTEMS
Compressed air distribution	<ul style="list-style-type: none"> - Ø16 to Ø110 mm - < PN12,5 @ 25°C - Fire classification: B-s1 d0 (Class I surface lining) IST EN 13501-1 - Priming: Use dedicated primer fluid or water - Welding Polimer: GAFIX - Service temperature 0°C to +40°C 	GIRAIR
Domestic hot- and cold water conveyance	< 100°C, PN10.	SYSTEM'O® (HTA® + HTA-F®)
Low temperature heating	< 100°C	HTA®
Gravity Drainage	< 100°C	HTA-AE®
Potable and treated water conveyance		PVC-U K62
Air conditioning		KRYOCLIM®
Drainage	Acoustic	FRIAPHON

9.1 Plastic pipes

9.1.1 Design

Only the following material categories shall be accepted for plastic pipes

Pastic	Nomination	Property requirements	Applicable standards
High Density Polyethylene	HDPE	Only MRS 100 and MRS 80 shall be accepted	Dimensions: DIN 8074 Safety factors: DIN EN 12162 Allowable pressure: DIN 8074
Polybutylene	PB	MRS 125	
Polypropylene	PP-P	MRS 80	

9.1.2 Tests

General

The test procedures consist of two steps, the initial expansion and the test phase. When test pressure is applied to a water filled pipe, the pipe expands. During the initial expansion of the pipe under test, sufficient make-up water must be added to the system at hourly intervals for 3 hours to maintain the test pressure. After about 4 hours, initial expansion should be complete and the actual test can start.

An alternate leakage test consists of maintaining the test pressure (described above) over a period of 4 hours and then dropping the pressure by 1 bar. If the pressure then remains within 5% of the target value for 1 hour, this indicates there is no leakage in the system.

Under no circumstances shall the total time under test exceed 8 hours at 1.5 times the system pressure rating. If the test is not complete within this time limit (due to leakage, equipment failure, etc.), the test section shall be permitted to "relax" for 8 hours prior to the next test sequence.

Air testing is not acceptable

If preferred, the procedure described in: PPI Technical Report TR-31 by the Plastic Pipe Institute may be laid down as acceptable test procedure.

Pressure Testing Outside the Trench:

If advantageous, pressure testing may be conducted prior to pipe installation.

After the pipe has been joined

- 1) Fill it with water
- 2) Carefully bleed off any trapped air
- 3) Subject the pipe to a hydrostatic test pressure that is 1.5 times the system design pressure for a maximum of 3 hours.
- 4) During this time, add water periodically to maintain the test pressure; this is to compensates for the initial stretching of the pipe.
- 5) Determine the line pressure tightness by visual observation
- 6) It is not necessary to measure the make-up water
- 7) Examine every fused joint
- 8) Any leakage must be repaired and then retested from step 1)

Testing In The Trench:

- 1) Fill the pipeline with water after it has been laid
- 2) Bleed off any trapped air
- 3) Subject the LOWEST element in the system to a test pressure that is 1.5 times the design pressure
- 4) Check for any leakage
- 5) Examin every fused joint
- 6) Any leakage must be repaired and then retested from step 1)

9.1.3 Technical delivery conditions

Refer to DIN EN ISO 1043.