

Tata Steel Technical Standard

S1450401 Execution and inspection of welding work

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1 Introduction

1.1 General

For Tata Steel, safety has top priority. In addition, the production reliability of all installations on the site of Tata Steel IJmuiden BV, location IJmuiden, is very important. To guarantee the integrity of these installations, high standards are set in this Standard for the quality of all welding work on these installations, both in the construction phase and in the in-service phase.

This standard specifies the requirements that the welding work for Tata Steel, IJmuiden site, shall meet.

The design code of the object to be welded is leading and shall be stated in the assignment, the request for quotation or the specifications. The welding work shall at least comply with the (harmonized) standard(s) or standard sheets to which the design code refers.

For repairs, changes to, or 1-on-1 replacement of existing installations, the assigned welding category classification can be maintained.

Additional or heavier quality control requirements may be imposed for certain objects or applications, this must be stated clearly in the assignment, the request for quotation or the specifications. Reference can be made in this standard to additional standards and / or guidelines. If no date of issue is specified, the most recent version applies.

If no design code is known or can be adhered to for an object or part, then the welding work shall be prepared and carried out in accordance with the welding category requirements, given in chapter 9 and 10. In the event of uncertainties or any doubts, the requirements of weld category will fall in Category 1.

Welding poses various health and safety risks for both the welder as well as the direct environment. The welding contractor is responsible to recognize all risks and take care of all required preparations, to prevent or minimize the risks and consequences. This should be documented in the health and safety policy/plan of the welding contractor.

1.2 Scope

This Tata Steel Standard applies to welding activities that are carried out for Tata Steel IJmuiden BV, location IJmuiden.

An exception to this are welding work for standard purchase parts, stock items, off-the-shelf items and the like, not Tata Steel specific, manufactured according to "manufacturing standard".

The requirements mentioned in this Tata Steel Standard are valid for welding of steel and steel based alloys. Use and processing of other materials must be assessed by the Tata Steel welding expert. Additional or different requirements may be specified in the request for quotation, the specifications or the assignment.

1.3 Tata Steel Inspectors

With regard to welding inspections by the Tata Steel Inspector, the conditions set in accordance with the "General Purchase Conditions Tata Steel" apply. This sets out the rights of the Tata Steel Inspector in relation to the Contractor with regard to access by the Contractor and subcontractors, providing information, providing cooperation, inspection, interim rejection and applying markings.

2 Agreement

2.1 General

The basis of this Standard is the ISO 3834 standard series, which sets the quality requirements for fusion welding of metals.

New installation structures, parts, etc. shall comply with:

- 1) Applicable legal requirements,
- 2) Applicable design code requirements,
- 3) Contract requirements,
- 4) Applicable standard requirements.

For existing installations, constructions, etc. or parts thereof, the design code should be followed as much as possible. If the design code is not known or it is not practical to follow, then the subdivision into welding categories according to chapter 9 and 10 should be followed. The welding category classification depends on the risk level and required reliability. These welding categories describe the requirements that the welding work shall meet.

- 1) welding category 1; most risky.
- 2) welding category 2; less risky.
- 3) welding category 3; least risky.

For a detailed explanation and classification of the welding categories, see chapter 9. For the quality requirements per welding category, see chapter 10.

If nothing is specified in a specification, quotation request or assignment, the most stringent requirements of welding category 1 apply.

2.2 Conflicting or missing information

Data or provisions that are missing, unclear or that conflict with each other must be reported in writing by the Contractor to the Client before the commencement of the work. The consequence of non-reporting is at the risk of the Contractor.

3 Companies

3.1 Welding firm as a Contractor

The Contractor shall be certified in accordance with the appropriate version of ISO 3834, by a recognized accredited certification body.

Table 3-1 applies to welding work on existing installations that are classified in one of the welding categories.

Table 3-1 Certification for welding contractors

Tata Steel welding category according to S1450401	Welding firm certified according to standard
Welding category 1	ISO 3834-2
Welding category 2	Minimal ISO 3834-3
Welding category 3	Minimal ISO 3834-4

3.2 Welding firm as a subcontractor

The same requirements apply to the subcontractor as to the main contractor, as stated in paragraph 3.1 "Welding firm as a Contractor".

3.3 NDT Company

The NDT company shall be accredited according to ISO / IEC 17020 type A or ISO / IEC 17025.

3.3.1 NDT Personnel

The executive NDT personnel shall be certified for the applied NDT technology according to level 1 or 2 according to ISO 9712. NDT reports shall be assessed and signed for approval by a NDT level 2 . This also applies to visual inspection.

3.4 Heat treatment firm

Heat treatment firm shall use a quality assurance system according to ISO 9001 or equivalent.

3.4.1 Heat treatment operators

Personnel carrying out heat treatment work (heat treatment operators) shall have sufficient relevant knowledge and experience to be able to carry out heat treatment in accordance with the heat treatment procedure.

4 Documentation

All welding-related and associated documents shall be submitted and approved prior to start of work. Starting without documents approved by Tata Steel is not permitted and entirely at the risk of the contractor.

4.1 Inspection and test plan (ITP)

The ITP indicates the various inspection points in chronological order that shall be adhered to for the relevant work.

The ISO 3834-2 and -3 codes par. 14.2, 14.3 and 14.4 provides the welding related aspects to be verified and prior to start of work, it shall be agreed which aspects need be recorded and documented.

The applicable implementation standard and acceptance criteria are stated per inspection point. The ITP shall be submitted to the Tata Steel Inspector for approval 10 working days after the purchase agreement has been placed.

4.2 Welding documentation

The welding documentation (welding plan, WPSs, PQRs, WPQRs) shall be presented to the Tata Steel Welding Expert for approval shortly after the confirmation of the purchase order/ agreement. Starting welding work without welding documents approved by Tata Steel welding expert is not permitted.

The welding documentation shall be compiled by the responsible (or delegated) welding coordinator. Each WPS shall be signed by the responsible (or delegated) welding coordinator. Signing includes legible name, initials and IWT or IWE certificate number and date.

If welding work is outsourced by the contractor, the contractor shall first assess and approve the welding documents of the subcontractor by signing. These must then be presented to the Tata Steel welding expert for approval.

4.2.1 Welding plan

The welding plan shall be submitted and approved before the start of the work. It is a document that indicates which WPS/LMB is to be used for which weld seam. Each weld must have a unique identification. The welding plan contains one or more drawings with all welds on it. For pipework, a Line Inspection Summary List (LISL) shall be used as a welding plan.

4.2.2 Welding procedure specification (WPS)

Welding procedure specifications shall be stated in accordance with EN ISO 15609-1.

4.2.3 Procedure qualification record (PQR)

The PQR shall be carried out and documented in accordance with the relevant part of the EN ISO 15614 series. The PQR must contain the original DT and NDT test reports, sending only CBI/Nobo cover sheets is not acceptable.

In specific cases and after permission from the Tata Steel welding expert, the EN ISO 15613 may also be used, the nature and scope of the tests must then be determined and agreed upon in advance.

4.2.4 Welders qualification (WPQ)

Hand welders shall be ISO 9606-1 certified. Extension according to ISO 9606-1 par. 9a) or 9b). Operators of mechanized or automated welding systems shall be ISO 14732 certified.

For welding work in special circumstances, additional requirements can be set regarding welding skills, such as in EN 12732, with regard to position, free space, mirror welding, etc. If required and at the request of Tata Steel, the skill shall be demonstrated by means of a mock-up.

If there is any doubt about the skill of a welder, Tata Steel reserves the right to stop the welding work.

4.3 Manufacturing data book (MDR)

According to an approved manufacturing data book index list, all inspection documents and / or overview lists of inspection documents shall be stamped and signed after acceptance by the Contractor and subsequently by the Tata Steel Inspector and / or agreed CBI. These documents shall be collected and completed in a manufacturing data book (up-to-date) during manufacture. For pressure equipment and pipes, the final pressure test may only take place after review and acceptance of the manufacturing data book and that all previous points of the ITP have been signed for acceptance. The manufacturing data book shall be supplied with the delivery of the goods or be delivered within 30 working days in the agreed indexation and format.

Such as, but not limited to the following original documents, signed off for acceptance:

- Cover page with reference to order number and description
- Index sheet with chapter division and reference to numbered tabs
- Inspection and test plan
- Material certificates (copy permissible, if legible) and index list
- Welding plan with WPSs, the supporting PQRs, the WPQs or summary lists and an overview of welders used
- Inspection / NDT reports
- As-built drawings
- Contractor release note
- FAT factory acceptance test certificate
- FAC factory acceptance certificate
- Letter of compliance

If applicable, supplemented with the following stamped original documents:

- Declaration of conformity & instructions of use
- RT films and copy of undersigned/stamped NDT report packed in plastic cover per RT report
- Heat treatment procedure and heat treatment curve
- Measurement reports
- Test load statement
- Leak test
- Pressure test reports including pressure gauge calibration reports
- Coating reports
- Etc.

5 Material

5.1 Base material

Base material shall meet the requirements in the agreement, specifications and engineering documents and shall be sound and suitable for the intended use.

The base material to be used shall be traceable for many applications. If material is separated and must remain traceable, the material identification and marking must be clearly legibly copied to the part to be separated (re-authenticated) by an authorized person.

The traceability of materials (forgings, castings, plate, construction steel, etc.) shall be maintained during the manufacturing process, which means that for every piece or component it shall be possible to retrieve its history by marking the parts by means of hard stamping or equivalent (i.e. marking shall remain visible during the manufacturing process)

The workshop has to ensure a dedicated person who is responsible and appointed by the company for material traceability or hard stamping of the materials

The certificate type for base material shall be specified in the purchase order or purchase specification. Unless specified otherwise, the material certificate for base material for welding category 1 and 2 shall be a 3.1-certificate 3.1 according to EN10204.

For material for pressure containers falling under PED / WBDA, additional requirements apply with regard to ISO 9001 certification of the material manufacturer (mill). The marking shall remain visible and legible until the material has been released for coating by the Tata Steel inspector.

For welding work where the material is loaded in the thickness direction (in the use phase), an edge zone and lamination/segregation examination shall be carried out in accordance with EN 10160 class E2 and S2 before welding. Excluded are hot-rolled profiles and materials with specified mechanical values in thickness direction (Z quality or TTP quality), unless stated otherwise in the agreement.

5.2 Welding consumables

The welding consumables and base material shall be carefully matched. Basically, the welding consumable material shall be of the same chemical composition and mechanical strength as the base material to be welded. In the case of dissimilar connections, the choice of the welding consumables shall be agreed in advance with a Tata Steel Welding Expert, whereby most commonly the welding consumables are adapted to the highest alloyed part.

Use may only be made of welding consumables approved by an independent body (TÜV, DNV, Lloyds, etc.). This can only be deviated from after written permission from a Tata Steel Welding Expert. For welding consumables for pressure containers falling under the PED, there is also the requirement that EN 12074 and EN 13479 shall be met, to be demonstrated by means of an EC Declaration of Conformity and 2.2 certificate in accordance with EN 10204.

Electrodes and other welding consumables shall be stored and handled according to the instructions of the welding consumables manufacturer.

6 Execution of Welding work and NDT

6.1 Surface condition, damage and cleanliness

Welding to surfaces having an oxide layer (e.g. after hot rolling) or coating is not permitted, these shall be removed prior to welding.

The weld seam and adjacent material shall be free of dust, grease, flame cutting hardened heat affected zones, rust and the like.

When material has been cut or removed by thermal means (autogenous cutting / gouging), the cutting edges shall be NDT examined after grinding, 100% MT or 100% PT.

Arc strikes outside the weld seam/bevels shall be removed by grinding and NDT examined, 100% MT or 100% PT.

If material must be preserved after welding, then Tata Steel Standard S3105601 shall be followed, with respect to the quality requirements for material and welding work prior to conservation.

6.2 Working conditions

The following conditions shall be prevented during welding by taking appropriate measures:

- temperature of base material lower than 5 ° C
- precipitation on or near weld or weld seam preparation (e.g. rain, snow and the like)
- condensation on the base material
- wind force greater than 5 Beaufort at welding location
- other conditions that can have a negative effect on the welding quality

6.3 Welding procedure specifications (WPS's) in the workplace

The approved WPSs shall be present at the workplace, so that it can be checked on site whether the welder works according to the agreed procedure.

6.4 General tolerances

The general tolerances for welded constructions according to ISO 13920 apply to all welding work, whereby tolerance class C as a minimum shall be used for lengths and angle dimensions and class G as a minimum for straightness, flatness and parallelism tolerances. Cutting edges shall comply with ISO 9013, whereby a minimum of range 3 must be fulfilled for the height profile (Rz5 value).

6.5 Mutual distance between two welds

When welds come in close proximity, either projected in drawings or in practice during shop or field work, the requirements in the design code shall be observed. If the design code sets no requirements, a minimum toe-to-toe distance of 50 mm shall be used as a guideline. Exceptions are crossings of weld seams, for example longitudinal and circumferential seams of pipes or pressure vessels.

6.6 Interpass temperature

The maximum interpass temperature according to the PQR shall be observed. The interpass temperature shall be checked with temperature crayons or a calibrated contact thermometer in accordance with ISO 13916. The use of contactless infrared thermometers is not allowed due to their significant deviation between actual and measured temperature.

6.7 Welding inspection /NDT

6.7.1 Assignment

The NDT requirements shall be clearly and unambiguously specified by the client or the lead engineer in the quotation request or technical assignment, both in terms of scope, nature and execution of the examination (area, volumetric) and the quality level of the acceptance criteria.

6.7.2 NDT-procedures

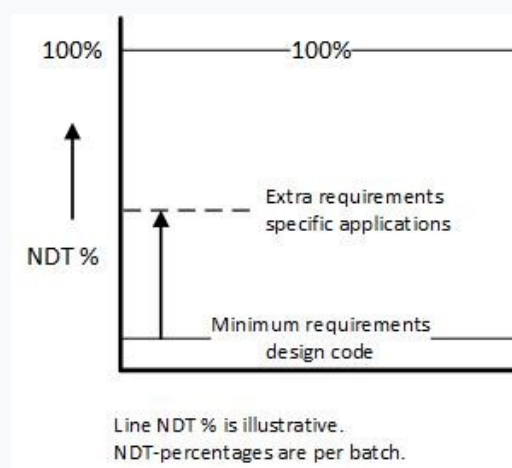
The NDT procedures shall be authorized by a level 3 examiner according to ISO 9712.

NDT shall be performed based on approved procedures. Approval for general (not project-specific) procedures shall have been carried out and signed by a recognized CBI/Nobo. Project-specific procedures shall be approved and signed by the KDT welding expert.

6.7.3 Execution of NDT

The visual inspection must have been carried out and accepted after PWHT (when applicable) but always prior to the supplementary NDT. The NDT must take place before preservation / coating.

- 1) The design code, stating the year of publication, is always the starting point and determines the nature and scope of the NDT examination by making specific choices in the design and / or ordering phase. For the supplier, only the end result shall be stated in the specifications, the tender request or assignment. The following shall be specified per batch (= welder x welding method x number of welds made):
 - A) Visual inspection prior to NDT is always 100%
 - B) NDT percentage for both the surface survey and the volumetric survey
 - C) Quality level of the acceptance criteria to be used
- 2) If an assignment consists of several parts based on different design standards, for example a pipe on a steel structure, the corresponding NDT requirements shall be specified for each part / design standard in the application or assignment.
- 3) For specific applications, the minimum requirements of the design code can be extended. The additional NDT requirements shall be clear and unambiguous be specified in the request for quotation or assignment.



- 4) When specification of the design code or specification of the NDT size, nature and Quality level is missing, then table 10-1 or table 10-2 in chapter 10, based on the welding category, shall be followed.

The Inspection and Test Plan (ITP) shall state the scope and type of the examinations, the examination procedures that apply to the execution, the acceptance criteria and the quality level of the examination to be used.

If NDT procedures of (sub)contractors are proposed to use, these shall be based on the NDT codes, as referred to in the applicable design code(s). If the design code does not provide a reference to NDT codes, then the codes / standard sheets as stated in Table 10-1 or 10-2 of chapter 10 shall be used.

7 Heat treatment

1. Preheating

When preheating applies, then preheat shall be done with a minimum preheating temperature according to EN 1011-2 or ISO / TR 17671-2.

If no material certificate type 3.1 or 3.2 is available for the material to be welded, the preheating temperature must be determined using the max. Ceq of the base material. This is calculated using the Ceq formula, taking the maximum permitted percentage of each of the elements according to the applicable material standard.

If the ambient temperature is below 5°C or condensation takes place, then pre-heating to a temperature of at least 50°C is required. The prescribed preheating temperature shall be checked with temperature crayons or a calibrated contact thermometer in accordance with ISO 13916. The use of contactless infrared thermometers is not allowed due to their significant deviation possible between actual and measured temperature.

2. Post weld heat treatment for hydrogen removal (soaken)

Post weld heat treatment for hydrogen removal is carried out immediately after welding according to the instructions of the material supplier. If these instructions are missing, 100°C above the preheating temperature, with a minimum temperature of 250 ° C, shall be maintained for at least 2 hours. Soaken shall be used if the AGREEMENT prescribes such heat treatment or if the applied base material or construction, in combination with the applied welding process, has a certain risk of cold cracking.

3. Stress relieving

If stress relieving is required, the following shall be taken into account:

- The requirements in accordance with the applicable design code, material standard and the guidelines in accordance with ISO / TR 17663.
- The requirements stated in the material datasheet of the manufacturer (mill) of the material in the case of material with special properties. The stress relieving temperature of tempered steel shall be at least 20°C lower than the tempering temperature applied by the steel manufacturer.
- The equipment and measuring instruments used shall be calibrated less than 1 year ago.
- The heat treatment carried out shall be recorded by means of a paper or digital recorder.
- If PWHT is specified, the NDT shall be carried out after the heat treatment. Exceptions must be requested and motivated in advance via a Technical Query and approved by the KDT welding specialist.

4. Heat treatment procedure

The heat treatment procedure shall be submitted to the Tata Steel Welding Expert for assessment prior to heat treatment.

8 Specific welding applications

8.1 Welding of buttering, cladding

8.1.1 Welding with welding material of the same properties of as the workpiece material (buttering)

This includes repair welding of base material and buttering of welding edges. Non-destructive testing of welded layers always at least 100% visually.

8.1.2 Welding with welding material of the unequal properties of as the workpiece material (cladding)

This means the welding of parts with special welding alloys to increase the wear resistance and / or corrosion resistance. Non-destructive testing of welded layers always at least 100% visual with additional penetrant or magnetic testing. Extent shall be specified in the request for quotation or assignment. WPS, material certificate 3.1, welding consumables and welding protocol shall be available for inspection to the Tata Steel Inspector or Tata Steel Welding Expert.

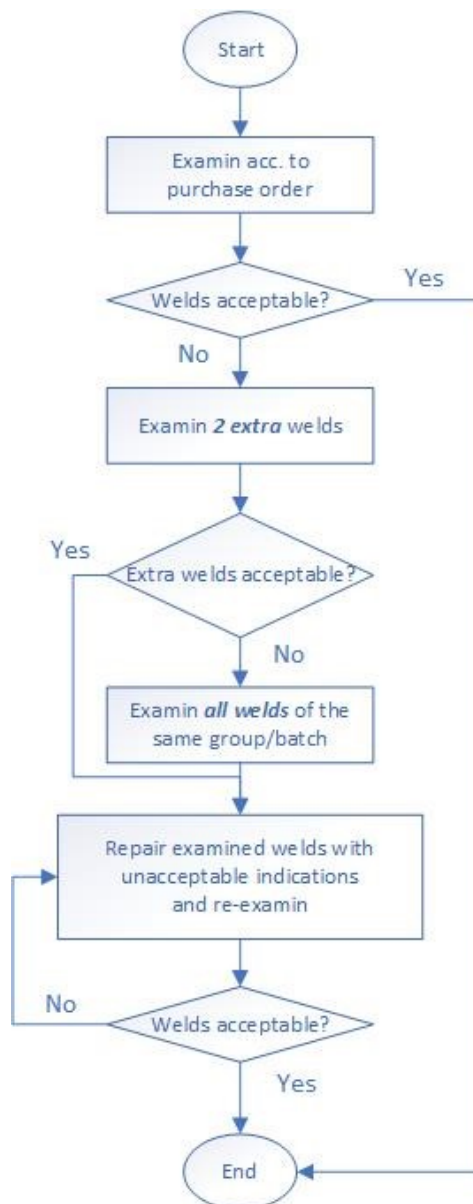
8.2 Repair of Weldments

When repairing welds, the design code, the original method of welding shall be used as much as possible, or current "best practices" shall be followed when the design code does not specify repair.

With respect to the number of permitted repairs, requirements may be specified in the design code.

For pipework, regardless of what is stated in the design code, the extent of the NDT is escalated according to EN13480-5, see also figure. 8-1. The term "random testing" also means: "NDT according to specification". A maximum of two (2) repairs at the same location are permitted.

Figure 8-1 Flow chart according to EN13480-5 of the required additional test, if imperfections have been revealed, to be assessed per batch (= group).



For repairs in welding work after heat treatment, the Tata Steel Welding Expert shall always be consulted. It will be assessed on a case-by-case basis whether re-heat treatment is required and feasible.

100% NDT of completed weld repairs shall be carried out with the same NDT technique and acceptance criteria as originally used and extended, if this is prescribed in the relevant design code or NDT code(s). The end result shall meet the original requirements. The manufacturing data book shall always contain the NDT-report of the rejected weld too.

8.3 Non ferrous metals welding

Welding non-ferrous metal objects shall be welded in accordance with current best practices and applicable codes and standards. Furthermore, the relevant standards and guidelines shall be followed, as specified in the assignment.

9 Division into welding categories, only applicable to existing installations/components

9.1 General

If it is decided according to paragraph 2.1 to work according to the welding category classification, then the following applies:

Welding work that is directly or indirectly related to safety, installation availability or production reliability of installations, falls into welding category 1 or 2. For weld connections between components that are not classified in the same welding category, the highest category applies.

9.2 Steel structure

Welding category 1

Dynamically loaded structures, such as crane tracks, brake girders, crane track column heads, crane and rail tracks, brake portals, rigid gantry angles, machine foundations, (temporary / permanent) welded-on lifting points. Constructions under heavy static load, where the local stresses are greater than or equal to $0.7 R_e$. Atmospheric storage tanks in tank category 1 according to QHSE 5.24. Apart from the NDT percentage, welding category 1 corresponds to EN 1090-2 Exc3.

Welding category 2

Statically loaded structures such as columns, footsteps, trusses, floor beams, minor beams, constructions for support or suspension of boilers, pressure vessels and pipelines and / or installations. Atmospheric storage tanks in tank categories 2 and 3. Apart from the NDT percentage, welding category 2 corresponds to EN 1090-2 Exc2.

Welding category 3

Slightly static structures, such as gutters and drainpipes, steel windows, stairs, landings, railings, cable racks and instrument boxes. Atmospheric storage tanks in tank category 4a. Welding category 3 corresponds to EN 1090-2 Exc1.

9.3 Machines / equipment, excluding hoisting, lifting and transport equipment

Welding category 1

Bearing housings and frames of engines and turbines, wheel constructions, flanges on axles, bed constructions of machine tools, (temporary / permanent) welded-on lifting points, water-cooled rails in ovens.

Welding category 2

Gearboxes and foundations: stiffeners, consoles, inspection holes and shutters. Foundations of various tools.

Welding category 3

Hand wheels and operating handles, light chair structures, protective plates.

9.4 Hoisting / lifting and transporting equipment

Welding category 1

Beams of loading bridges, booms and cranes, portals for cranes, equators, hoisting drums, jacking blocks, hoisting yokes, bogies, balances, drums of conveyor installations, (temporary / permanent) welded-on lifting lugs.

Transport means for liquid iron and steel. Mixers, pig-iron pans, steel pans, snail pans and main frames of cross-trolleys

Welding category 2

Columns under conveyor belts, belt drums, frames of winches and drives, stiffeners, gearboxes and rail vehicles.

9.5 Pressure containers, excluding piping/pipelines

Tata Steel Standard S1300401 and R1300401 also apply to all pressure containers.

Welding category 1

Connections in pressurized components (both overpressure and vacuum): boilers, hulls, fronts, walls, tubelures with stiffeners, wall stiffeners, flanges, connections with pipes. Fans of fans, glow plugs, wind heaters, (pressurized) storage tanks, (temporary / permanent) welded lifting lugs.

Welding category 2

Connections of non-pressurized parts that are connected to parts that do come under pressure. Climbing and running bars, insulation supports, supports in boilers or barrels.

Welding category 3

Welding work on parts that will not be pressurized, outer casing, shielding plates.

9.6 Piping/Pipelines

When determining the welding category of welding work on pipes, the following information is required. This information shall appear in the specification, on the drawing or on the ISO drawing:

- Medium
- Pipe diameter
- Wall thickness
- Design drawing
- Design temperature
- Design code or standard, see Table 9-1 for most applied standards.

Table 9-1 Design codes in use for piping/pipework at Tata Steel, IJmuiden

Type of pipework/piping	Code
Gas (except steam & process gasses)	EN 15001
Liquid, steam & process gasses	EN 13480
Falling under Dutch "Stoomwezen" rules	RToD

When in doubt, please consult PTC-HPM dept.

Weld category 1

- Piping for very hazardous media.
- Piping for hazardous media with design pressure greater than 16 barg.
- Piping for hazardous media with a design pressure below or equal to 16 barg and, in addition, DN 300 or larger.
- Piping designed according to RToD, with a wall thickness above 8 mm.
- Piping designed according to RToD that are pneumatically tested or hydraulically tested after application of coating.
- Piping for gaseous media, designed according to a design code other than RToD, with design pressure above 5 barg and, moreover, pneumatically tested.
- Piping with a design pressure above 40 bar and / or design temperature above 350 ° C.
- Piping with gaseous oxygen-displacing or (very) hazardous media in confined spaces.
- Weld seams in piping where hydraulic or pneumatic strength testing is not possible (so-called "golden welding"). For golden welding requirements, see Golden Welding Procedure and associated Golden Welding Motivation form, as referred to in Chapter 12.
- Longseams in piping with design pressure greater than 5 barg.

Welding category 2

- Pipelines, not covered by welding category 1 or 3.

Welding category 3

- Pipelines for non-hazardous media * with a design pressure of less than or equal to 0.5 barg.
- Central heating and cooling water ("Lekwater") pipes with a maximum operating pressure of 3,5 barg and a maximum diameter of DN 150.

In the welding categories described above for piping/pipelines, the following classifications are used for media, in accordance with WBDA 2016, based on the PED directive 2014/68 / EU:

Very hazardous medium (substance group 1B)

Explosive or very toxic. This includes (typical examples); acid gas, schwaden, cyanides and sodium dichromate solution.

Hazardous medium (substance group 1A)

(very) (highly) flammable, toxic or oxidising. This includes natural gas, Cokes gas, Blast furnace gas, Oxy gas, hydrogen, oxygen, HNX gas, AX gas, ammonia, BTX, hydrazine 35% and chromium (VI) oxide.

Environmentally hazardous medium (substance group 2B)

Medium which falls into substance group 2, but which is known to cause harm to the environment.

Non-hazardous medium (substance group 2A)

Medium not covered by definition hazardous medium or very hazardous medium. This includes steam, nitrogen, air, hot / cold wind HO6 / 7, cooling water, drinking water, hydraulic oil.

10 Quality requirements per welding category

If welding is still classified according to the old welding categories, then the following applies:

Welding work is classified by the Client in accordance with chapter 9 into the welding categories 1, 2 or 3. This classification shall be specified in the agreement, on (work) drawings and in specifications. The indication of welding category shall be indicated on the drawing by means of the class designation in the trailing end of the weld designation according to ISO 2553:

- Welding category 1 is the highest quality level, requirements according to EN3834-2
- Welding category 2 is the middle quality level, requirements according to EN3834-3
- Welding category 3 is the lowest quality level, requirements according to EN3834-4

Table 10-1 below shall only be applied to welding category 1 if no design code or NDT is specified in the tender request, the specifications or the assignment.

Table 10-1 Implementation and acceptance criteria for standard NDT Techniques

NDT technique	Object	TataSteel weldcategory	Applicable technical standard	Applicable class with respect to technology	Applicable acceptance standard	Applicable class of acceptance
VT	Weld	1	ISO 17637	N.A.	ISO 5817	B
RT ²	Weld	1	ISO 17636-1	B	ISO 10675-1	1
UT ³	Weld	1	ISO 17640	B	ISO 11666	2
ToFD ³	Weld	1	ISO 10863	N.A.	EN 15626	1
PA-UT ³	Weld	1	ISO 13588	C	ISO 19285	1
MT	Weld	1	ISO 17638	N.A.	ISO 23278	1
PT	Weld	1	ISO 3452-1	N.A.	ISO 23277	1
VT	Weld	2	ISO 17637	N.A.	ISO 5817	C/B ¹
RT ²	Weld	2	ISO 17636-1	B	ISO 10675-1	2/1 ¹
UT ³	Weld	2	ISO 17640	A/B ¹	ISO 11666	3/2 ¹
ToFD ³	Weld	2	ISO 10863	N.A.	EN 15626	2
PA-UT ³	las	2	ISO 13588	B	ISO 19285	2
MT	Weld	2	ISO 17638	N.A.	ISO 23278	2/1 ¹
PT	Weld	2	ISO 3452-1	N.A.	ISO 23277	2/1 ¹
VT	Weld	3	ISO 17637	N.A.	ISO 5817	D
UT	Plate	N.A.	EN 10160	N.A.	EN 10160	S2, E2

If the design code is RToD, then the below table 10-2 shall be followed. This table applies for all welding categories.

^{1**} In the case of pressure containers designed according to RToD, required class with regard to execution and acceptance equal to welding category 1, extent (% NDT) according to welding category 2.

^{2**} Ir 192 isotope testing is only permitted in the case of irradiated thickness larger than 20 mm; Se75 isotope examination for irradiated thickness smaller than 14 mm is only permitted after completion and signature of the form KDT-FORM-032 Motivation Se75 examination thin wall, prior to the NDT examination, where standard additional condition A1 applies. For the latest version of the form, see <http://safety.tatasteel.nl/en/supportions/standardization/> Additional condition A2 applies in the case of design code RToD, in combination with a survey by Lloyds Register

^{3**} Where possible, the use of ToFD or UT-PA (Phased Array) is preferred.

Table 10-2 Execution and acceptance criteria for standard NDT-techniques for pressure containers according to the design code RToD

NDT technique	Object	Required code for execution	Required level for execution	Required code for acceptance	Required level for acceptance
VT	Weld	ISO 17637	n.a.	T0112 + ISO 5817	B
RT	Weld	T0201	T0201	T0111	n.a.
UT	Weld	T0202	n.a.	T0117	n.a.
MT	Weld	T0203	n.a.	T0110	n.a.
PT	Weld	T0203	n.a.	T0110	n.a.

11 Terms & Definitions

Acceptance criteria

Criteria or limit values, which determine whether a deviation, indication, impurity is acceptable or not. The limit values for new construction/installation are determined by the design code and the required quality level. During the user phase, "Fit for purpose" criteria can also be defined and used.

Agreement

Written agreement (contract / order) between Client (may be Tata Steel or main contractor) and Contractor (may be main contractor or subcontractor), which includes an AGREEMENT for the execution of welding work for installations of Tata Steel, location IJmuiden.

Batch (or Group)

A batch (or group) is the amount of welds made by one welder with one welding method. It is used to determine the number of NDT welds to be tested based on the specified percentage of NDT. The specified percentage must always be applied per BATCH, not to the total number of welds made.

CBI

Dutch abbreviation for "Conformity Assessment Body", NL or EU, is the institute that assesses the conformity of a product (formerly AKI or NoBo)

C_{eq} (Carbon equivalent)

Carbon equivalent base material according to IIW formula:

$$C_{eq} = C + Mn / 6 + (Cr + Mo + V) / 5 + (Ni + Cu) / 15 \quad [\%]$$

Golden weld

The final tie-in weld that cannot be subjected to a pressure test. This weld shall be treated according to the Golden weld procedure.

ISO(-metric)

Isometric drawing made during the maintenance of pipework on the IJmuiden site. All welding-related and inspection-related matters are stated on the ISO before the maintenance or change is carried out.

KDT (Kwaliteits Dienst Techniek)

Tata Steel inspection department, department code PTC.CTY.KDT, email inspection@tatasteel.eu.com.

Magnetic Testing (MT)

Is an inspection technique to detect flaws at or close to the surface of ferromagnetic materials. As a rule, the workpiece is magnetized using an electric current (directly or indirectly), after which magnetizing iron particles are easily applied which will collect around a imperfection.

NoBo (nowadays CBI)

NoBos are institutions to which specific tasks have been assigned under the PED. They are designated by the national government under whose jurisdiction they fall and they are notified to the European Commission.

Non Destructive Testing (NDT)

Is a method of inspection with which an impression can be obtained of the quality of an object without damaging. It yields imperfections, indications, deviations, which need evaluation on acceptance or rejection. The most important NDT technique is visual examination, which shall always take place prior to any other NDT techniques. In choosing the NDT technology, due account shall be taken of factors such as material, nature of

possible deviations and accessibility of the object. Sometimes several NDT techniques have to be applied to supplement each other, to get a good overview of the imperfections present. Imperfections must have a certain minimum size to be detectable.

PED (Pressure Equipment Directive)

The PED, or Pressure Equipment Directive or European Directive 2014/68 / EU, is a directive for pressure containers issued by the European Community, which states that member states, including the Netherlands, are obliged to adopt the provisions of this directive and have a legal status. The PED is aimed at new installations.

Penetrant Test (PT)

The NDT method where only surface defects can be made visible, also in non-magnetic materials. The penetrant liquid can fill a deviation due to the penetrating effect. A developer is then applied to obtain a record of the deviations.

Phased Array Ultrasonic Technique (PA-UT)

Ultrasonic examination technique, whereby the sound beam is electronically controlled and focussed. The examination result is presented on a computer screen. Specialized equipment and probes are needed.

PQR (Procedure Qualification Record)

The PQR is a welding method qualification on behalf of the welding company, in which the welding parameters of a welding test carried out by the welding company are recorded together with its test results. It demonstrates that the welding company is able to reproduce welds that meet the prescribed requirements. Each PQR has its own validity range, derived from the welding parameters of the welding test conducted and based on a specified welding standard (EN-ISO 15614, T0210 etc.).

PRDA (Praktijk Regels voor DrukApparatuur)

The Dutch "Practice Rules for Pressure Equipment" states all legal & safety rules and requirements for the use phase of pressure equipment. The information helps organizations to work safely with pressure equipment, such as pressure vessels, installation pipes and safety fittings, according to Dutch laws. The PRDA deals with the phase of use and maintenance.

Pressure containers

Boilers, equipment, vessels, installation pipes and (safety) fittings, of which one or more spaces are pressurized (overpressure or vacuum service, without limit value).

Radiographic Testing (RT)

In radiographic examination, the workpiece to be examined is irradiated with X-rays or γ -rays. Imperfections such as weld defects, cracks, inclusions and porosities can be detected because the radiation is absorbed differently in an imperfection and in an equally thick, flawless material. The imperfections are recorded on a film for evaluation of weld quality and that can later also serve as evidence.

RToD (Regels voor Toestellen onder Druk / "Stoomwezen Rules")

The RToD is a Dutch design code for pressure containers, issued by SDU in The Hague, last edition (frozen) is September 2005. The RToD describes measures with regard to material, construction, manufacture, research, testing and use of devices under pressure, their protective equipment and other accessories.

Tata Steel Inspector

The IKT2, IKT3, LPI (IWE) or MLT (IWT) certified person designated by Tata Steel KDT who performs inspections on behalf of Tata Steel.

Tata Steel NDT expert

The ISO 9712 / SNT-TC-1A certified level 3 or level 2 from Tata Steel, appointed by KDT.

Tata Steel Welding expert

The LPI (IWE / EWE) certified welding expert from Tata Steel, appointed by KDT.

Tata Steel Project Manager

Designated project leader or contact person within Tata Steel organization who directly controls and / or monitors the implementation of the AGREEMENT.

ToFD (Time of Flight Diffraction)

An ultrasonic test technique for detection and flaw size determination of indications in welds and base material.

Ultrasonic Testing (UT)

Ultrasonic testing uses the phenomenon that homogeneous materials with a crystal structure that is not too coarse are good conductors of sound. Narrow sound beams can detect differences in the material up to a large distance from the surface. Data about the size and location of the deviation can be obtained. A distinction can only be made between flat and non-flat deviations. The method places high demands on the examiner in terms of skill and interpretation.

Ultrasonic Testing Phased Array (UT-PA)

Ultrasonic testing which uses probes with segmented crystals. The crystal segmentation allows computer controlled beam steering, both in angle as in focal distance. Results are plot on-screen, in D-scan (cross section) or C-scan (thickness mapping) lay-out.

Visual Test (VT)

In the visual examination, using simple aids with the naked eye, an examination is performed for visible imperfections, flaws. The distance from the eye to the surface to be examined shall be no more than 600 mm and light level at least 800 lumen.

Welding firm

Company (Contractor or subcontractor) who carries out the welding work specified in the AGREEMENT of the Client.

WPQR (Welder Performance Qualification Record)

The WPQR is a welder qualification, which states the welding parameters of a welding test carried out by the welder, together with their test results, demonstrating that the welder is able to reproduce welds that meet the prescribed requirements. Each WPQR has its own validity range, derived from the welding parameters of the welding test performed and based on a specified welding code such as EN ISO 9606-1, EN 14732 etc.

WPS (Welding Procedure Specification)

The WPS is a document that has been approved on the basis of an PQR and contains the required variables of the welding method to ensure repeatability in production. The WPS contains information on, among other things, the number of layers, the welding consumables, the process to be used, the welding position, the welding seam shape, the welding current, the preheating temperature, and so on. The WPS is 1) an instruction for the welder and 2) part of the as-built documentation. It must also be stated in a reproducible way, with welding parameters related to the product to be welded.

12 Referenced documents

This Tata Steel Standard refers to the following applicable standards:

NEN / EN / ISO / IEC-standards

NEN 2078	Requirements for industrial gas installations
EN 1011-2	Recommendations for welding of metals Part 2: Arc welding of ferritic steels
EN 1775	Gas pipes in buildings - Maximum working pressure less than or equal to 5 bar - Functional recommendations
EN 10160	Ultrasonic examination of flat steel products with a thickness equal to or larger than 6mm (reflection method)
EN 10204	Metal products; Types of inspection documents
EN 12074	Welding consumables - Quality requirements for the manufacture, supply and distribution of welding consumables for welding and related processes
EN 12732	Gas infrastructure – welding steel pipework – functional requirements
EN 13479	Welding consumables - General product standard for filler metals and fluxes for fusion welding of metallic materials
EN 13480	Industrial Piping
EN 15001-1	Gas installation pipelines with operating pressures greater than 0.5 bar for industrial and non-industrial gas installations - Part 1: Detailed functional requirements for design, materials, construction, inspection and testing
ISO 2553	Welding and soldering joints - Symbolic representation on drawings
ISO 3552-1	Non-destructive testing - Penetrant Examination-Part 1: General principles
ISO 3834	Quality assurance systems for welding; Fusion welding of metallic materials
ISO 5817	Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (excluding laser welding and electron beam welding) - Quality levels for imperfections
ISO 8501-3	Pre-treatment of steel for application of paints and related products - Visual assessment of surface cleanliness - Part 3: cleanliness levels of welds, saw cuts, and other areas with surface imperfections
ISO 9001	Quality management systems - Requirements
ISO 9013	Classification of thermal cuts - Geometrical product specification and quality tolerances
ISO 9606-1	Qualification of welders - Fusion welding - Part 1: Steel
ISO 9712	Non-destructive testing - Qualification and certification of personnel
ISO 10675-1	Non-destructive testing of welds Acceptance levels for radiographic testing Part 1: Steel, nickel, titanium and their alloys
ISO 11666	Non-destructive testing of welds - Ultrasonic examination - Acceptance levels
ISO 13916	Welding Guidance on the measurement of preheating temperature, interpass temperature and preheat maintenance temperature
ISO 13920	Welding - General tolerances for welded constructions. Length and angle measurements. Form and place.
ISO 14175	Welding consumables - Protection gases for fusion welding and related processes
ISO 14731	Welding coordination - Tasks and responsibilities
ISO 14732	Welding personnel - The qualification of operators and welding technicians for the mechanized and automated welding of metals
ISO 15609-1	The describing and qualifying of welding procedures for metallic materials - Welding method description - Part 1: Arc welding
ISO 15614-1	Describing and approving welding methods for metals - Welding method testing - Part 1: Arc and autogenous welding of steel and arc welding of nickel and nickel alloys
ISO 15626	Non-destructive testing of welds – Time-of-flight diffraction technique (TOFD) – acceptance levels
ISO/IEC 17020	Conformity assessment - General criteria for the functioning of different types of institutions carrying out inspections
ISO/IEC17021	Conformity assessment - Requirements for institutions that carry out audits and certification of management systems
ISO/IEC17025	Conformity assessment - Requirements for certification institutions that issue certificates for products, processes and services
ISO/IEC 17065	Non-destructive testing of welds - Visual inspection of fusion welded joints
ISO 17635	Non-destructive testing of welds - General rules for metals
ISO 17636-1	Non-destructive testing of welds - Radiographic examination - Part 1: X-ray and gamma-ray techniques with film
ISO 17637	Non-destructive testing of welds - Visual inspection of fusion welded joints
ISO 17638	Non-destructive testing of welds - Magnetic examination of welds

ISO 17640	Non-destructive testing of welds - Ultrasonic examination - Techniques, examination levels and assessment
ISO/TR 17663	Welding - Guidelines for quality requirements for heat treatment in connection with welding and allied processes ISO/TR 17671-2 Welding - Recommendations for welding of metallic materials Part 2: Arc welding or ferritic steels
ISO 23277	Non-destructive testing of welds - Penetrant examination of welds - Acceptability levels
ISO 23278	Non-destructive testing of welds - Magnetic examination of welds - Acceptability levels

Other standards, (national) guidelines

RToD-T0110 Non-destructive welding testing
RToD-T0111 Radiographic welding research
RToD-T0112 Visual investigation
RToD-T0117 Ultrasonic examination
RToD-T0201 Radiographic research
RToD-T0202 Ultrasonic examination
RToD-T0203 Surface research
RToD-T0210 Acceptance of welding methods
PED 2014/68 / EU Pressure Equipment Directive
PRDA Practice rules for Pressure equipment
WBDA 2016 Commodities Act Decree Pressure Equipment

Tata Steel Standards & Guidelines

S1481001 NDT percentages for metal piping
S3105601 Corrosion control through conservation

Tata Steel Documents & forms

The following documents and forms may apply during the preparation, execution and inspection of welding work, both in the shop and field:

S1450401 KDT-FORM-011 Inspection and Test Plan (ITP)
S1450401 KDT-FORM-019 "Golden weld" motivation
S1450401 KDT-FORM-020 Technical Query (TQ)
S1450401 KDT-FORM-032 Motivation Se75 examination thin wall
S1450401 KDT-FORM-044 Line Inspection Summary List (LISL)
S1450401 KDT-FORM-045 "Golden weld" procedure

The Tata Steel standards and guidelines, documents and forms can be downloaded via: www.tatasteel.nl/veiligheid

For the latest english version of the welding standard and of the forms mentioned above, please see following link:

<http://veiligheid.tatasteel.nl/nl/voorschriften/standaardisatie/tata-steel-standaards/werktuigbouwkunde/overige.html>.

13 Explanation of revisions

Version 7.0 Completely overhauled.