



S1 47 40 01 Tata Steel Standard

General requirements for testing of pipe systems

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Information and changes:

Document content

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1. GENERAL

1.1. Scope

This standard applies to the following situations:

1. Testing of new industrial pipe systems before first use.
2. Testing of an industrial pipe system when repairs and/or modifications have been made.

This standard does not apply to the following situations:

1. HVAC systems; refer to ATB-HVAC (e.g. central heating systems, radiators).
2. Pneumatic pipe systems; refer to R1 41 01 01 & R1 41 01 08.
3. Hydraulic pipe systems; refer to R1 42 01 01 & R1 42 01 08.

The objective of the tests is to determine whether the particular pipe(s) are strong enough to withstand the pressure they are designed to, including the applicable margins, and to determine whether the system is sufficiently leak-free. To test these aspects, a strength test and a leak test are carried out. These tests may be combined as a single test if the design code permits this.

This standard only applies to strength and leakage tests of metal and plastic pipe systems. Other aspects that influence the safety of pipe systems are not taken into account.

1.2. Rules

Through the implementation of this standard, Tata Steel IJmuiden creates a basis for compliance with the applicable requirements regarding the testing of pipe systems. The rules are mainly based on the requirements specified in the applicable design code. The choice for the design code should be specified in the order for new, modified or repaired pipe systems. The requirements set out in this standard apply additionally.

1.3. Safety

Tata Steel has drawn up this standard to set a standard procedure for testing metal and plastic pipe systems to ensure their safety. Before a pipe system is taken into use, all tests shall have been performed successfully.

If part of the system shall be secured before the tests are performed, the manager/owner of the system is responsible for carrying this out.

A previously specified safety distance and waiting time shall be observed while carrying out the tests (see chapter 3.5). If the safety distance is greater than 5 metres, a “high-level” work permit shall be used.

After the tests have been carried out, the person who carried out the tests is responsible for leaving the system in a safe state.

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2. Definitions and terminology

In this chapter, the most important terms are explained for the sake of clarity. As far as possible, the terms defined in the applicable standards and guidelines have been used. The terms are arranged in alphabetical order.

- Designer
The designer is the party that determines the design code and under whose responsibility the design specifications for one or more pipe systems are drawn up.
- Design code
Norm that sets out the requirements with regard to the design, manufacture and testing of the pipe system (e.g. EN 13480, EN 15001 or RtoD).
- Design pressure
The internal pressure, on which the calculations are based, taking the design code into account. The pressure a pipe system is designed to hold in terms of technical strength, may differ from the design pressure.
- Design specifications
The specifications as drawn up by the designer, including the requirements for the design, construction and testing of the particular pipe system and references to the applicable design code.
- Distribution medium
The medium that will be transported through the pipe system under normal operating conditions.
- Hydrostatic testing
Testing using water as the test medium.
- Inspection Test Plan (ITP)
The ITP sets out the various inspection points (hold, witness, surveillance and review points), as a result of the test plan.
- Leak test
The method used to test the pipe system for leaks.
- Modification
A modification to a pipe system is understood to mean a relatively small modification to the design of an existing pipe system. This includes installing a by-pass or an additional branch. In cases of doubt, department SPME-PTC-CTY-KDT-DTD should be contacted.

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- New pipe system
The construction of a new pipe systems implies building a new pipe system that does not involve any modification or repairs.
- NoBo (Notified Body)
The legally designated certifying organisation, for example, Lloyd’s Register, Gasunie, Kiwa.
- Operating pressure
The maximum pressure that may arise in any point in a system under normal operating conditions.
- Order
The agreement in writing between the principal and the contractor describing the new, modified or repaired pipe systems, including a reference to the applicable design code and possibly the design specifications.
- Permissible operating pressure
The maximum pressure for which a pipe system has been determined to be suitable by design.
- Pipe
Metal or plastic piping consisting of the pipe, fittings, flanges, gaskets, bolt connections, welds etc.
- Pipe system
The system of pipes including the related valves, instrumentation, equipment, etc.
- Pneumatic testing
Testing using air or nitrogen as the test medium.
- Pressure
Unless otherwise specified, this is the static overpressure compared to ambient pressure of the local environment.
- Repair
Repairs to pipe systems are understood to mean 1:1 replacement of a relatively small part of the existing pipe system. This includes replacing a pipe section, fitting or flange. In cases of doubt, the department SPME-PTC-CTY-KDT-DTD should be contacted.
- Safety zone
The area around the pipe system to be tested, determined by delineating the calculated safety distance.

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- Strength test
The method of testing the pipe system to test whether the pipe system is sufficiently strong.
- Tata Steel
Tata Steel is understood to mean Tata Steel IJmuiden BV, location IJmuiden.
- Tata Steel Inspector
The person designated by Tata Steel project leader or SPME-PTC-CTY-KDT who carries out inspections before and during the tests.
- Test medium
The medium used to fill the pipe system during testing of the pipe system.
- Test plan
The test plan sets out the steps required to carry out the tests including naming the authorised persons who will carry out the tests and will be permitted to enter the safety zone.
- Test pressure
The pressure at the highest point in the system during a test. This applies to the leak test and strength test.
- Test report
The test report describes the results of the tests.

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3. ASSUMPTIONS REGARDING TESTS

3.1. General

Assumptions described in this chapter shall be applied by the designer. By applying the assumptions, the designer will come to the proper test methods.

The test methods as described in the chosen design code, forms the basis for the test methods.

Before carrying out each test, the pipe system shall be inspected visually by the contracting company and the Tata Steel inspector to check that the connections and joints have been made properly (e.g. welds, flanges, supports, etc.).

Before carrying out a pneumatic strength test, the contracting company and the Tata Steel inspector shall ensure that all welds to be pressure tested have been 100% NDO inspected for compliance with the requirements of welding category 1 of the Tata Steel welding standard S1450401.

Pipes systems that are in immediate contact with the atmosphere (i.e. ventilation and blow-off pipes) are not tested for strength. Depending on the requirements specified in the design specifications and the design code for these systems, a leak test may possibly have to be carried out.

Pipe systems that are under pressure shall first be subjected to a strength test and then to a leak test unless the design specifications or design code specifies otherwise.

3.2. Test plan

For hydraulic tests with a test pressure greater than 5 barg and for all pneumatic tests, a test plan shall be drawn up by the company that will carry out the test. This plan shall be made available to the Tata Steel project leader at least two weeks before the actual test and assessed by the designated Tata Steel inspector. The test plan shall be approved before the tests are carried out.

For new pipe systems, the test plan shall meet the requirements of the design code specified in the design specifications. If the work concerns a minor modification to or repair of a pipe system, the test plan shall meet the requirements of the original design code (as used during original construction of the system, see the original drawings/calculations). If the design code is not known, it shall be determined according to Tata Steel standard S1475001. If this is not conclusive, department SPME-PTC-MCE-HPM should be contacted.

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The test plan shall at minimum cover the follow issues:

- 1) The design code
- 2) The test pressure and required hold time according to the design code.
- 3) The way in which the pressure is built up (pressure increase steps according to the design code).
- 4) Safety distance and waiting time according to appendix B.
- 5) The test medium.
- 6) Practical preparations.
- 7) The test-equipment that will be used and how it will function.
- 8) Possible additional measures that shall be taken for critical points in the pipe system.
- 9) Lay-out drawing with delineated safety zone.
- 10) A drawing of the test arrangement, including manometers, pressure/temperature recorders, thermometer, filling hose, operating valve, mobile gas cylinders containing the test medium, test unit, etc.
- 11) Test report filled in with general details, design details and test requirements, see appendix C.

3.3. Test medium

In general, air, nitrogen or water is used as the test medium. The choice depends to a large extent on the size of the pipe system and distribution medium. The test medium shall not, under any circumstances, be toxic, explosive or combustible. Furthermore, the medium should preferably not pose a risk of suffocation. The last requirement applies particularly in the case of enclosed spaces.

From a safety point of view, water is the preferable test medium. Exceptions are oxygen pipes or nitrogen pipes that can be used to flush oxygen pipes. In these cases, nitrogen is prescribed as the test medium (in accordance with EIGA IGC doc 33-06, appendix C, paragraph 4.5).

For hydraulic tests, uncontaminated fresh water should be used with a minimum temperature of 5 °C unless the design code specifies a higher temperature.

For pneumatic tests, the minimum wall temperature required is 5 °C unless the design code specifies a higher temperature.

In the case of stainless steel pipes and an operating temperature of <50 °C, the chloride content of the water may be a maximum of 200 mg/kg (200 ppm). If the operating temperature is higher, the chloride concentration may not exceed 2 mg/kg (2 ppm).

For determining the test medium see appendix A.

3.4. Test equipment

If the design code does not (adequately) specify the equipment to be used for testing, the following requirements apply:

- Pressure and temperature sensors and recorders shall have valid calibration certificates, not older than one year old.

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- Manometers used for strength tests shall meet the requirements of EN 837-1 class 1.0. For leak tests, manometers shall meet the requirements of class 0.6. The measurement range of manometers shall be such that the operating pressure falls within the range of 60% to 100% of the full scale.
- The accuracy of pressure recorders shall meet the requirements of class 1.0 of EN 837-1. The measurement range of recorder cards shall be such that the testing pressure is within the range of 60% to 100% of the full scale of the recorder card.
- Temperature sensors (e.g. pipe wall and ambient temperature) shall have an accuracy of ± 0.5 °C. The sensor shall have a measurement range of at least -5 to 40 °C.
- Fluids used to carry out soap bubble tests shall meet the requirements of EN 14291.

3.5. Safety distances and waiting times

When carrying out strength tests and leak tests, the minimum safety distance and minimum waiting time before each increase in pressure shall be observed in accordance with appendix B. This applies to both hydrostatic and pneumatic tests. The distances and times for the strength test and leak test shall be calculated separately.

The test equipment shall be set up so that it is possible to regulate and observe the test pressure from outside the safety zone. If mobile gas cylinders are used to build up the pressure, these cylinders shall be set up outside the safety zone.

While carrying out the strength test and leak test, the safety zone may only be entered if absolutely necessary and by as few (authorised) persons as possible. If the safety zone needs to be entered, this may only be done if the test pressure is constant and only after the specified waiting time has passed.

If implementing the safety zone would lead to serious problems, it is possible to reduce the safety distance if this is combined with additional measures. In this case, a Technical Query (see appendix D) shall be submitted to the SPME-PTC-MCE-HPM.

3.6. Marking of the safety zone

Barriers with the warning text “PRESSURE TESTING - NO ENTRY FOR UNAUTHORISED PERSONS” shall be set up on all access routes to the pipe systems.



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Buildings that are (partially) within the safety zone shall be evacuated completely or fenced off with red and white safety ribbon and/or a warning sign with the text “PRESSURE TESTING - NO ENTRY FOR UNAUTHORISED PERSONS”.

At the location where the test pressure is regulated and measured, locations where the safety distance is reduced locally (special situation) and or other locations where it is deemed necessary, the safety zone shall be marked with red and white safety ribbon.

3.7. Other general principles

The requirements below apply to every kind of pressure testing:

1. Prior to the placing of a casing pipe around underground pipes, the particular pipe section that will be installed in the casing pipe shall be pressure tested separately unless no (welded) joints will be present in the casing pipe.
2. Valves that will be pressure tested as part of the test shall always be in the open position. If a pressure separator is needed at the location of a valve with a flange, the valve shall be opened and a blind plate or blind flange shall be installed. If it is not possible to create a physical separation by the valve (for example a valve with welded end connection), the separator shall be installed at another location in the system between the section to be pressure tested and the rest of the system.
3. Bellows that are suitable for pressure testing shall be mechanically locked in the direction in which they are designed to move. Refer to the user instructions for the bellows concerned.
4. Valve and instruments that are not suitable for subjecting to the test pressure shall always be removed to prevent damage.
5. During strength tests and leak tests, the entire length of the pipe shall be accessible for visual inspection. Welded joints and a 50 mm zone on each side of welds shall be free of coatings and other preservative measures.
6. If requirements in terms of this standard are not feasible due to circumstances, the contracting company shall submit a Technical Query (see appendix D) to SPME-PTC-MCE-HPM for evaluation.

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4. TESTING PROCEDURE

4.1. General

Appendix A contains a flowchart that shall be used to determine the type of test to perform.

This chapter lists the main applicable design codes with potential additional information.

To prepare for the test, the contracting company shall adhere to the requirements in the order description, the design code and the design specifications and shall draw up and submit the following documents to the Tata Steel Inspector for approval:

- Inspection and Test Plan (ITP), including Hold, Witness, Surveillance and Review points (see appendix E)
- Test plan (if applicable)
- Test report (the general details, design details and test requirements shall be filled in, see appendix C).

To carry out the test, the required inspection points shall be carried out in chronological order according to the ITP and signed for by the parties involved. In all cases, the test operator from the contracting company and the Tata Steel Inspector, as well as the NoBo (if specified in the ITP), shall be present during the tests.

During the test, the contracting company shall fill in the test results on the test report.

After attending the test, the persons named above shall sign the ITP, the test report and the record cards.

Appendix C contains a template for a test report. The use of this template is obligatory for every test. It is permissible for the contracting company to use its own template, if it includes all the information specified in appendix C and this information is filled in.

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4.2. Possible design codes

Possible design codes are:

- EN 13480 (industrial pipe systems, general)
- EN 15001 (industrial pipe systems, gaseous media 0.5 - 60 barg, -20/+40 °C)
- EN 1775 (industrial pipe systems, gaseous media ≤ 0.5 barg)
- ISO 14692 (industrial GRP pipe systems)
- NEN 2078 (industrial pipe systems, gaseous media < 40 barg)
- NEN 3650 (industrial plastic pipe systems)
- RToD (industrial pipe systems, general)

Other design codes in consultation with SPME-PTC-MCE-HPM.

4.2.1. EN 13480

For strength and leak testing see paragraph 9.3 of EN 13480-5.

4.2.2. EN 15001

For strength and leak testing see paragraph 9.4 and appendix B of EN 15001-1. Tata Steel regards the safety distances give in paragraph 9.4.4 as being insufficient. For this reason, the safety distance shall be determined according to appendix B.

4.2.3. EN 1775

For strength and leak testing see chapter 6 of EN 1775.

4.2.4. ISO 14692

For strength and leak testing see paragraph 5.6 of EN 14692-4.

4.2.5. NEN 2078

For strength and leak testing see paragraph 5.6 of EN 2078. This standard now only applies to modified pipe systems that originally used design code NEN 2078. This design code can never apply to new pipe systems.

4.2.6. NEN 3650

With regard to strength and leak testing, paragraph 9.5 of NEN 3650-3 refers to paragraph 9.7.3 or NEN 3651. This design code can be applied to several kinds of pipe systems, but the tests specified in this code apply specifically to plastic pipe systems.

4.2.7. Dutch Rules for Pressure Vessels (Regels voor Toestellen onder Druk, RToD)

For strength and leak tests see T-0101, T-0240 and T-0255.

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5. References

This document refers to:

ATB-HVAC	General technical requirements for heating, ventilation, cooling and sanitary systems at Tata Steel Europe, IJmuiden site.
R1 41 01 02	Pneumatic guideline for suppliers, fitting companies, managers and users, part 2: General
R1 41 01 08	Pneumatic guideline for suppliers, fitting companies, managers and users, part 8: Selection of pipes
R1 42 01 02	Hydraulic guideline for suppliers, fitting companies, managers and users, part 2: General
R1 42 01 08	Hydraulic guideline for suppliers, fitting companies, managers and users, part 8: Selection of pipes
S1 47 50 01	Media Design Table
EIGA IGC	Cleaning of equipment for oxygen service - guideline doc 33-06
EN 1775	Gas supply – Gas pipework for buildings – Maximum operating pressure less than or equal to 5 bar – Functional recommendations
EN 13480	Metallic industry piping
EN 15001	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.
ISO 14692	Petroleum and natural gas industries. Glass-reinforced plastics (GRP) piping.
NEN 3650	Requirements for pipe systems
NEN 3651	Additional requirements for pipes where they cross important waterways, dikes, dams and similar public works
RToD	Dutch Rules for Pressure Vessels (Regels voor Toestellen onder Druk)
T-0101	First certification: nature, size and requirements (RToD)
T-0240	Pressure testing: Procedure (RToD)
T-0255	Leak testing procedure (RToD)

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6. Revisions

Version 1.0

This edition replaces HO standard 00.57.40.001

Version 2.0

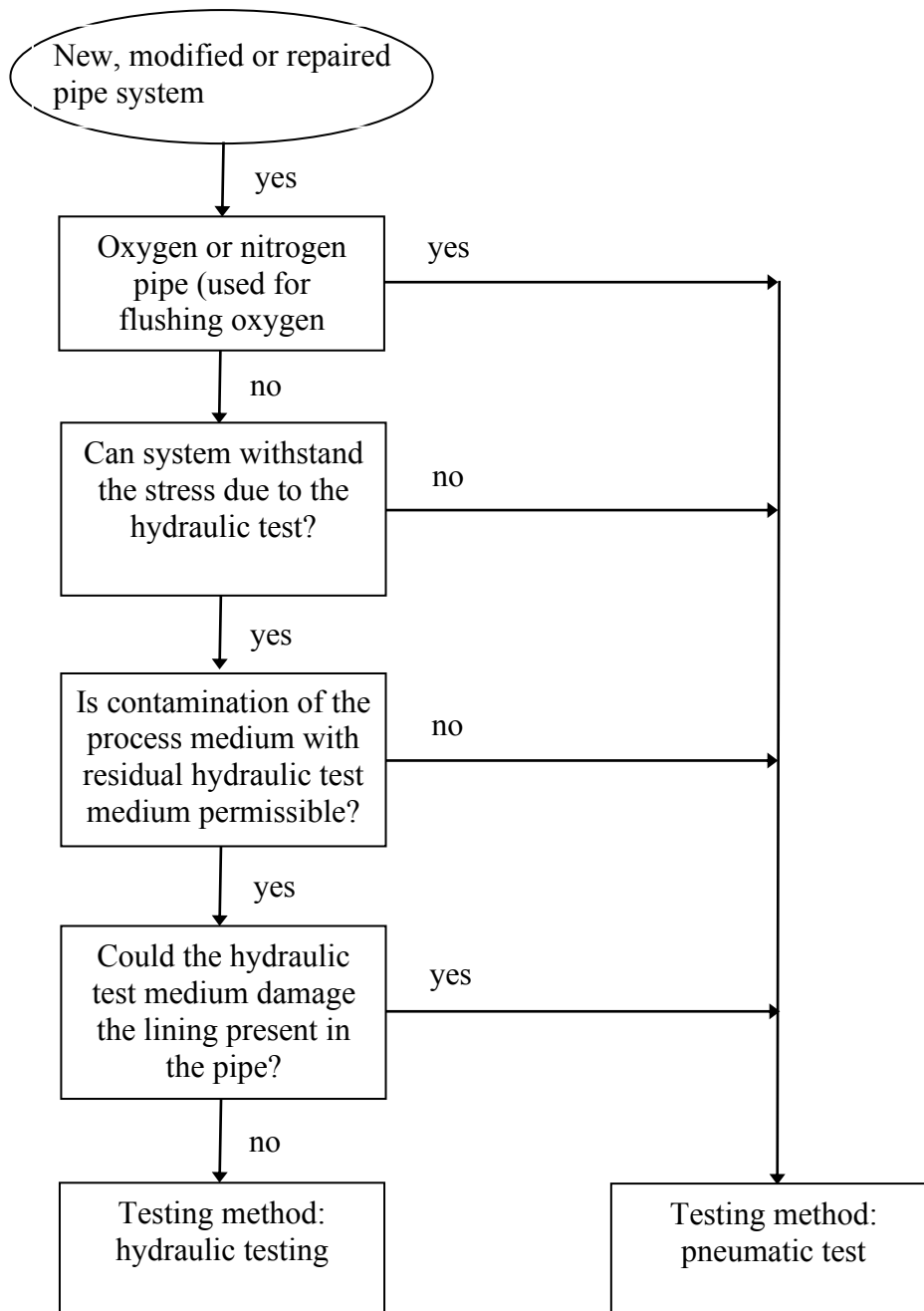
Completely revised version

Version 3.0

Completely revised version

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7. Appendix A: Flowchart for determining the testing method



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8. APPENDIX B: Safety distances and waiting times

This appendix applies to **all** cases, no matter which design code was used. If the correct distance and waiting time cannot be determined successfully, department SPME-PTC-MCE-HPM shall be contacted.

8.1. Hydraulic tests

The formula below applies to hydraulic tests:

$$l = 0,15 \cdot D_i \cdot \alpha^{0,4} \cdot \left(\frac{p_t}{\sqrt[3]{\rho_r}} \right)^{0,6}$$
$$t = \max [10 \cdot l ; 300 \text{ s}]$$

Where:

- l : safety distance (metres)
- D_i : internal diameter of pipe (metres)
- α : l_i/D_i (-)
- l_i : length of the pipe section to test (metres)
- p_t : test pressure (bars)
- ρ_r : density of the liquid used for pressure testing relative to water (-)

The minimum safety distance for hydraulic tests is 5 metres

8.2. Pneumatic testing

The formula below applies to pneumatic tests:

$$l = 3,6 \cdot \sqrt[3]{V \cdot \{(p_t + 1) - (p_t + 1)^{0,714}\}}$$
$$t = \max [10 \cdot l ; 300 \text{ s}]$$

Where:

- l : safety distance (metres)
- V : capacity of the pipe system (m³)
- p_t : test pressure (bars)
- t : waiting time (seconds)

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9. APPENDIX C: Template for the test report

TATA STEEL		WORK UNIT: << WORK UNIT >>	PROJECT NUMBER: << PROJECT NUMBER >>
		PROJECT: << PROJECT >>	DOCUMENT NAME: << DOCUMENT NAME >>
TEST REPORT			
GENERAL			
Contracting company			
Description of object			
Extent of object	from		to
Drawing no. + version			version
Test location			
Test number			
Date / time pressurisation started	date		time
<< ADDITIONAL GENERAL DETAILS >>			
DESIGN DETAILS			
Distribution medium			
Design code			
Design pressure		bar	
Design temperature - underground		min.	max. °C
Design temperature - above ground		min.	max. °C
Object diameter / length / contents		mm	metre m ³
<< ADDITIONAL DESIGN DETAILS >>			
TESTING REQUIREMENTS			
Testing standard Tata Steel + version		S1 47 40 01	version
Testing procedure + version			version
Testing method: strength test or leak test		strength test	leak test
Test medium		water	nitrogen
Required max. chloride concentration (for stainless steel) and water use		≤ 2 ppm	200 ppm
Required temperature of metal		min. °C	max. °C
Required test pressure Pt		bars	tolerance +/- bar
Required safety distance		metre	
Required pressure increase steps		0.6Pt	0.9Pt
Required waiting time after each increase in pressure		min	Pt
Required stabilisation time		min	
Required time for application of test pressure		min	
Max. permissible pressure drop after application time		mbars	
Required inspection pressure for visual inspection		bar	n/a
Required inspection pressure for soap bubble test of welds		bar	n/a
Required inspection pressure for soap bubble test of flange/thread seals		bar	n/a
Pressure recording with manometer required		yes	class n/a
Pressure recording with pressure recorder required		yes	class n/a
Measurement of metal temperature with contact thermometer		yes	class n/a
Measurement of metal temperature with temperature recorder		yes	class n/a
<< ADDITIONAL TESTING DETAILS >>			
MEASURING EQUIPMENT			
Registration number of contact thermometer			Calibration report attached
Registration number of temperature recorder			Calib. report + recorder card attached
Registration number of manometer			Calibration report attached
Registration number of pressure recorder			Calib. report + recorder card attached
<< ADDITIONAL MEASURING EQUIPMENT >>			
TEST RESULTS			
Measured chloride concentration in water as measured		ppm	Test report attached
Temperature of metal measured with contact thermometer		min. °C	max. °C
Temperature of metal measured with temperature recorder		min. °C	max. °C
Pressure start of hold time using manometer		start bar	end bar
Pressure start of hold time using pressure recorder		start bar	end bar
Chloride concentration		ACCEPTED / N/A	REJECTED
Temperature measurement on the wall		ACCEPTED / N/A	REJECTED
Pressure drop		ACCEPTED / N/A	REJECTED
Visual inspection for corrosion / leaks		ACCEPTED / N/A	REJECTED
Soap bubble test of weld		ACCEPTED / N/A	REJECTED
Soap bubble test of flange/thread seals		ACCEPTED / N/A	REJECTED
Test as a whole: accepted / rejected		ACCEPTED	REJECTED
<< ADDITIONAL TEST RESULTS >>			
WITNESSED BY TATA STEEL		WITNESSED BY CONTRACTING COMPANY	
Name		Name	
Position		Position	
Department		Department	
Date		Date	
Signature/ stamp		Signature/ stamp	


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10. APPENDIX D: Technical query

		Technical Query	
Project: Item number:		Principal: Corus Staal BV Contract number:	
Supplier: Contract number:		Subcontractor: Contract number:	
Query type (crossmark with "X", as applicable) <input type="checkbox"/> Reporting contradiction in Contract requirements <input type="checkbox"/> Reporting error in Contract requirements <input type="checkbox"/> Reporting omission in Contract requirements <input type="checkbox"/> Reporting ambiguities in Contract requirements <input type="checkbox"/> Request for deviation of Contract requirements			
Query subject:			
Query description			
Contract requirement			
Contract paragr.:	Doc. No.:	Doc. No.:	Part No.:
Contract paragr.:	Doc. No.:	Doc. No.:	Part No.:
Consequence of Query			
Quality:			
Other:			
Commercial consequences, if any, shall be reported by the Contractor in the event of a Technical Query without commercial consequences. In the event of unforeseen consequences, the Contractor shall report them in the event of a Technical Query without commercial consequences. In the event of unforeseen consequences, the Contractor shall report them in the event of a Technical Query without commercial consequences.			
Approval shall be given by the Contractor in the event of a Technical Query without commercial consequences. In the event of unforeseen consequences, the Contractor shall report them in the event of a Technical Query without commercial consequences.			
Deviation accepted (Y/N): _____ Contract Change to be issued (Y/N): _____			
Query registration		TQ-number:	
Query issued by		Query appraised by	
signature:		signature:	
name:		name:	
function:		function:	
company:		company:	
date:		date:	

11. APPENDIX E: Inspection and Test Plan

Tata Steel Strip Products IJmuiden Kwaliteitsdienst Techniek								
Inspection and Test Plan (ITP)						Document approved:		
						Supplier	Authority	Tata Steel
Principal	Tata Steel		Project No.	:		Document No.	:	
Tata PO No.	:		Item No.	:		Revision No.	:	
Supplier	:		Article	:		Issue Date	:	
Supplier PO No.	:		Article No.	:				
No.	Description	Inspection Point	Specification	Acceptance Criteria	Signing Off ¹⁾			
					Sub contractor	Supplier	Authority	Tata Steel
1) H = Holdpoint, W = Witness Point, R = Document Review, M = Monitor								
This report does not discharge the supplier of his responsibility to deliver the work in accordance with the order and the herein mentioned specification.								
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