



NET4GAS, s.r.o

HP PIPELINE DN1400, NODE KATEŘINSKÝ POTOK - NODE PŘIMDA

WELDING SPECIFICATION

27.11.2018

DVZ

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1 INTRODUCTION

This Specification covers field welding of line pipes and pipeline appurtenances for the pipeline constructed in scope of work of Project.

It applies to butt-welding, fillet welding and socket welding of pipes, valves, bends, flanges, branch outlet fittings and other fittings in carbon steel and low alloy steel for construction of main line pipes and block valve station piping systems relating to the Project

It includes welding procedures, welder qualification, welding and repairs. This Specification will be applicable for welding of line pipe and block valve stations piping.

The specification outlines the execution of pipeline welds on steel pipe material grade L485ME manufactured according to standard CSN EN ISO 3183.

This specification be focused on the electric arc welding process to be used on butt weld joint pipes for the construction of high pressure gas pipeline.

Generall the welding processes for main line pipe are considered as following:

- Manual, with covered electrodes (SMAW);
- Semiautomatic, mechanised or automatic with gas protection (GMAW);
- Semiautomatic, mechanised or automatic with or without gas protection, flux cored wire (FCAW);

2 GENERAL

2.1 Environmental conditions

The environmental conditions, operating conditions, product data, etc. under which the pipeline shall operate are defined in the relevant Project specifications.

2.2 Definitions

Term	Explanation
Project	High Pressure Pipeline DN 1400, Node Kateřinsky Potok- Node Primda
Employer	NET4GAS
Consultant	ILF Consulting Engineers
Contractor	Means responsible contractor regarding engineering, manufacturing and supplying of total scope as outlined within this

	specification
Others	Other Suppliers to the Project
Third Party	Independent experienced and approved expert/authorized institute
Employer's Supervisor of works	Carries out all the required works assigned to him by the Employer by proxy or by contract, in the interest of the Employer.

Further the following definitions shall be applicable:

Welding Procedure Specification (WPS):

A written procedure, based on applicable codes, standards and good engineering practice and listing the materials, detailed method and parameters to be employed during welding of a joint.

Welding Procedure Qualification (WPQ):

A demonstration of welding a joint (qualification weld) by using approved equipment and methods, utilizing the parameters outlined in the proposed specification (pWPS). To demonstrate that the given weld will have suitable mechanical properties and soundness the qualification weld has to be subjected to non-destructive and destructive testing.

Welding Procedure Qualification Record (WPQR):

A document containing all information concerning the welding of the qualification joint (as run parameters, detailed methods and conditions) as well as the results of the subsequent tests, material certificates, calibration certificates etc.

Welder Qualification:

Demonstration of the abilities of the welder to produce a weld that meets the requirements of the applicable qualified WPS. The qualification weld has to be subjected non-destructive testing.

2.3 Related documents

No.	Number	Title
1	C4G-HPPL-ILF-GENER-STR-SPC-822	NDT Specification
2	C4G-HPPL-ILF-GENER-	Line Pipes DN1400 - Specification

	STR-SPC-813	
3	C4G-HPPL-ILF-GENER-STR-SPC-811	Insulation Joint \geq DN 300 Specification
4	C4G-HPPL-ILF-GENER-STR-SPC-805	Fittings (T-pieces, Reduction pieces, Caps) \geq DN 300 - Specification
5	C4G-HPPL-ILF-GENER-STR-SPC-814	Line Valves DN1400 - Specification

2.4 Abbreviations

ISO	International Organisation for Standardisation
EN	European Standard
SMAW	Shielded Metal Arc Welding
GMAW	Gas Metal Arc Welding
TIG	Tungsten Inert Gas Welding
MIG	Metal Inert Gas Welding
MAG	Metal-arc Active Gas Welding
FCAW	Flux-cored wire metal arc welding with inert gas shield
pWPS	preliminary Welding Procedure Specification
WPQ	Welding Procedure Qualification
WPQR	Welding Procedure Qualification Record
WPS	Welding Procedure Specification
HV	Vickers Hardness
NPS	Nominal Pipe Size
MPI	Magnetic Particle Inspection
RT	Radiographic Testing
UT	Ultrasonic Testing
HAZ	Heat Affected Zone
TPG	Technical Rules
TP	Technical Guidelines

2.5 Codes and Standards

The latest editions of the following standards and guidelines shall establish the minimum standards for work:

No.	Number	Title
1	ČSN EN 1594	Gas supply systems - Pipelines for maximum operating pressures over 16 bar – Functional requirements
2	CEN ISO/TR15608	Welding - Guidelines for a metallic material grouping system
3	ČSN EN ISO 3183	Petroleum and natural gas industries – Steel pipe for pipeline transportation systems
4	ČSN EN 1708-1	Welding – Basic welded joint details in steel – Part 1: Pressurized components
5	ČSN EN 10204	Metallic products - Types of inspection documents
6	EN 12732	Gas supply systems - Welding steel pipe works - functional requirements
7	ČSN EN ISO 14732	Welding personnel – Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic
8	ČSN EN ISO 15609-1	Specification and qualification of welding procedures for metallic materials - welding procedure test
9	ČSN EN ISO 15614-1	Specification and qualification of welding procedures for metallic materials - welding procedure specification
10	ČSN EN ISO 17639	Destructive tests on welds in metallic materials - Macroscopic and microscopic examination of welds

No.	Number	Title
11	ČSN EN ISO 3834	Quality requirements for fusion welding of metallic materials Part 1-Criteria for the selection of the appropriate level of quality requirements Part 2-Comprehensive quality requirements Part 5-Documents with which it is necessary to conform to claim conformity to the quality requirements of ISO 3834-2 ISO 3834-3 or ISO 3834-4
12	ČSN EN ISO 4136	Destructive tests on welds in metallic materials - Transverse tensile test
13	ČSN EN ISO 5173	Destructive tests on welds in metallic materials - Bend tests
14	ČSN EN ISO 5817	Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections
15	ČSN EN ISO 6507	Metallic materials - Vickers hardness test
16	ČSN EN ISO 6892	Metallic materials - Tensile testing
17	ČSN EN ISO 9015	Destructive tests on welds in metallic materials - Hardness testing
18	ČSN EN ISO 9016	Destructive tests on welds in metallic materials - Impact tests - Test specimen location, notch orientation and examination
19	ČSN EN ISO 9606-1	Qualification testing of welders - Fusion welding
	ČSN EN 50504	Validation of arc welding equipment specifies validation methods for arc welding equipment
20	ISO 148	Metallic materials - Charpy pendulum impact test
21	ČSN EN ISO 17636-1	Non-destructive testing of welds - Radiographic testing - Part 1: X- and gamma-ray techniques with film
22	ČSN EN ISO 17637	Non-destructive testing of welds - Visual testing of fusion- welded joints

No.	Number	Title
23	ČSN EN ISO 17638	Non-destructive testing of welds - Magnetic particle testing
24	ČSN EN ISO 10675-1	Non-destructive testing of welds - Acceptance levels for radiographic testing - Part 1: Steel, nickel, titanium and their alloys
25	ČSN EN ISO 10863	Non-destructive testing of welds - Ultrasonic testing - Use of time-of-flight diffraction technique (TOFD)
26	ČSN EN ISO 15626	Non-destructive testing of welds - Time-of-flight diffraction technique (TOFD) - Acceptance levels
27	ČSN EN ISO 23278	Non-destructive examination of welds - Magnetic particle testing - Acceptance levels
28	SM_I05_02_01	Principles of Occupational Health and safety organization
29	TPG 702 04	Gas Mains and Service Pipelines of Steel for Maximum Operating Pressure up to 100 bar included
30	TPG 923 01	Certification of processes testing the professional level and working qualities in the field of gas installation
31	TPG 905 01	Basic Safety Requirements for Operating Gas Facilities
32	TP T01 01 01 03	Principles for the design, construction, reconstruction and repair of HP pipelines and connections up to 100 bar.

2.6 Conflicting requirements, exceptions

The Contractor shall notify the Employer representative of any conflict between this specification, the related datasheets, the Codes and Standards and any other Specifications included as part of the documentation package.

Any exceptions to this Specification and referenced documentation, resolution and / or interpretation precedence shall be obtained from Employer representative in writing before proceeding with the construction.

Contractor must use an appropriate welding and alignment method with respect to the real geometrical parameters of pipes and other material (tolerances of outside diameter, out-of-roundness, wall thickness, geometric of welding edges, etc. Refer to related Specification for line – pipe, fittings and valves as listed in the chapter 2.5

2.7 Technical requirements

In general the requirements of TPG 702 04 chapter 7.5, TP_T01_01_01_03 and EN 12732 shall be fulfilled.

The selected welding technology must be based on the qualitative and geometric parameters of the pipes, fittings and other material formulated in the purchasing specifications referred to in chapter 2.3.

3 MATERIALS

3.1 Base Materials

3.1.1 Pipes and pipe sections identification

Before welding, the pipe number shall be marked out on the outside surface of all the pipes.

Contractor is responsible for the proper remarking of products with certification after cutting of certified pipes. This activity shall be provided by authorized Contractor inspector only. This authorisation shall be approved by Employer's inspection representative.

Sections not giving this information shall not be welded in the line.

3.1.2 Inspection of the ends to be welded

Before welding is carried out, the Contractor shall visually check the condition of the pipes, fittings and the ends of the pipes in order to ascertain they are not dented, cut, split or out-of-roundness. Defects must be notified to the Supervisor of works / Third Party who will decide on whether to install or reject the pipe.

If the supplied pipe shows any bevel damage or has been repaired the bevel ends of the cut pipe shall be prepared and inspected as stated below. This also applies to pipes, which have been cut to shorter length.

Pipes, valves and fittings to be supplied with bevel design in accordance with the specifications mentioned in chapter 2.3.

If necessary pipe ends shall be beveled by machining, grinding or machine thermal cutting.

Fusion faces and the surrounding surfaces within 25 mm of the joints shall be free from heavy scale, moisture, oil, or any other substance that may have a detrimental effect on the weld quality.

If a gas cutting machine is used, the edges shall be free of slag and the cut surface shall be machined or ground back removing the heat-affected area. After grinding the beveled edges shall be visually and MT examined to ensure no defects.

If the pipe is cut back more than 100 mm from the factory bevel, the pipe end shall also be ultrasonic tested in accordance with original mill standard to ensure that no laminations are present.

3.2 Filler Materials

3.2.1 Filler material I classification

Weld materials shall generally correspond to one of the following specifications or equivalent:

Filler materials must comply with applicable ČSN EN ISO 2560, ČSN EN ISO 636 (GTAW), ČSN EN ISO 14341 (GMAW) or ČSN EN ISO 17632 (FCAW) requirements. Other filler materials to the above Specifications may be used only with the authorization of the Supervisor of works / Third Party. In any case, the filler materials used for production welds shall be the ones indicated in the qualified WPS.

Filler metal identification, trade name and batch certificates shall be kept and maintained during the entire welding operation. Filler metals should be used from Employer pre-qualified producers ESAB, Böhler or Lincoln. If Contractor intends to use filler metal from other producers, these producers require prequalification form Employer in advance.

The Contractor must supply the certificates of chemical analysis and mechanical tests of the filler materials in accordance with ČSN EN 10204 type 3.1.

Using of additional material will be verified on a test weld pre-production welding test. The test welds will undergo non-destructive and destructive tests in the scope of the WPQR according to ČSN EN ISO 15614-1

The Supervisor of works / Third Party may, at his discretion, verify the characteristics of the filler materials.

Filler materials for welds shall meet the same minimum impact test requirements as those imposed on base metals.

3.2.2 Storage and handling of filler materials

Electrodes, filler wires, and fluxes shall be kept clean, dry, and properly stored according to the manufacturer's recommendation and in accordance with Contractor's approved welding consumable storage procedure.

Any consumables that cannot be properly identified or are damaged or contaminated in any way shall be segregated and removed from the job site.

3.3 Gases for Welding

Gas mixtures for welding shall comply with the requirements according to ČSN EN ISO 14175. Mixtures other than those in the above Specification may be used only with the authorization of the Supervisor of works / Third Party. In any case, the gas mixtures used for production welds shall be the ones indicated in the qualified WPS.

The Contractor must ensure the constant degree of purity, humidity and gas mixture composition indicated in the qualified WPS.

4 QUALIFICATION OF WELDING PROCEDURES

4.1 General

In general the requirements of ČSN EN 12732 and ČSN EN ISO 15614-1 shall be fulfilled in addition to the requirements mentioned in this specification.

Written procedures, based on ČSN EN ISO 15609-1, listing the materials, detailed method and parameters to be employed during welding, shall be prepared.

All testing equipment and facilities shall be supplied and/or at least one accredited and experienced test laboratory has to be nominated to perform all necessary destructive and non-destructive testing as per requirements of this specification and other referenced standards and specifications.

The equipment and facilities shall be subject to approval by Employer.

Sufficient notice shall be given before commencement of any procedure qualification and related testing.

The Employer has the right to supplement or amend/reduce evaluated acceptance criteria of welds after submission of specific welding procedures or during construction.

Procedure qualification previously performed in accordance with ČSN EN ISO 15614-1 may be considered applicable at discretion of the Employers or Third Party, provided that they will fulfil the remaining requirements and they will be suitable/applicable for project parameters.

The Contractor must beforehand present to the Third Party and Employer's supervisor of works the preliminary welding procedure specifications (pWPS) for approval.

The welding procedure specification shall be developed in accordance with EN ISO 15609-1 and must also contain the additional information in order to reflect specific conditions applicable for pipeline welding. Also procedures for repair welding shall be qualified. For details see the respective chapters of this specification.

The Contractor must be certified according to ČSN EN ISO 3834-2. Employers, Third Party and Employer's supervisor of works has the right to carry out inspections / audits of any phase of the welding process.

4.1.1 Qualification test

Preparation of test samples and testing shall be performed at an approved test laboratory.

After Employer and Third Party approval of the preliminary WPS, the Contractor must demonstrate the suitability of the procedure he has proposed by means of a welding procedure qualification (WPQ).

This WPQ has to be performed in accordance to ČSN EN ISO 15614-1.

The Contractor shall notify the date and place where he intends to carry out the WPQ.

The qualification test shall be carried out in accordance with the pWPS and must adequately simulate the on-site welding conditions, including lining-up, pre-heating, tacking, root-welding, lifting and lowering operations, clamp removal, etc.

All welding parameters and conditions influencing the essential variables shall be recorded.

The Employer's supervisor of works / Third Party must immediately notify the Employer of the result of the WPQ.

Before starting production work, the Contractor must have the welding procedure qualification report (WPQR) issued with the mechanical test certificates, the NDT reports, etc. and handed over to Employer's Supervisor of works / Third Party. The reports must be conserved on the site for the entire duration of the work.

4.1.2 Qualification validity

If the Contractor intends to make changes to the qualified WPS which exceed the allowed variations given in Paragraph 8 of ČSN EN ISO 15614-1, he/she must present the new WPS to the Employer's Supervisor of works / Third Party for approval and requalification.

In addition to the requirements of ČSN EN ISO 15614-1 the following shall be considered as essential variable:

- change of the geometry of the bevel outside the tolerances stated in the qualified welding procedure

4.1.3 Qualification confirmation

Regardless whether the Contractor has pre-qualified WPQR since the past or newly qualified WPQR for this project, a pre-production weld test on site shall be done before the commencement of the field welding. This weld will be a subject of VT and NDT determined for the field welds by NDT Specification Doc. Nr. C4G-HPPL-ILF-GENER-STR-SPC-822 as well as of destructive mechanical tests with scope and criteria in line with the requirements of ČSN EN ISO 15614-1.

4.1.4 Grouping of Materials

The applicable welding standards EN 12732 1104 and ČSN EN ISO 15614-1 allow a wide range of materials to be grouped for the qualification of welding procedures. This can be considered sufficient for most applications in pipeline construction.

However, taking the project specific parameters like operating pressure, stress levels, environmental hazards or hazards for population in case of pipeline fail-ure etc. into consideration it is good engineering practice to qualify separate procedure for case where materials of considerable different strength, chemical properties, heat treatment conditions etc. shall be welded together.

Different requirements for material grouping shall be identified in the standard CEN ISO/TR15608 - Welding - Guidelines for a metallic material grouping system.

4.2 Testing of Welded Joint for Qualification

Each test weld, carried out for the qualification of the WPS presented by the Construction Contractor, shall pass the non-destructive testing (visual, radiographic, ultrasonic) and the destructive testing as required by ČSN EN ISO 15614-1 and this specification.

If a mechanical tests fail for whatever reason, the contractor shall immediately investigate the causes of the failure, and take all necessary actions including but not limited to retest and/or re-evaluation of WPQR parameters.

If after re-testing as described below the qualification weld finally fails to meet the minimum requirements, a new WPS proposal shall be established and qualification welding and testing repeated.

If the test joint finally fails to meet the minimum requirements, a new WPS proposal shall be established and qualification welding and testing repeated.

4.2.1 Visual examination (VT)

The visual examination shall be performed by the Inspector of Construction Contractor both during and after the weld execution in accordance with ČSN EN ISO 17637. The visual examination shall be carried out by minimum Level 2 Inspector according to ČSN EN ISO 9712.

The Inspector must check that all the operations are in compliance with the approved WPS, that no operative difficulties occur, that there are no surface defects exceeding the acceptance limits of the applicable standards and this specification.

The weld and adjacent surfaces shall be free from cracks, craters, pores and other surface imperfections and shall be evaluated following ČSN EN ISO 5817 Class B.

If operative difficulties occur, the test weld will be considered as rejected and the WPS shall be updated.

4.2.2 Other NDT examination

All Qualification Welds shall be subjected to NDT after the completion of welding. Where post-weld heat treatment is necessary, this shall be performed prior to NDT.

NDT shall consist of the following:

- Radiographic testing and/or
- Ultrasonic testing and/or
- Magnetic Particle Inspection

as applicable to the joint design and the specific requirements.

NDT shall be carried out and evaluated according to NDT Specification Doc. Nr. C4G-HPPL-ILF-GENER-STR-SPC-822 Destructive examination

After passing NDT, the test weld shall be subject to destructive testing.

For destructive testing as a minimum all Qualification Welds shall be subjected to Macro Examination, Hardness Test, Transverse Tensile Test, Bend Test and Charpy Test as described below, supplemented by further tests required in the applicable standards.

Table 1. The following schema states the required destructive testing.

Test	Transverse Tensile Test	Bend Test	Macro Examination	Hardness Test	Charpy Test
Reference Standard	ČSN EN ISO 6892-1 ČSN EN ISO 4136	ČSN EN ISO 5173	ČSN EN ISO 17639	ČSN EN ISO 6507-1 ČSN EN ISO 9015-1	ISO 148-1 ČSN EN ISO 9016
Number of Specimen	2	2 + 2 (cap and root)	1	1	2 + 2 (cap and root)

The test temperature shall be the minimum design temperature.

The accredited laboratory, selected by Construction Contractor to carry out the tests, must be approved by the Employer's supervisor of works / Third Party.

4.2.3 Transverse tensile test

Preparation:

The specimens for transverse tensile must have the dimensions as indicated in ČSN EN ISO 4136.

They must be cut with a tool or by oxygen flame cutting, but in the latter case the specimens must be machined so that the sides are smooth, parallel and not affected by heat input.

Method:

Tensile test specimens must be broken under an axial load. The tensile strength must be calculated by taking the ratio between the maximum load recorded during the test and the initial transverse area of the test piece before the test.

The test for transverse tensile must be carried out in accordance with ČSN EN ISO 4136.

Requirements:

The tensile strength of the welded area must be equal to or greater than the specified minimum tensile strength ensured by the base material of the pipe, but it is not necessary for it to be equal to or greater than the actual tensile strength of the base material of the pipe.

If the specimen breaks outside the welded area, i.e. in the base material, and complies with the specified minimum required tensile strength requirements, the weld shall be considered in compliance with the requirements.

If the test piece breaks in the weld or the heat affected zone (HAZ) and its tensile strength is equal to or greater than the minimum required tensile strength of the base material of the pipe, then the weld shall be considered in compliance with the requirements.

If the specimen breaks in the weld or the HAZ and its tensile strength is less than the minimum specified for the base material of the pipe, the weld must be rejected and a new test weld must be made.

If the specimen breaks outside the welded area with a tensile strength less than the minimum specified for the base material of the pipe, a new tensile specimen will be prepared and tested. If this second test also fails to meet the minimum requirements, a new weld shall be made. The Employer's supervisor of works / Third Party shall notify the Employer of the event.

4.2.4 Transverse bend test

Preparation:

The transverse bend test specimens shall be prepared in accordance with ČSN EN ISO 5173. For pipe wall thicknesses of 12 mm and exceeding, four side bend specimens shall be prepared. For thinner pipe, two root and two face bend specimens are recommended.

Method:

The test must be carried in accordance with ČSN EN ISO 5173.

The mandrel must be forced between the groove and the support rollers until the test piece takes on approximately the shape of a U.

The dimension of the mandrel to be used in the test must be 4t.

Requirements:

The bending test must be considered acceptable when the specimen, after bending, shows no cracks greater than 3.0 mm and 1.5 mm in the longitudinal and transverse direction, respectively.

Cracks originating at the edges of the specimen during bending shall not be taken into consideration unless they originate from obvious weld defect.

4.2.5 Macroscopic examination

Preparation:

The specimens shall be prepared in accordance with ČSN EN ISO 17639.

The specimens shall be carefully examined under a microscope with a magnification of at least 5 times (5:1).

Requirements:

The results of the examination shall comply with the requirements of Evaluation Class B according to ČSN EN ISO 5817.

The welded joints must show good penetration and fusion. No evidence of cracking, imperfections, inclusions or other deleterious features is allowed.

4.2.6 Hardness test**Preparation:**

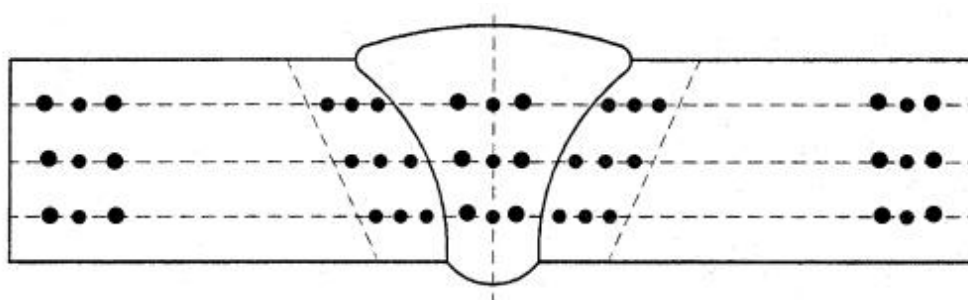
On all the cross-sections subjected to the macroscopic examination. The hardness indentations shall be made in symmetry with the centre line of the joint and distributed on three horizontal alignments (traverses), as shown in Figure 1:

- the first one at a maximum of 2 mm from the external surface of the pipe (cap);
- the second one at approximately half of the pipe wall thickness (mid-weld), if applicable, depending on the bevel configuration (welding from both sides) and wall thickness;
- the third one at a maximum of 2 mm from the internal surface of the pipe (root).

The indentations must be two on the base metal, six in the heat affected zone and one on the weld metal at the centre line of the joint for each of the three alignments.

For each traverse, 3 individual indentations per area (both parent metals, both heat affected zones and weld metal), shall be recorded, as shown in figure 1.

Figure 1 Schematic presentation of specimen for Vickers Hardness testing



Note: Distance of the indentations in HAZ 0.5 mm and in any case greater than 2.5 times the dimension of the indentation.

Method:

The test shall be carried out accordingly to the method Vickers in accordance with ČSN EN ISO 6507 - 1 and ČSN EN ISO 9015-1, using a load of 98.07 N (10 kgf).

Requirements:

Each single value of each area tested shall not exceed the value listed in Table 2 below.

Table 2 Permitted maximum hardness values HV10

Hazard location	WM		HAZ		PM
	Root	Cap	Root	Cap	---
Welding proces	275	275	350	350	300

4.2.7 Impact test Charpy-V notch

Preparation:

The number of specimens is indicated in Table 3. They shall be withdrawn from the weld complying with the positions indicated in ČSN EN ISO 15614-1.

The specimens must be prepared in accordance with ČSN EN ISO 9016. Three specimens per set shall be obtained from each position and be cut and machined so that their length is transverse to the welded joint. The notch shall be positioned perpendicular to the surface of the pipe and located on the centre line of the joint (weld metal) and on the fusion line, respectively.

For pipes with nominal thickness over 11 mm, the width (b) shall be 10 mm (standard specimen).

In exceptional cases, the Employer's supervisor of works / Third Party can authorize widths (b) less than the ones indicated above.

Methods:

The test shall be carried out in accordance with ISO 148-1.

Test temperature:

The specimens shall be tested at minimum design temperature defined in the relevant Project specifications..

For that purpose, the specimens must be immersed in a thermostatic bath and kept at the test temperature for at least 15 minutes.

The specimens shall be tested within 10 seconds after taking them out of the bath.

Requirements:

At the test temperature the values of energy absorbed, on standard test pieces, must be equal to or greater than the ones given in the following Table 3.

Table 3 Impact test values

Dimensions of specimen	Average value of specimens	Single value
10 mm x 10 mm	47 J	32 J

Note: The indicated values apply to full size specimens removed in transverse direction.

4.3 WPS Statements and Certificates

The results of the qualification tests must be reported on specific forms. The forms to be used must have at least the same content as indicated in a recognized international codes and shall be approved by Third Party.

Documents are required containing all information concerning the welding of the qualification joint (as run parameters, detailed methods and conditions) as well as the results of the subsequent tests, material certificates, calibration certificates etc.

During procedure qualification all the parameters used shall be recorded. After completion of the welding procedure qualification a qualification record shall be compiled, containing the following information:

- Revised WPS based on “as-run” parameters
- Printout or datasheets of the “as-run” parameters and welding details
- Summary of the welding parameters including heat input calculation
- Certificates of base materials
- Certificates of filler materials and other welding consumables
- Calibration certificates of equipment
- Pre-heat treatment Records (as applicable)
- Visual inspection report
- Results of NDT
- Results of destructive testing

The final WPS, accompanied by the WPQR, shall be submitted for review and approval to third party. Based on satisfactory results the WPS will be stamped and signed as “APPROVED FOR CONSTRUCTION”.

5 WELDER QUALIFICATION

5.1 General

Contractor shall be certified according to ČSN EN ISO 3834-2.

Welders shall be qualified according to ČSN EN ISO 9606-1. The results of the qualification test shall be reported as per Appendix A of ČSN EN ISO 9606-1.

Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials shall comply with the standard ČSN EN ISO 14732.

The limits of welder qualification are the essential variables of the WPS. The use of pre-qualified welders, obtaining qualification, which is covering the range of the qualified WPS's, shall be subject to approval by Employer.

The qualification test is carried out by using two line pipes or two sections of pipe of the same group of diameters thicknesses and materials.

Welders must before starting work perform operational test on the test weld corresponding range of applications with the participation welding Employer's supervisor of works / Third Party. Welders, who worked for Employer in the last year, may apply for exemption from this test.

Every welder qualified according to ČSN EN ISO 9606-1 shall weld in the test weld at least half the circumference of the pipe before commencing work on the pipeline. The welder performs the test weld completely (root, filling the covering layer), no matter where it will be deployed on the forehead of pipeline. Evaluation of the test weld will be the visual inspection according to ČSN EN ISO 5817 grade B and radiographic test will be performed with the same evaluation as in C4G-JI73-ILF-GENER-STR-SPC-822 -NDT – Specification. Welding operators shall be certified according to ČSN EN ISO 14732. Welding operators do not have to prove their skills on the weld test as welders. However, the whole group will make the test according to item 6.1.

Before commencing work, the Construction Contractor shall present the Employer's supervisor of works / Third Party with the list of names of the welders he intends to employ on the construction sites.

5.2 Welder Identification

A unique identification number shall be assigned to each welder and a welder identification card with the welder's name, photograph, identification number, and WPS's for which the qualification is valid shall be issued for each qualified welder.

Each welder shall have the card or a copy available at work location and shall produce the card to the welding inspector if asked for. Welders performing work without identification card shall be suspended from production welding until such time as the card can be produced and shown. In case a welder terminates his work, the identification number shall not be reassigned to another welder.

Before commencing work, Contractor shall present the Employer / Third Party with the list of welders intended for the works on site.

All non-destructive testing reports and weld maps shall reference the responsible welder's number. Weld maps shall also indicate the weld procedure(s) used.

The Construction Contractor shall keep the list of names and qualifications of the welders qualified by the Employer's supervisor to carry out the work on the site up to date.

Each welder employed for pipe welding shall be assigned a unique identifying number/symbol. Upon completing a joint, the welder shall place his identifying number/symbol approximately 4cm from the completed weld cap. All non-destructive testing reports and weld maps shall reference the responsible welder's identifying number/symbol. Weld maps shall indicate what procedure(s) were used.

5.3 Validity of Welder Qualification

Qualification shall be valid for a period of six months unless otherwise stated in the applicable standards. This period may be extended by a further six months when it can be shown by NDT from production welding that the welder has produced satisfactory welds. Therefore a "Welder Performance Record" shall be maintained, showing the number of welds and NDT results for each welder and/or operator.

The qualification can be withdrawn at the judgement of the Employer's supervisor of works / Third Party if the welder has been inactive for a period longer than six months during the course of the works.

Qualified welders must be re-qualified if changes of essential variables for the qualification test, according to ČSN EN ISO 9606-1, occur.

5.4 Welder Qualification Statements and Certificates

The results of the qualification tests must be reported on specific forms as per Appendix B of ČSN EN ISO 9606-1

All the documents required by this Specification (Certificates, mechanical tests reports, NDT reports, etc.) must be enclosed with the statements.

6 PREPARATION AND EXECUTION OF WELDING

6.1 Pre-Production Test

Each of the qualified welders shall pass a pre-production test before being admitted to production welding. This test has the purpose of demonstrating the skill of the welder in applying the qualified WPS.

During this pre-production testing, each workgroup of welders shall make a weld on a test pipe. The diameter of the test pipe will be proposed by the Contractor's welding engineer

and approved by Employer's welding engineer in line with ČSN EN ISO 9606-1. A range of weld parameters may be covered with a single test pipe, as far as feasible and agreed with Employer's welding engineer. The test shall be performed on a test piece pursuant to the provisions of ČSN EN 15614-1.

The test of welder shall be carried out on ½ circumference of the pipes keeping the parameters of WPQR.

The welder can be disqualified after VT when such imperfections will be found out that it is obvious that the subsequent RT would be also unsatisfactory.

Further, the welder can be disqualified when the time limit for welding of the test piece would be significantly exceeded.

The test must be carried out exactly according to the WPS while observing all technological parameters – preheating, clamp removal, lifting and lowering operations, compliance with work times. It is particular necessary to observe the maximum permitted delay between welding of individual layers.

The pre-production welding shall be performed on-site. The Employer's supervisor / Third Party must agree with the Contractor on the place and date of the welder pre-production tests. The welders who have successfully performed the test welds for the WPS qualification may be qualified without further test at the judgement of the Employer's supervisor / Third Party.

Welders and/or operators who welded the procedure qualification test welds, which have been satisfactory non-destructive and destructive tested, shall be deemed as being qualified welders.

6.2 Re-Tests

If the mechanical tests fail for whatever reason, the contractor shall immediately investigate the causes of the failure, and take all necessary actions including but not limited to retest and/or re-evaluation of WPQR parameters.

If after re-testing as described below the qualification weld finally fails to meet the minimum requirements, a new WPS proposal shall be established and qualification welding and testing repeated.

If the test joint finally fails to meet the minimum requirements, a new WPS proposal shall be established and qualification welding and testing repeated.

6.3 Equipment for Production Welding

The Contractor must supply all welding systems, equipment and appliances necessary for welding, cutting, shaping, pre-heating, demagnetization of pipes etc.

The equipment for aligning and lining up the pipes must not damage weld ends.

The Contractor must propose and use welding equipment which enables welding of line pipes and other pipeline materials (i.e. insulating joints, induction bends, welding bosses of pig signalers, cathodic protection connections and the caps in special case if required, scraper traps etc.) specifically supplied to the site in accordance with the project specifications and all the tolerances must be considered. Deviations from standards required by project specifications cannot be claimed.

All the equipment must be in conformity with the current regulations and must be used in compliance with them to ensure safety at work.

The above equipment must have such features as to satisfy the requirements given in the qualified WPS, ensure operative continuity and safety for the personnel.

The Contractor must ensure the efficiency, maintenance and immediate replacement of all systems, equipment and appliances that are not suitable.

Systems for automatic or semi-automatic welding must be equipped with instruments for measuring the current and voltage of the arc while making the joint.

The equipment for aligning and lining-up the pipes must be such as to avoid damaging the ends.

The Contractor is responsible for handling and storing the gas cylinders on the sites and must keep them in sheltered places not subject to great changes in temperature and far from any source of heat.

6.4 Applicable Processes

For the construction of the pipeline, several different welding processes are considered appropriate. Depending on the pipe diameter to be welded, the following general rule of thumb should be applied.

Applicable Welding Process (es) depending on the welding pipes diameters is shown in the Table 4 below.

Nominal Diameter	Applicable Welding Process
< DN 50	TIG (141)
≥ DN 50 and ≤ DN 400	TIG (141), SMAW (111)
> DN 400 up to main line pipe DN1400	TIG(141), SMAW (111), MIG(131), MAG(135),
Main line pipe (DN1400)	Automatic welding process As automatic welding processes gas tungsten arc welding (GTAW-143), gas metal arc welding (GMAW-135) and flux cored arc welding with external shielding (FCAW -136) may be used.

Contractor must use an appropriate welding and alignment method with respect to the real geometrical parameters of pipes and other material (tolerances of outside diameter, out-of-roundness, wall thickness, etc.). The following welding processes are not allowed:

- SMAW using the cellulose electrodes
- any automatic or semi-automatic process using the copper backing
- oxygen – acetylene welding (311).

Pipes and other pipeline materials to be joint welded during the construction of the pipeline are specified in the Project documents.

Welding of root pass using TIG shall be mandatory used where proper cleaning / sweeping out of slag and other impurities is impossible. Blowing with air is not considered as proper cleaning approach.

The Contractor must propose and use such a welding method/process which enables welding of line pipes and other pipeline materials specifically supplied to the site in accordance with project specifications and all the tolerances must be considered. Deviations from the standards required by those project specifications cannot be claimed as an extra work.

6.5 Distance between Welds

The minimum requirements for the distance between two welds shall be:

- Two girth welds on pipeline: $1,5 \times D$
- Two girth welds on station piping: $0,5 \times D$, but at least 100mm
- Two various types of welds (i.e. fillet weld of pipe socket to the nearest girth weld: $10 \times WT$, but at least 100mm
- Exemption from the rules above may only be applied after written approval of Employer's responsible welding engineer.

Generally the longitudinal or spiral welds of two abutting line pipes shall be staggered to have a distance of at least ten times the pipe wall thickness between the cap passes, min.100 mm.

6.6 Ends Preparation for Welding

6.6.1 Bevel

The ends of the pipes must be bevelled in accordance with the joint established in the qualified WPS.

Unless established otherwise, the pipes are supplied with the bevel machined at the pipe mill according to the Line Pipe Specifications- refer to Chapter 2.3.

The ends of different thickness pipes to be welded shall be prepared in accordance with ČSN EN 1708-1 and ČSN EN 12732. The ends of the pipes (bevel and root face) shall be cleaned with a metal brush, file or grinder. The bevels shall have an even surface free from laminations tears, scale, slag, grease, paint, etc...

6.6.2 Cut out and field bevels

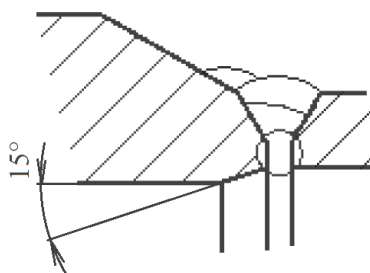
Prior to any cutting of pipes, fittings etc. the relevant information for identification (usually pipe number or heat number) has to be transferred by hard stamping next to the cutting line. This has to be performed by qualified personnel, which is authorized by the Third Party.

If pipes are cutting, must be secured transfer of marking pipes on a separate section in accordance with Art. 21.3 TPG 702 04 before making cut.

The cuts and bevels must be made with machine tools or thermal cutting machines. It is not allowed to make the bevel manually by a flame.

After making cuts with a thermal cutting machine, at least 2 mm of material must be removed with mechanical tools all around the circumference.

Unless established otherwise, the field bevel shall be machined in such a manner, that the quality of the bevel is in accordance with the Line Pipe Specifications- refer to Chapter 2.3. Weld outside edges will be bevelled under the angle of 30° with limit deviation +5° / - 0°(measured from line perpendicular to the pipe axis) and with edging of 1.6 ± 0.8 mm.



Bevel inside edges will be under the angle of 15°.

An ultrasonic test for laminations shall be performed. This ultrasonic examination shall include 100% of a circumferential band at least 50 mm wide starting from the bevel edge.

6.6.3 Cleaning and checking of the ends for welding and NDT

Before lining up for welding, all the bevelled ends must be thoroughly cleaned to eliminate paint, oil, grease, oxide and foreign matter in general, harmful for making the weld.

Cleaning must be done using suitable tools (metal brushes, grinding wheels, files, etc.).

Before lining up the pipes the Contractor shall visually inspect the pipe ends, both internally and externally, and the bevels, checking any surface flaws.

On the pipe ends and on the bevels there must be no burrs, notches, splits, dents, etc. Defective ends can be cut and a new bevel to be carried out.

After welding the ends of welded pipes in whole circumference shall be cleaned up to the glossy metal surface for purpose of NDT in the width of at least 120 mm on both sides of the weld.

6.6.4 Alignment

On longitudinally submerged-arc welded pipes, the seam welds must be at the top half (180°) of the pipe.

Generally the longitudinal or spiral welds of two abutting line pipes shall be staggered to have a distance of at least ten times the pipe wall thickness between the cap passes, min. 100 mm.

The pipes to be welded must be aligned so as to minimize the offset (high-low) between surfaces.

Bevel cuts must be no more than 1.5°. The angle axes of two adjoining pipes should be less than 3°. Changes in the direction of the two adjoining pipes must be submitted to the Employer for approval.

Permitted internal and external misalignment of edges of two successive pipes shall be in line with requirements of ČSN EN 12732, Table G2. The Construction Contractor must use an appropriate welding method with respect to the real geometrical parameters of pipes (outside diameter, ovality, wall thickness...).

6.6.5 Use of line-up clamp

Mainline pipes are normally lined up with internal pneumatic-expansion line-up clamp. For external line-up clamp is required using of hydraulic line-up clamp.

External line-up clamp is allowed in the case of crossing and tie-in welds and in cases of technical impossibility in using internal clamp.

Internal line-up clamp must not be removed before completing the root pass. In case of using vertical-down welding progression for the root pass, the internal line up clamp shall only be removed after completion of hot pass and resting the pipe onto the skids or berms.

External clamp must not be removed until the maximum possible length of root pass has been made and anyhow no less than 60% of the circumference of the joint, with evenly spaced segments. Subsequently, the weld must not be exposed to any movement and the

additional stresses. Is not possible to move with welded pipes until is completed at least 4 mm overall of weld size, approx. after two layers.

With the external line-up clamp, the root pass must be done with the uphill technique. Detail and description use of line-up clamp must be specified in WPS.

6.7 Weather Conditions

In case of wind, rain, snow, etc. welding operation must be suspended unless adequate protective measures are taken. Therefore, in case ambient conditions should cause condensation on the joints and especially in case the joints are wet, the edges shall be dried by heating with a torch on min. 100 mm at each side of the weld.

In case of wind, rain, low ambient temperature (lower than +10°C), welding operations shall not be carried out without having taken all necessary precautions. Necessary precautions shall be specified in the WPS and checked during welding.

Especially in case of rain, or wind (particularly in presence of sand) special shelters shall be erected to protect welders and joints.

If the weld inspector finds that the precautions taken are not sufficient he can, at his unquestionable judgement, suspend the welding operations.

The protective measures are subject to approval of the Employer's Supervisor of works / Third Party.

In case of ambient temperature lower than 5°C and/or the weld joint is damp, special precautions shall apply. Special precautions must be specified in the WPS and checked during welding.

The welding operations must be suspended if is not possible carry out NDT or special precautions will not be accept for low temperature.

6.8 Clearance

The work space around the pipe to be welded must be no less than 80 cm. The welder(s) have to have easy access and space for work in compliance with the current safety standards for work.

When it is necessary to weld a pipe located in a trench, the welder's clearance must be sufficiently large for the welder(s) to have easy access and work in compliance with the current safety standards for work in trenches.

6.9 General requirements for the execution of the welding

Contractors carrying out welding and related works on the project shall be qualified/certified in accordance with the requirements of ČSN EN 12732 and ČSN EN ISO 9606-1.

Employers, Third Party and Employer's supervisor of works has the right to carry out inspections / audits of any phase of the welding process.

Contractor has to employ responsible welding supervisors in accordance with the requirements of ČSN EN ISO 9712.

All welds must be made with the parts to be joined secured against movement and with adequate clearance around the joint to allow the welder(s) space in which to work.

At the completion of each pass, and especially at the completion of the root pass, the oxides and slag shall be removed and the surface of the weld must be cleaned for the following pass.

The number of passes must be established in the qualified WPS and as such as to give the finished weld a basically uniform cross section.

The welding procedures must specify the requirements concerning the interpass temperatures and the acceptable rest times between the different runs.

The weld stops and starts must be staggered so that they do not coincide with those of other welding passes.

Stop welding is possible only after completion of 2/3 of weld size. The remaining 1/3 of the weld must be welded immediately following day at the latest.

Arc strikes and arc burns are not allowed.

The minimum number of welders working simultaneously on one weld:

- up to DN 300 1 welder
- from DN 300 up to DN 800 2 welders
- from DN 900 up to DN 1000 3 – 4* welders
- DN 1200 and DN 1400 4 welders

* minimum number of welders working for weld of the main front of pipeline DN 1000 is four.

The minimum number of welders and the welding sequence must be those established in the qualified WPS.

The pipe must not be bumped or shaken during welding and prior to removal of the line-up clamp; the piping must be placed on supports, avoiding dangerous stress to the weld just made.

After cap completion, the weld must be protected if environmental conditions require it, so as to avoid too sudden cooling.

The tie-in welds must be started and completed without interruption.

Use of cellulose covered electrodes and welding of gas pipeline with flame is not permitted.

During welding of pipes any operation, which could cause scratches, grooves, bulges or other mechanical damage and/or deformation of the material pipe and/or the welded pipe, is strictly prohibited.

In the assembly and welding operations the following is strictly prohibited

- manipulate with the pipe during welding of root and first filling pass.
- Ignite arc outside of the weld joint.
- Heat up and strike any deformation of the ends of the pipes in their splicing before welding of circumferential welds,
- canopies on pipe cut out, pipe wall burn it or grinding through and its subsequent welding.

All welds and weld repairs shall be carried out in accordance with qualified welding procedures, by qualified welders. In the event of wind, rain or low temperatures which may affect the stability of the arc, welding tents or other suitable protection shall be used. One end of the pipe shall be sealed off during welding to avoid drafts which may influence the stability of the arc.

After welding all weld spatter will be removed by grinding and/or brushing.

The visual examination record will be indelibly written near by the weld together with the date and result of inspections.

6.10 Pre-Heating

Preheating, if necessary, shall be carried out with the provision required in the WPS, preferably using induction heaters or propane torches.

The temperature must be controlled as per ČSN EN ISO 13916. The necessary temperatures must be reached prior of starting to weld. It shall be measured 75mm from the weld preparation at one (minimum) in each quadrant.

If the welding is interrupted at the end of the welding piece, isolating blankets should be put on the weld to avoid a quick cooling of the weld.

Preheat and interpass temperature measurements are to be performed on the external pipe surface using calibrated digital thermometers or temperature measuring crayons.

The minimum preheating temperature for weld repair shall be as stated in the relevant WPS

The minimum preheating temperature for tie-in welds shall be as stated in the relevant WPS.

6.11 Tie-in Welds

Tie-in welds distinguish between 'regular' welds and guarantee or golden welds. The regular tie-in welds are subjected to hydrostatic testing, whereas the golden welds are not subjected to such a test. The golden weld is carried out after the completion of the hydro-test, for jointing (tie-in) of hydro-tested sections or the replacement of damaged pipe sections, which will not be re-tested.

Prior to commencing any tie-in work, Contractor shall, in consultation with Employer's supervisor of works / Third Party, agree the procedures to be followed for aligning, pre-heating, welding and annealing.

For tie-in welds, the use of coated cellulose electrodes is not permitted. Welding shall be carried out using a manual, semi-automatic or automatic process.

Each tie-in weld shall be carried out as pipe to pipe joint. Tie-ins between pipe and fitting are not allowed and require a pup piece to be welded to the fitting first.

Prior to welding, the aligned construction shall be made available for inspection to Employer's supervisor of works / Third Party.

The tie-in welds must be started and completed without interruption.

6.12 Welder and Welds Identification

Each welder shall mark the pipe in a manner accepted by the Employer's supervisor of works / Third Party (e.g. non-washable paint) with his own identifying number on the section of weld made.

The welders involved in the root pass must affix their numbers at the top, the other welders must affix the numbers afterwards and under the one identifying the root bead welder, observing the sequences of passes. Marking for welds completed by two welders per each pass shall consider this, i.e. by distinguishing between welders on "trench" side or "right of way" side of the pipe. Marking the welds shall be carried out in accordance with Art. 7.5.7 of TPG 702 04.

For manual welding must be each of the weld part marked with the names/numbers of welders that this part welded. For mechanized welding are not required marking of welding operators.

It is not allowed to use cold die stamp.

All the welds must be numbered with a numbering system established by the Employer's supervisor of works / Third Party before starting the works.

Each weld must be marked preferably during welding or before the start of the first NDT at the latest. Weld mark must contain the kilometer stationing, serial number of weld, welding method.

For example: NAME G XXX-Y ZZ R/N NAME – name of welding company

G - guarantee weld / gold weld - without pressure test XXX - kilometre stationing

Y - welding method

ZZ- serial number of weld

R/N - In case of repair weld will be behind mark added letter "R". In case of repair weld with cut out will be behind mark added letter "N".

Mark of successful visual inspection of the weld will be added to weld mark "VD" as visually good including date of control.

For above a specific job instruction shall be issued for approval before the beginning of works.

7 REPAIR AND REMOVAL OF DEFECTS

7.1 General

All not acceptable welds, must be repaired in accordance with the provisions of this specification, or be removed by cutting from the pipe.

7.2 Authorization for Repair

Repairs of weld defects are allowed, after resolving / fulfilling all the hereunder mentioned restrictions / criteria:

- Approval of Employer
- The repair procedure is approved and qualified
- Maximum length of weld repair does not exceed 20% of the circumference
- The entire (group of) defect(s) is removed
- A repair of a repair weld is not allowed (no second repair at the same spot)
- The weld defect is not a crack
- Repair of the root is only allowed with basic coated or rutile basic electrodes or the GTAW process. In addition, repair welds shall be performed in upwards welding direction.

Minimum length of weld defect repair shall be 50mm plus 25 mm on the each site.

If one or more of the above mentioned restrictions / criteria is not resolved / fulfilled, the weld shall be completely cut out, including 20 mm pipe material on each sides of the weld.

By cutting out of defect welds the length of inserted new intermediate piece of pipe shall have a length of min. 1.5 times the diameter of the pipe.

7.3 Qualification of a repair welding procedure

Repair procedure qualification shall be carried out as far as possible with simulated on site conditions.

The test methods and evaluation criteria are the same as listed in this specification and as per Figure 6 of ČSN EN ISO 15614-1.

WPQR document will specify the method of repair.

7.4 Defective Pipes

The Employer's supervisor of works / Third Party shall be notified of all defective pipes to take the appropriate measures.

The Employer's supervisor of works / Third Party, after written approval of Employer, can make one of the following provisions:

- a) The defect on the body of the pipe shall be removed by grinding, afterwards, checking that the remaining thickness of the pipe is within the limits of the minimum thickness allowed by the pipe specification. After repair, the Employer's supervisor of works / Third Party may request additional non-destructive tests on the repaired area (ultrasonic, radiographic, magnetic particle inspections, dye penetrant, etc.). In no case repairs by welding are allowed either on the seam weld or on the pipe body.
- b) The section of pipe containing the defect shall be cut and the remaining length of pipe reused after marking and inspection of the ends in accordance with preparation of welds described in this specification.
- c) The pipe shall be rejected.

8 DOCUMENTATION

On the site welding documentation must consist of at least, but not limited to, the following documentation:

- WPS's
- WPQR's
- List of qualified welders with their mark, copy of certification and range of permitted welding activity (proved by site pre-production test)

- Pipe book
- Daily and weekly weld testing summary, including total number of repairs and the number of repairs per welder.

The details of the required documentation to be provided therein shall be approved by the Employer's supervisor prior to start of welding work on site. All of the reports above shall be included in the field quality control plan.