



TECHNICAL REQUIREMENTS

MECHANICAL

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GENERAL WELDING, FABRICATION AND INSPECTION

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1. SCOPE

- 1.1 This specification covers the minimum requirements for welding in both shop and field fabrication and the weld inspection of the following equipment:
- 1.1.1 Pressure containing equipment and piping whether code stamped or not, including but not limited to rotating equipment, boilers, pressure vessels, heat exchangers, air coolers, shop and field fabricated piping, fired heaters tubes, storage tanks, and their attachments.
- 1.1.2 Equipment or piping containing toxic or corrosive materials when specified in the job specifications.
- 1.1.3 Other fabrications where specified.
- 1.2 This Specification modifies the requirement of applicable EN, ASME and ANSI codes and standards in effect at the time. It also modifies API and AWS standards when specified. The applicable edition, revision, addenda, etc., shall be specified in the equipment design, drawing data sheet, job specification and/or purchase order. If an applicable code or standard is more stringent than this specification, that standard shall govern.
- 1.3 Harmonized standards, EN ISO standards shall be used for shop and field welding performances. ASME, API codes and AWS std. can be used only for shop fabrication when ASME manufacturing code was designated
- 1.4 Conflicts between requirements of these specifications, related specifications, standards, codes, purchase orders or drawings shall be clarified with OL prior to proceeding with the fabrication of the affected parts. Regarding conflicts, OL reserves the right for final decision.

2. REFERENCES

The actual (newest) revision of documents shall be used.

CEN ISO/TR 15608	<i>Welding - Guidelines for a metallic material grouping system</i>
CEN/TR 13480-7	<i>Metallic industrial piping — Part 7: Guidance on the use of conformity assessment procedures</i>
EN 10204	<i>Metallic Products – Types of Inspection Documents</i>
EN ISO 2553	<i>Welding and allied processes - Symbolic representation on drawings - Welded joints</i>
EN ISO 2560	<i>Welding consumables - Covered electrodes for manual metal arc welding of non-alloy and fine grain steels – Classification</i>
EN ISO 3452	<i>Non-destructive testing - Penetrant testing - Part 1: General principles</i>
EN ISO 4063	<i>Welding and allied processes - Nomenclature of processes and reference numbers</i>

EN ISO 5817	<i>Welding. Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded)</i>
EN ISO 6520-1	<i>Welding and allied processes — Classification of geometric imperfections in metallic materials — Part: 1 Fusion welding</i>
EN ISO 6947	<i>Welds. Working positions. Definitions of angles of slope and rotation</i>
EN ISO 9606	<i>Qualification test of welders — Fusion welding — Part 1: Steels</i>
EN ISO 9712	<i>Non-destructive testing - Qualification and certification of NDT personnel</i>
EN ISO 10675-1	<i>Non-destructive testing of welds - Acceptance levels for radiographic testing - Part 1: Steel, nickel, titanium and their alloys</i>
EN ISO 11666	<i>Non-destructive testing of welds — Ultrasonic testing — Acceptance levels</i>
EN ISO 14172	<i>Welding consumables - Covered electrodes for manual metal arc welding of nickel and nickel alloys</i>
EN ISO 14341	<i>Welding consumables - Wire electrodes and deposits for gas shielded metal arc welding of non alloy and fine grain steels – Classification</i>
EN ISO 14344	<i>Welding consumables - Procurement of filler materials and fluxes</i>
EN ISO 14732	<i>Welding personnel - Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials</i>
EN ISO 15156 (all parts)	<i>Petroleum and natural gas industries - Materials for use in H₂S-containing environments in oil and gas production</i>
EN ISO 15607	<i>Specification and qualification of welding procedures for metallic materials - General rules</i>
EN ISO 15609 (all parts)	<i>Specification and qualification of welding procedures for metallic materials - Welding procedure specification</i>
EN ISO 15614 (all parts)	<i>Specification and qualification of welding procedures for metallic materials - Welding procedure test</i>
EN ISO 17635	<i>Non-destructive testing of welds - General rules for metallic materials</i>
EN ISO 17636 (all parts)	<i>Non-destructive testing of welds - Radiographic testing</i>
EN ISO 17637	<i>Non-destructive testing of welds - Visual testing of fusion-welded joints</i>

EN ISO 17638	<i>Non-destructive testing of welds - Magnetic particle testing</i>
EN ISO 17640	<i>Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels, and assessment</i>
EN ISO 18274	<i>Solid wire electrodes, solid strip electrodes, solid wires and solid rods for fusion welding of nickel and nickel alloys – Classification</i>
EN ISO 23277	<i>Non-destructive testing of welds - Penetrant testing of welds - Acceptance levels</i>
EN ISO 23278	<i>Non-destructive testing of welds - Magnetic particle testing of welds - Acceptance levels</i>
EN ISO 23279	<i>Non-destructive testing of welds - Ultrasonic testing - Characterization of indications in welds</i>
EN 13445 (all parts)	<i>Unfired pressure vessels</i>
EN 13480 (all parts)	<i>Metallic industrial piping</i>
ASTM	<i>American Society for Testing & Materials</i>
ASME SECTION II	<i>Materials</i>
ASME SECTION IX	<i>BPVC Section IX - Welding, Brazing, and Fusing Qualifications</i>
ASME SEC VIII D1	<i>BPVC Section VIII - Rules for Construction of Pressure Vessels - Division 1</i>
OL-TR-MR-000	<i>Mechanical. General</i>

3. TERMS AND DEFINITIONS

Inspector: Appointed inspector.

Contractor: Any party in contract for the purpose of carry out works or services.

Alloy: All non-carbon steel, including but not limited to, Cr-Mo steels, austenitic, ferritic, martensitic and duplex stainless steels, nickel and copper alloys, titanium.

Bulk Material: Material purchased in bulk where individual items are not allocated a unique tag number (eg. random pipe lengths, tubes, valves, fittings, flanges, bolting, non-process strainers)

Lot: All units from a common heat of material presented for inspection against a single purchase order item. In the case of valves, or similar items, where bodies/bonnets/covers may be from different heats, the Lot shall consist of all units with the same combination of heat numbers for pressure containing components.

Sample: One, or more, units selected at random from the Lot which are to be examined to determine acceptability of the Lot.

4. WELDING PROCEDURES

4.1 Welding Procedure Specifications and Procedure Qualification Test records for vendor welding covered by this Specification shall be submitted to OL for review and acceptance prior to start off, any welding. No welding shall commence until welding procedure specifications and qualification records have been accepted.

4.1.1 Welding performed by subvendors is also required to have welding procedures submitted for review and acceptance by purchaser the same as above. Vendors are urged to review their subvendors' welding procedures for conformance to this Specification prior to submitting to OL or its designee for acceptance.

4.2 The information contained in Welding Procedure Specifications (WPS) and Procedure Qualification Test Records (PQR) shall include, but not be limited to the information contained in EN ISO 15609, EN ISO 15614 or ASME Code, Sect. IX in case when ASME fabrication code was accepted. Welding Procedure Specifications shall conform to EN ISO 15609 or ASME Sect. IX form QW-482 if ASME fabrication code was accepted. Procedure Qualification Records shall conform to EN ISO 15614 or ASME Sect. IX form QW-483.

NOTE: This Specification includes additional requirements or restrictions throughout which may not be listed in the vendor's submitted welding procedure. They are to be listed, when required by this specification, either in the Welding Procedure or the Weld Map. The main additional requirements are summarized in Par. 13.

4.3 Applicable "Vendor's Weld Map and Weld Description" as illustrated in Appendix A of this specification shall also be completed and submitted at the same time as welding procedures for OL acceptance.

4.4 Welding Performance Qualification test records shall be made available for review to the OL personnel upon request. Welding Performance tests shall be in accordance with EN ISO 15614 (or ASME Sect. IX), under conditions of restraint and accessibility as demanding as those to be experienced in production by the welder. Welding Performance test records shall conform to EN ISO 15614 (or ASME Sect. IX form QVI-484). Welder qualifications for new hires require new qualifications.

4.5 Weld overlay or clad back-welding shall be qualified in accordance with EN ISO 15614 (or ASME Sect. IX).

4.6 Weld overlaying or clad restoring (back-cladding) shall be applied with a minimum of two passes and capable of controlling dilution as evidenced by a chemical analysis. Depth of chemical analysis shall be 3/4 of the required overlay thickness unless specified otherwise.

4.7 When impact testing is required by the code or job specifications, impact test results for weld and heat affected zone shall be reported with the welding procedure qualifications.

4.8 When maximum Brinell Hardnesses are required by code, the job specifications, or Par. 11.3.7 of this Specification, they shall be reported with the Welding Procedure Qualification Record and they shall not exceed the maximum specified.

5. WELDING PROCESSES (GENERAL)

- 5.1** The following welding processes are permitted, subject to the limitations set forth in Par. 6 below, providing that satisfactory evidence is submitted showing that the procedures qualified are in accordance with applicable codes, standards, job specifications and this Specification.
- 5.1.1** Manual shielded metal arc with covered electrode (SMAW). 111 (EN ISO 4063)
- 5.1.2** Gas Tungsten Arc: manual or automatic (GTAW). 141 (EN ISO 4063)
- 5.1.3** Automatic submerged arc (SAW). 121 (EN ISO 4063)
- 5.1.4** Oxy-Acetylene (OAW). 311 (EN ISO 4063)
- 5.1.5** Gas Metal Arc (GMAW). 131, 135 (EN ISO 4063)
- 5.1.6** Flux-Cored Arc (FCAW). 136, 137 (EN ISO 4063)
- 5.2** Welding Processes other than those listed above require specific approval by OL and shall not be assumed as acceptable by vendor during bid preparation.

6. WELDING PROCESS LIMITATIONS

- 6.1** Oxyacetylene and similar oxy-gas processes shall be limited to cast iron, and hard facing only.
- 6.2** GMAW and FCAW shall have stated in the WPS, and on the required weld map (see Appendix A), whether the current is in the short circuiting arc or spray transfer range. The shop and the welding personnel shall have demonstrated production welding experience with each process to the satisfaction of OL.
- 6.3** GMAW is acceptable for root passes and completion of welds up to 10mm (3/8") wall thickness. When specific OL permission is obtained to exceed this maximum wall thickness, all such welds shall be 100% ultrasonically shear-wave examined throughout their entire length.
- 6.4** FCAW welding process is not acceptable for low alloy steels.
- 6.5** FCAW, in the short circuiting arc mode, is unacceptable.
- 6.6** FCAW, spray transfer, without shielding gas, is acceptable with specific OL approval for structural steel welding fabrication only.
- 6.7** FCAW, spray transfer, with shielding gas is acceptable for welding shop fabricated pipe, structural steel and for welding pressure retaining parts of pressure vessels provided the following conditions are met:
- 6.7.1** The procedure qualification record shall include results of Brinell hardness testing for both as-welded and PWHT'd conditions as applicable. In addition, Charpy V-notch testing at -29°C (-20°F) for the weld and heat affected zone shall be performed and recorded on the PQR.
- 6.7.2** All production welders shall be requalified by means of welding performance testing in accordance with EN ISO 15614 or ASME Section IX requirements prior to any production welding.
- 6.7.3** When utilized in the field, adequate protection from wind shall be in place at all times.

NOTE: OL reserves the right to disallow the use of the FCAW welding process based on excessive rates of repair.

- 6.8** Automatic or machine type SAW is preferred. The SAW process shall have stated on the WPS that the procedure is automatic or machine type welding in order to be acceptable. Manual or semi-automatic SAW is prohibited.
- 6.9** Automatic or machine type SAW welding of group P-1 materials (group 1, 11 acc. to CEN ISO/TR 15608) shall be limited to 12 mm (1/2") maximum thickness per layer of deposit for material of 32 mm (1-1/4") thickness or greater and 10 mm (3/8") maximum thickness per layer of deposit for material less than 32 mm (1-1/4") thick. Maximum deposit per pass for alloy and stainless steel shall be limited to 10 mm (3/8").

7. FILLER MATERIALS AND FLUXES

- 7.1** Filler materials and fluxes shall be as specified in EN ISO 14344 or ASME, Section II, Part C. Filler materials and fluxes other than those specified in the above code and which meet other requirements of this specification shall not be assumed as acceptable by vendor during bid preparation.
- 7.2** All welding shall employ a filler metal unless approved by OL in writing. Welding employing no filler metal shall not be assumed as acceptable by vendor prior to bid preparation. Friction welding is prohibited.
- 7.3** The specific EN or AWS grade, EN or ASME Specifications, Manufacturer and trade name for filler metals and fluxes to be used on the job shall be indicated on the welding procedure specification and Weld Map (Appendix B).
- 7.4** Use of filler metals and fluxes for other than the manufacturer's primary recommended application is prohibited. For example: Filler wire intended for OFW shall not be used for GTAW. Filler wire intended for certain welding positions specified by the manufacturer shall not be utilized in other welding positions. Alloy GTAW filler metal shall be flag tagged on both ends. Fluxes recommended for single pass shall not be utilized on multipass welds.
- 7.5** FCAW filler metal on stainless steel, to be used for high temperature service (above 700°C), shall be bismuth-free.
- 7.6** Automatic or machine submerged arc welding fluxes are subject to the following limitations:
- 7.6.1** Fluxes used for welding carbon or low alloy steels shall not contribute alloying elements to the weld.
- 7.6.2** A separate welding procedure qualification shall be required for each brand and grade of flux and electrode combination.
- 7.6.3** Welding procedures employing "active" fluxes for carbon steel shall demonstrate that hardness does not exceed 200 HB. Hardnesses shall be reported with the procedure qualification record.
- 7.6.4** Alloy steel shall be welded using an alloy wire and a "neutral" flux. Fluxes shall not contribute alloying elements to the weld deposit.
- 7.6.5** *Solar flux (Type B)* shall not be used.

- 7.7** Fluxes shall be reconditioned prior to re-use per manufacturer's recommendations.
- 7.8** For welding 483 MPa (70,000 psi) tensile strength of P-1 (group 1, 11 acc. to CEN ISO/TR 15608) material subject to a PWHT operation, filler metals containing 1/2 percent Mo are permitted in order to meet the minimum tensile strength requirement.
- 7.9** Similar base materials shall be joined with a weld metal deposit that matches the base metal in both chemistry and mechanical properties. In cases where this cannot be accomplished, the vendor shall propose a choice of filler for OL review and state the reasons for their choice.
- 7.10** Nickel based filler metal shall not be used for Cr – Mo steels (5; 6 gr. CEN ISO/TR 15608).
- 7.11** For welding of stainless steel materials, where high carbon grade materials (i.e. 304H (1.4948), 316H, 321H (1.4878), and 347H) are welded together the filler metal shall have a carbon content of 0.04% to 0.08%.
- 7.12** For welding of Ti or Nb stabilized stainless steel materials the filler material shall be stabilized too.
- 7.13 Dissimilar Base Materials (Ferritic Steels)**
- 7.13.1** Welds joining pressure containing parts of two different ferritic steels shall have a weld metal deposit conforming to the nominal composition of the higher alloy base materials unless otherwise approved by OL.
- 7.13.2** Welds joining two different ferritic steels, only one of which is a pressure retaining part, shall have a weld metal deposit conforming to the nominal composition of the pressure retaining part unless the engineering design specifies otherwise or written approval is given by OL.
- 7.14** When joining two different austenitic stainless steels, the filler metal may match either and must result in a ferrite number range of 3-12. Delta ferrite shall be determined from the certified chemical analysis and the "WRC Delta Ferrite Diagram".
- 7.15** Welds joining austenitic stainless steels to ferritic steels shall be made with filler metal as follows:
- 7.15.1** Type 309 (E 23 12; W 23 12) for design temperatures not exceeding 343°C (650°F).
- 7.15.2** Coated electrodes of EN ISO 14172 (SFA5.11) classes E Ni 6133, E Ni 6182 (AWS classes ENiCrFe-2 and ENiCrFe-3) or bare electrodes of EN ISO 18274 classes G Ni 6082 and NiCr15Fe8Nb (SFA 5.14 of AWS Classes ERNiCrFe-5 and ERNiCr-3) except where process conditions do not permit.
- 7.15.3** TP 310 (E 25 20; W 25 20) is prohibited.
- NOTE: TP 310 (E 25 20; W 25 20) fillers are acceptable only for welding of Type 310 (E 25 20; W 25 20) base materials to themselves.*
- 7.16** For GMAW welding of group P-1 materials (group 1, 11 acc. to CEN ISO/TR 15608) exceeding 450 MPa (65,000 psi) minimum tensile strength, only EN ISO 14341-A classification G2Ti or G2Si (AWS classification ER 70-S2 or ER 70-S3 filler metals of

SFA 5.18) shall be used. The use of EN ISO 14341-B class G 49A Z C SZ (ER 70-SG of SFA 5.18) is prohibited.

7.17 Use of SMAW electrode groups F-1 (EN ISO 2560-A-E 42 0 RR), F-2 (EN ISO 2560-A-E 35 X XX), and F-3 (EN ISO 2560-A-E XX 0 C) as specified in ASME Sec. IX, QW-432, are limited as follows:

7.17.1 To fillet welds or butt welds on material not exceeding 450 MPa (65,000 psi) minimum tensile strength, in material thickness not exceeding 13mm (1/2 inch) thickness.

7.17.2 They are not permitted on materials requiring impact tests either by code or job specifications.

7.17.3 F-1 (EN ISO 2560-A-E 42 0 RR) or F-2 (EN ISO 2560-A-E 35 X XX) electrodes shall not be used for pressure retaining parts or non-pressure attachments to pressure retaining parts.

7.17.4 F-3 (EN ISO 2560-A-E XX 0 C) electrodes may be used for root passes of butt welds regardless of base metal thickness.

7.18 The receipt, use, dispersal and retrieval of welding filler materials shall be maintained under strict control, with storage, baking and drying as recommended by the manufacturer to assure that completed welds conform to the approved welding procedure specification requirements for welding materials.

8. WELD JOINT PREPARATION AND WELDING FABRICATION

8.1 Joint designs shall be in accordance with applicable code or job specification requirements.

8.2 Weld joints shall be prepared by machining, grinding or thermal cutting. When thermal cutting is performed, the joint surfaces shall be ground to sound metal prior to welding. Materials must be subjected to the same preheat requirements for thermal cutting as required by the applicable welding procedure. Alloy pipe shall be saw or plasma cut.

8.3 For materials 50 mm (2") and thicker, plate edges, including weld bevel shall be magnetic particle tested or if material is austenitic, edges shall be liquid penetrant tested.

8.4 Welded butt joints shall meet the minimum requirements for penetration or fusion per the applicable code or job specification.

8.5 The addition of permanent backing such as rings, bars, or strips are unacceptable and shall not be used without OL's written approval. Their utilization shall not be assumed as acceptable by vendor during bid preparation. The additional backing referenced in this Specification is not defined by this Specification as the weld installed on the first side of a butt weld welded from both sides.

8.6 Temporary (removable) backing rings, bars, or strips shall not be used without OL's written approval. Their utilization shall not be assumed as acceptable by vendor during bid preparation.

NOTE: If approved by OL, the weld area exposed when backing is removed shall be dressed and examined for cracks or defects by visual and liquid penetrant or magnetic particle examination methods, whichever is applicable. All backing material shall be

removed and unacceptable indications shall be removed completely and repaired utilizing a weld procedure which has been accepted by OL.

- 8.7** Materials of permanent and temporary backing ring, if approved by OL, shall conform to the nominal chemistry of the weld filler metal as defined in Par. 7.8 through 7.18, inclusive of this Specification.
- 8.8** When OL's approval is given for use of backing rings, the vendor welding procedure and the Weld Map (Appendix A) submitted for review shall either indicate that welding was qualified with backing ring (state on PQR) or that backing ring will be added (stated on WPS and the Weld Map, Appendix B).
- 8.9** Consumable inserts require written approval by OL. Their utilization shall not be assumed as acceptable by vendor during bid preparation unless they have been stipulated in OL's engineering design specification.
- If approved by OL, they shall, in all cases, conform to the nominal chemistry of the weld filler metal as defined in Par. 7.8 through 7.13, inclusive, of this specification. In all cases, they shall require root shielding with inert gas.
- 8.10** The materials used for pipe purging dams and methods employed in their placement, use, and subsequent removal shall be as required to ensure that no damage results to the piping or related components.
- 8.11** The method that is proposed by the fabricator to obtain and maintain adequate root shielding shall be included either as part of the submitted welding procedure or as a separate specification for review.
- The procedure for root shielding by inert gas shall contain the following:
- 8.11.1** The composition and purity of shielding gas to be used.
- 8.11.2** Flow rates and time required to obtain adequate purging.
- 8.11.3** Pipe dam details materials to be used, type of construction, method of placement and removal.
- 8.12** Back-purging (root shielding) is required for all ferrous alloy and non-ferrous alloy pipe and shall be maintained until completion of 2 weld layers.
- 8.13** Weld joint tolerances for root opening and alignment shall meet the requirements of applicable codes and job specifications, and also the weld joint sketches contained in the submitted welding procedures to ensure against lack of penetration and lack of fusion.
- 8.14** For shop and field fabrication, when poorly fitted joints occur with excessive joint gap or excessive offset, the vendor shall submit a separate weld repair procedure indicating with a sketch the method proposed to bring the joint back to original design requirements in conformance as close as possible to the original OL accepted welding procedure. The vendor cannot assume that backing rings or strips-permanent or temporary, are acceptable without OL's review. Any weld joints of this nature found to be slugged with supplementary filler metal are unacceptable. Buttering of beveled ends to close excessive gap is unacceptable unless a vendor welding procedure is submitted for doing so and is accepted by OL.

- 8.15** Grinding and cleaning of stainless steels and nonferrous material shall be done only with tools that will not leave detrimental deposits on the base metal; aluminum oxide or silicon carbide grinding wheels and austenitic stainless steel wire brushes shall be used. These tools shall not have been previously used on any material types other than the material to be cleaned.
- 8.16** Surfaces to be welded shall be clean and free of paint, oil, dirt, scale and other foreign materials detrimental to welding which may contain lead, sulfur, and other low melting point elements.
- 8.17** Peening of welds to enhance mechanical properties is prohibited.
- 8.18** Tack welds which are to be incorporated into the final weld shall:
- 8.18.1** Be subject to all the same requirements as the applicable welding procedure accepted by OL and are to be performed by welders qualified for performance on the welding procedure accepted for that joint. If separate tackers are used other than the welder performing the joint weld, they shall be qualified for performance on all the same welding variables for the portion of the weld they perform as stated in the applicable OL accepted welding procedure or else the tack welds are to be completely removed.
- 8.18.2** Be made with filler metal of the same composition as will be used for the first pass of the weld as stated in the applicable OL accepted welding procedure for the joint.
- 8.18.3** Have all slag thoroughly removed prior to welding the root pass or covering pass.
- 8.18.4** Be subject to the same preheat requirements as stated in the applicable OL accepted welding procedure for the joint.
- 8.18.5** Shall have leading and trailing edges ground and blended to a feather edge, or be completely removed.
- 8.18.6** Tack welds that violate any of the above shall be completely removed. Completed welds having tack welds found to violate any of the above shall be subject to complete removal.
- 8.19** Removable start-up and run-off tabs shall be used for certain test procedures on longitudinal welds. Materials used for these tabs shall be of the same composition as the base weld.
- 8.20** For alloy clad plate and alloy clad material, the following limitations shall apply for preparation at the joint prior to back-cladding.
- 8.20.1** Cladding shall be stripped back to a minimum of 6 mm (1/4") from the edge of base material. Bevels by machining, grinding, or arc gouging.
- 8.20.2** Removal of the cladding shall not reduce the base material thickness below the design thickness.
- 8.20.3** A minimum radius of 1.5 mm (1/16") shall be used at the limit of cladding removal unless the clad material is beveled at least 30 degrees.
- 8.20.4** Preparation of local repair cavities in overlay welds that penetrate into the base material more than 10% of its thickness, or 5 mm (3/16"), whichever is less, shall have the base material rewelded with the appropriate OL accepted welding procedure consistent with the base material prior to completing the overlay repair.

- 8.21** All stubs, rods, flux, slag or foreign material shall be removed from the equipment or piping after completion of welding and prior to postweld heat treatment or hydrotest.
- 8.22** The use of temporary welded attachments shall be avoided where possible. All locations of removed temporary attachments shall be examined visually after removal of the attachment.
- 8.22.1** Temporary attachment shall be removed by flame cutting, arc gouging or grinding. Hammering off is not permitted.
- 8.22.2** Defects discovered in the base metal such as gouges, cracks or undercuts shall be removed and repaired and the area reexamined using the same method of NDT that revealed the original defect.
- 8.23** It is required that vertical welding be performed vertical up.
- 8.24** For field erection of API storage tanks, the weld seams of sketch plates for tank bottoms and floating roofs shall contain a minimum of two weld passes. Single pass seams are unacceptable.
- 8.25 Branch Connections**
- 8.25.1** Branch connections such as weldolets, threadolets, sockolets, and stub-ins shall be joined to the header by full penetration welds. Incomplete penetration as defined by Table 327.4.1A, Notes A and H of ANSI B31.3, is not acceptable.
- 8.25.2** Start and stop welds on root pass shall be feathered in.
- 8.25.3** Branch Connections shall be prepared in accordance with Figure 327.3.3 (A), (B), or (C) of ANSI B31.3. A minimum root gap of 1.5 mm (1/16") shall be maintained during welding. The root gap shall be stated in the welding procedure specification.
- 8.25.4** Socket welds shall have at least two weld passes except for tubing connections.
- 8.25.5** Socket joints shall be prepared with gap of $1,5 \div 3$ mm.
- 9. PREHEAT AND INTERPASS TEMPERATURES**
- 9.1** Preheat shall be at least sufficient to dry surfaces to be welded but not less than 10°C (50°F).
- NOTE: Higher temperatures may be required for highly restrained joints such as closely spaced nozzles. Carbon steel plates 32mm (1-1/4") thick or more, shall be preheated to 100°C (212°F) minimum and ferritic alloy plates to 150°C (302°F) minimum prior to flame cutting and ground smooth prior to welding. All such prepared edges including holes cut for nozzles or manways, shall be liquid penetrant examined or magnetic particle inspected for cracks or laminations.*
- 9.2** Minimum preheat temperatures shall not be less than that stated in ASME, Sec. VIII, Div. 1, App. R and Par. UCS 56; ANSI B31.1, Table 131 or 132; ANSI B31.3, Table 331.2.1 or job specifications as applicable. Minimum preheat temperatures are required to be stated on the welding procedure specification.
- 9.3** Preheat Maintenance is to be applied when required by OL for the conditions stated below. Preheat Maintenance is the maintenance of the stated minimum preheat

temperature, without interruption, from start to completion of welding. Vendor must either state on the WPS or comment must be made by reviewer that preheat is to be maintained when so required by Par. 9.3.1 of this specification or by the job specification. Loss of preheat maintenance will require complete liquid penetrant or magnetic particle inspection of the uncompleted seam prior to any further welding. Any defects found must be reported to the OL inspector for his review.

9.3.1 OL requires preheat maintenance for the following:

- a) Equipment, regardless of service or wall thickness, of group P-4, P-5 and P-6 materials (group 4, 5, 6, 7 and 9 acc. to EN CEN ISO/TR 15608).
- b) Equipment, regardless of material or wall thickness in hydrogen service. Hydrogen service is defined as: Any service in which the partial pressure of hydrogen in the fluid handled is 345 kPa(a) (50 psia) or more.
- c) Pressure vessel and exchanger seams, nozzle and attachment welds of P-1 materials (group 1, 11 acc. to CEN ISO/TR 15608), regardless of service, if shell or head thickness is equal to or greater than 32 mm (1-1/4").

9.4 The same preheat requirements shall be met as are required on the OL accepted welding procedures for thermal cutting, gouging, tack welding and welding repairs.

9.5 The maximum preheat and interpass temperature for group P-8 materials (group 8 acc. to EN CEN ISO/TR 15608) shall be 150°C (300°F). The maximum preheat and interpass temperature shall be specified on the WPS for all materials of material group P-7 (group 7 acc. to EN CEN ISO/TR 15608) and higher.

9.6 OL requires preheating edges of fittings or other parts of exposed equipment in Hydrogen or H₂S containing fluids or gases, heating up to ~300 – 350°C and holding for 2 – 3h in this temperature range for hydrogen removal.

10. POSTWELD HEAT TREATMENT (PWHT)

10.1 Postweld heat treatment shall be performed in accordance with the EN Code, ASME Code or job specifications as applicable. The applicable code or standard for PWHT shall be referenced on the Weld Map (Appendix B). The maximum and minimum holding temperature and holding time shall also be stated on the WPS. Postweld heat treatment procedures shall be submitted to OL and approved prior to performing postweld heat treatment.

10.1.1 Complete temperature cycle of heating and soaking and cooling shall be recorded on a chart.

10.1.2 PWHT for piping, boilers, pressure vessels, heat exchangers, fired heaters, storage tanks and their attachments shall be as specified in Table 1.

10.2 Postweld heat treatment may be required for carbon steel equipment for certain service conditions even when not mandatory per the applicable code or standard. Postweld heat treatment for these services will be indicated by the project specifications. Welds in amine piping shall be postweld heat treated regardless of operating temperature. Welds in caustic piping shall be postweld heat treated if the operating temperature exceeds 65°C (150°F). This applies to caustic concentrations of 10% by weight or less. OL shall be consulted for higher concentrations for PWHT requirements. Welds in anhydrous ammonia service shall be postweld heat treated, if water content is 0.2% or less by weight. Welds in wet H₂S service shall be postweld heat treated when required by process design and job specifications.

Postweld heat treatment is required for shop and field fabricated piping of low alloy steel weldments regardless of thickness.

Postweld heat treatment is required for shop and field fabricated piping of carbon steel weldments regardless of thickness when design operating conditions are within 40°C (100°F) of the Nelson Curve for that material. Postweld heat treatment temperatures shall be as per EN 13445, EN 13480, ASME B31.3, Table 331.3.1, except as modified by this or other applicable job specifications.

Table 1. PWHT Temp. for Piping and Pressure Vessels

P-No.	Base Material %	Temp. Rise Deg./Hr. °C (°F)	Metal Temp. °C (°F)	Hrs./In. (Hrs./25mm) Nom. Wall	Min. Time Hrs.	Max. Temp. Fall Deg./Hr. to 300 (572) °C (°F)	Brinell Hardness Max.
1	Carbon Steel	150 (302)	595 – 650 (1100 – 1200)	1	1	100 (212)	200
3	Carbon ½ Mo	150 (302)	595 – 720 (1100 – 1325)	1	1	100 (212)	225
4	1¼ Cr ½ Mo	150 (302)	705 – 745 (1300 – 1375)	1	1	100 (212)	225
5	2¼ Cr 1 Mo	150 (302)	705 – 760 (1300 – 1400)	1	1	100 (212)	241
5	5% Cr ½% Mo	100 (212)	705 – 760 (1300 – 1400)	1	1	100 (212)	241
5	9% Cr 1% Mo	100 (212)	705 – 780 (1300 – 1436)	1	1	50 (122)	241
6	13% Cr	100 (212)	730 – 790 (1350 – 1450)	1	1	50 (122)	241

10.3 Acceptable methods for postweld heat treatment are:

10.3.1 Furnace method.

10.3.2 Local resistance method.

10.3.3 Local induction method.

Other methods for postweld heat treatment require OL's written approval.

10.4 For piping, postweld heat treatment performed by exothermic methods shall not be assumed as acceptable by vendor during bid preparation and requires OL's written approval. Welding procedures submitted for review using postweld heat treatment by exothermic methods shall be qualified as using that particular method. All weld joints postweld heat treated by exothermic methods when approved require 100% radiography.

10.5 Postweld heat treatment for stainless steels of material group P-8 (group 8 acc. to EN CEN ISO/TR 15608), nonferrous materials or dissimilar materials requires approval by OL.

10.6 Direct impingement by torch or furnace burner is not acceptable.

- 10.7** Threads and gasket surfaces shall be protected from excessive oxidation during heat treatment.
- 10.8** Equipment postweld heat treated for any reason, code or process, shall not be subjected to any further welding, hammering, pressing or forming after postweld heat treatment without OL approval.
- 10.9** Postweld Heat Treatment procedures describing cleaning requirements, heating and cooling rates, thermocouple locations, type of heating, equipment, etc. will be submitted to OL for review and permission to proceed.
- 10.10** For local Postweld Heat Treatment (PWHT) of thicknesses greater than 50 mm (2"), the manufacturer should verify that the minimum code required (PWHT) temperature is attained on the unheated side of the joint. Verification may be established either by the attachment of thermocouples or by the submittal of test data.
- 11. NON-DESTRUCTIVE EXAMINATION, TESTING AND INSPECTION**
- 11.1** Non-destructive examination procedures shall be submitted to OL and approved prior to the start of the job. Non-destructive examination shall be performed and results evaluated per the requirements of the applicable EN Code, ASME Code, ANSI Standard, or API Standard. Any additional NDE required above and beyond the above mentioned codes and standards shall be as specified in the job specification or this Specification.
- 11.2** As a minimum, or when non-destructive examination is not specified, all welds shall be visually examined. Plate 50 mm (2") and thicker and clad material shall be 100% ultrasonically tested at the mill. When postweld heat treatment is required, all specified NDE shall be performed after PWHT.
- 11.3** Brinell Hardness tests:
- 11.3.1** Hardness tests shall be performed when PWHT is specified, and when required by codes, standards or purchase documents. Hardness test results shall be given in equivalent Brinell values regardless of test method utilized. A test shall include one (1) examination in the weld and one (1) in each heat affected zone at the toe of the weld. Mandatory for steels of gr. 5; 6 acc. to CEN ISO/TR 15608.
- 11.3.2** Hardness tests on pressure vessels, exchangers, etc., where required, shall be taken as follows:
- a) One test for one longitudinal seam per course section, on the I.D. surface where practicable.
 - b) One test for each circumferential seam per 15 m (50 ft) of weld, on the I.D. surface where practicable.
 - c) One test for each major joint weld for box-type headers on air coolers.
 - d) One test for each size nozzle DN100 (4") and over in size, if accessible.
 - e) As a minimum, one test shall be taken for each welding process employed on pressure containing welds and also one test per welder or welding operator.
 - f) When PWHT is required, hardness tests shall, be performed after PWHT.
 - g) All welds group 5, 6 acc. to CEN ISO/TR 15608 shall be tested.
- 11.3.3** Hardness tests on piping not covered by ANSI standards shall be as stated in the job specification.
- 11.3.4** Hardness testing on equipment other than pressure vessels, exchangers, and piping shall be as stated in the applicable code, standard or job specification.

- 11.3.5** Results of hardness tests shall be documented by vendor for review by the OL assigned inspector. The OL assigned inspector shall be consulted on choice of location for tests.
- 11.3.6** Hardness tests exceeding the maximum Brinell hardness number (HB) allowed shall have two more tests taken near each failed location and both are required to be within the maximum acceptable hardness requirements for acceptability.
- 11.3.7** Hardness test results shall be reported with the procedure qualification record by the vendor with submittal of welding procedure review by OL for the following:
- a) Whenever hardness tests are required by codes, standards, or job specification.
 - b) Whenever equipment is to be postweld heat treated.
 - c) Whenever automatic or machine type welding processes are employed, or whenever FCAW is to be utilized.
 - d) Hardness for carbon steel shall not exceed 200 HB, hardness for low alloy shall be in accordance with applicable codes or standards. For other materials requiring hardness testing, acceptance values shall be stated in purchase documents.
 - e) Hardness for steels of gr. 5; 6 acc. to CEN ISO/TR 15608 shall not exceed 240 HB.
- 11.4** Production test requirements on weld overlay and back-cladding on vessels and exchangers:
- 11.4.1** One chemical analysis of overlay from each girth section and component (such as head, tube sheet, etc.) and from each back-cladded longitudinal and circumferential seam. Also, back-cladded manway attachment and a representative number of nozzles, at least one of each size. Production tests shall include a minimum of one test per welding process utilized and one test per welder or welding operator employed.
- 11.4.2** For austenitic stainless steel, the overlay or back-clad for TP 347 (1.4550) stainless when specified shall have elements Cr, Ni, OL, Si, C, and Cb reported.
- 11.4.3** For others, the overlay or back-clad shall meet the minimum requirements of the specified alloy.
- 11.4.4** Ferrite content of austenitic stainless steel overlay and backcladding shall be checked by using a magnetic gage or other method approved by OL. Range of ferrite shall be that specified in 7.12.1 or 7.12.2.
- 11.5** Weld overlays and back-cladding for vessels and towers shall be examined by standard copper sulfate test prior to hydrotest and by liquid penetrant examination following hydrotest. Overlay clad tubesheets shall have the liquid penetrant prior to hydrotest.
- 11.6** The OL assigned inspector shall be authorized to reject work or materials and require repair or corrections where the applicable specifications or acceptance levels have not been met.
- 11.7** The OL assigned inspector may require additional examination over and above the minimum specified. If the weld proves to be acceptable, the cost of examination shall be borne by OL. If the weld proves to be unacceptable, the cost of the examination and all required repairs and re-examination shall be borne by the fabricator.
- 11.8** Final welds in vessels and exchangers fabricated from P-1 (group 1, 11 acc. to EN CEN ISO/TR 15608) materials ≥ 32 mm (1-1/4"), P-3 (group 1, 2, 3 and 4 acc. to EN CEN ISO/TR 15608) ≥ 19 mm (3/4"), P-4 (group 4, 5 and 9 acc. to EN CEN ISO/TR

- 15608) ≥ 16 mm (5/8"), P-5, P-6 and P-7 (group 5, 6 and 7 acc. to EN CEN ISO/TR 15608) in all thicknesses shall be magnetic particle examined.
- 11.9** Welds in all non-magnetic materials, either of solid alloy or alloy clad plate shall be examined by liquid penetrant methods.
- 11.10** Where strength welds for tube to tubesheet are required, vendor must submit a cut-off (test) sample before fabrication.
- 11.11** Permanent backing rings, if approved by OL for piping or other equipment shall have 100% radiography performed on the weld seam. If radiography is impractical or if the radiographic film is not interpretable to the OL inspector, 100% UT shall be performed instead and results evaluated per the applicable code or standard.
- 11.12** Pressure retaining butt welds in shell or heads over 46 mm (1.8") thick may be manual arc process welded and shall be radiographed 100 percent.
- 11.13** Heads fabricated from more than one piece shall have welds radiographed 100 percent prior to forming.
- 11.14** If the vessel working in creep range - lifetime monitoring actions should be described in operation instruction.
- 11.15** The requirements of EN ISO 15156 apply to vessels which intended for use in H₂S containing environments.
- 11.16** Hardness testing of welding joints shall be performed for materials group 5 and 6 acc. CEN ISO/TR 15608.
- 11.17** Ferrite measurements on austenitic stainless steel production weldments shall be performed when specified on Material Requisitions or when high carbon grade materials are welded (i.e. 304H (1.4948), 316H, 321H (1.4878), and 347H) and shall conform with the following restrictions:
- 11.17.1** Ferrite measurements shall be taken both in the as-welded condition prior to PWHT and after PWHT if any (if magnetic gages are used).
- 11.17.2** Ferrite measurements shall be performed in the centre of the weld utilizing a Ferritscope or by using the Delong or Schaeffler diagrams in conjunction with the results of a chemical analysis.
- 11.17.3** The chemical analysis samples shall be removed from the centre of the weld deposit at a thickness of 2 mm from the weld surface.
- 11.17.4** The magnetic gage shall be calibrated before measurements by the manufacturer on at least two standards (calibration test blocks) having a ferrite content in the range $3 \div 10$, and with a minimum spread of 5 numbers; the standards shall be either primary or secondary weld metal standards as referenced in AWS A4.2.
- 11.17.5** An annual calibration certification shall be available for the inspector.
- 11.17.6** One ferrite measurements shall be taken for every 3 m of weld with a minimum of 4 measurements for each circumferential and 2 measurement for each longitudinal weld. A minimum of 2 measurements shall be taken on each piping circumferential and longitudinal (if fabricated) joint. A minimum of one ferrite measurement shall be taken on all nozzles penetration welds. Measurement sites shall be designated by inspector.

11.17.7 Unless otherwise specified in drawings, all ferrite measurements shall fall within the ferrite number range 4 to 10. If any ferrite measurement falls outside the permitted range, two additional measurements shall be taken adjacent to the original test. If these additional measurements fall outside the specified ferrite number range, the readings shall be referred to OL for resolution and further action.

11.17.8 When ferrite measurements of solid austenitic stainless steel are required in production, they shall be reported in the PQR; test methods acceptable values, etc. shall be the same as for production welds.

12. REPAIRS

12.1 Welding repairs shall be performed utilizing OL accepted welding procedures under conditions and requirements as stringent as those imposed by the welding procedure originally accepted by OL for the particular weld.

12.1.1 It is required that the repair procedures using welding shall be submitted for review. Repair procedure should include the following:

- a) The method of defining the type and the extent of the defect.
- b) Methods used for removing the defect, and testing conducted to ensure that the defect has been removed.
- c) Welding procedures employed for re-welding and NDE methods used to inspect weld repair area after completion of the welding.

12.2 Unacceptable discontinuities shall be completely removed by chipping, gouging, grinding or other authorized methods (for the type of material being repaired) to clean, sound, metal and the excavated area shall be examined by magnetic particle or liquid penetrant methods to assure complete removal of defects.

Excavation for repairs by flame or arc gouging shall have the same preheat requirements imposed as the welding procedures used to perform the weld.

12.3 Preheat to be used for repair welding (such as attachments, undercutting, and other defects which do not penetrate the full weld thickness) shall be the same as required for the original weld for the full base metal thickness.

12.4 Undercutting shall be repaired by blend grinding provided the required base metal thickness by design is not reduced. Otherwise, weld metal buildup will be required.

12.5 Defective work or materials that have been weld repaired shall as a minimum, be re-examined by the same non-destructive test method by which the defect was originally located.

12.6 Only two repair attempts shall be allowed on any one defective area. No further attempts to repair shall be carried out without authorization of OL.

13. SUMMARY OF WELDING VARIABLE LIMITATIONS, RESTRICTIONS AND OTHERS

Limitations, restrictions and other requirements of this Specification, whether required by EN Code, ASME Sec. IX or not, are required to be stated in the vendor's WPS, PQR and Weld Map (Appendix B), on welding procedures submitted by the vendor for review.

The main requirements are summarized here as follows:

- 13.1 Impact test results on PQR (Ref: Par. 4.7, 6.7.1)
- 13.2 Brinell Hardness test results on PQR (Ref: Par. 4.8, 6.7.1, 7.6.3, 11.3.7)
- 13.3 Mode of transfer for GMAW and FCAW to be stated on WPS and Weld Map of Appendix B (Ref: Par. 6.2).
- 13.4 GMAW: Limitations and requirements. (Ref: Par. 6.3)
- 13.5 FCAW: Limitations and requirements. (Ref: Par. 6.4, 6.5 & 6.6)
- 13.6 Automatic SAW to be specified in WPS. (Ref: Par. 6.7)
- 13.7 Filler metals and fluxes: to have stated in the WPS and/or Weld Map (Appendix B) the AWS grades, ASME specifications, manufacturers, and trade names. (Ref: Par. 7.3).
- 13.8 When backing is approved for use, it is required to be stated on PQR, WPS and Weld Map (Appendix A). (Ref: Par. 8.6)
- 13.9 Root shielding (back purge) method to be stated on WPS or separate procedure submitted. (Ref: Par. 8.11)
- 13.10 Minimum preheat temperature to be stated in WPS (Ref. Par. 9.2).
- 13.11 Preheat maintenance when required to be stated in WPS. (Ref: Par. 9.3)
- 13.12 Maximum preheat and interpass temperature to be stated on WPS for P-7 (group 7 acc. to EN CEN ISO/TR 15608) group materials and higher (Ref.: Par. 9.5)
- 13.13 Postweld heat treatment holding temperature and holding time to be specified on Weld Map (Appendix B) and in WPS. (Ref: Par. 10.1)
- 13.14 Additional welding variables to be stated in the welding procedure whether essential or non-essential per EN or ASME Sect. IX are:
 - 13.14.1 Electrical characteristics: current and voltage ranges, and polarity, for all welding processes. Voltage ranges are not required to be stated on the WPS for the SMAW and GTAW processes.
 - 13.14.2 AWS Spec for non-consumable electrode for GTAW.
 - 13.14.3 Travel speed and whether single or multiple arc for automatic processes of GTAW, GMAW, SAW, FCAW/CO₂, and for overlay and back-clad welding.
 - 13.14.4 Amount of bead overlap, extent of oscillation and wire size for overlay and back-clad welding.
- 13.15 Block welding is prohibited unless OL's prior permission is obtained.
- 13.16 When welding titanium, each bead and adjacent base metal shall be cleaned to remove all surface discoloration prior to deposition of the next bead. The final weld surface may have intermittent, iridescent straw-colored oxides.
- 13.17 The root pass of butt welds in lube oil piping, accessible from one side only, shall be welded with the gas tungsten-arc welding process.

APPENDIX A. PROCEDURE FOR REVIEW AND ACCEPTANCE OF VENDOR WELDING PROCEDURES

- A-1.** OL requires vendors to submit a copy of each welding procedure appropriate for the fabrication as stated in Par. 4.1. A copy of the weld map (Appendix B) shall also be filled out and attached to the submittal. Procedures cannot be reviewed unless accompanied by the weld map.
- A-2.** Submittals of welding procedures for review shall be directly to OL. No portion of this Specification shall be waived without written OL approval.
- A-3.** Vendors must review the welding procedures of their own subvendors for compliance to this Specification prior to submitting for OL review and acceptance.
- A-4.** The OL Reviewer reviews the submitted welding procedures and Weld Map and makes comments back to the vendor in writing. Comments are either (1) Acceptable without comment, (2) Acceptable with comments, (3) Revise and resubmit per comments, or (4) Unacceptable with comment. All comments by Reviewer are to reference the paragraph number of this Specification to which the procedure must comply.
- A-5.** Upon receiving the welding procedure from OL, the vendor must comply with the Reviewer's comments. The surveillance inspector assigned by OL is to verify that welding will be performed to the accepted welding procedures including the Reviewer's comments.

APPENDIX B. WELD MAP AND DESCRIPTION FORM

Table B-1. Weld Map and Weld Description

<div>VENDOR _____</div> <div>LOCATION _____</div> <div>PURCHASE ORDER NO. _____</div> <div>VENDOR ORDER NO. _____</div> <div>TAG OR ITEM NUMBERS _____</div>							<div>DRAW A LINE SKETCH OF EQUIPMENT. LOCATE ALL WELDS OR TYPICAL WELDS. IDENTIFY EACH WELDING PROCEDURE BY LETTER OR NUMBER. DESCRIBE EACH WELDING PROCEDURE INDIVIDUALLY. SUBMIT WITH PROCEDURES.</div>					
WELD IDENT.	WELD PROCED. NUMBER	WELD PROCESS	SHORT ARC OR SPRAY TRANSF. GMAW/FCAW	JOINT TYPE	MATERIAL AND JOINT THICK.	BACKING TYPE (IF APP'D)	FILLER			FLUX MFGR. AND TRADE NAME	PREHEAT TEMP.	PWHT AND REASON
							SFA#	AWS#	MFGR. AND TRADE NAME			

APPENDIX C. RULES FOR QUALIFICATION TEST OF WELDERS

C-1. Purpose

This document is intended to establish the requirements for qualification test of welders performing welding works at potentially hazardous units of ORLEN Lietuva.

C-2. Scope of Application

The present Rules shall be applicable to all the employees of the Company and its contractors involved in installation, maintenance and operation of potentially hazardous units of the Company.

Qualification test of welder shall be focused on welder's ability to perform fusion welding of steels producing a weld of acceptable quality.

C-3. References

EN ISO 9606	<i>Qualification test of welders. Fusion welding. Part 1. Steels.</i>
EN ISO 15609-1	<i>Specification and qualification of welding procedures for metallic materials. Welding procedure specification. Part 1. Arc welding.</i>
CEN ISO/TR 15608	<i>Welding - Guidelines for a metallic material grouping system</i>
EN ISO 6947	<i>Welds. Working positions. Definitions of angles of slope and rotation.</i>
EN ISO 4063	<i>Welding and allied processes. Nomenclature of processes and reference numbers.</i>
EN 2553	<i>Welded, brazed and soldered joints. Symbolic representation on drawings.</i>
EN 5817	<i>Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections</i>
EN ISO 10675-1	<i>Non-destructive testing of welds - Acceptance levels for radiographic testing - Part 1: Steel, nickel, titanium and their alloys</i>

C-4. Qualification Testing

Welder's qualification is tested by AB ORLEN Lietuva Engineer for Welding of Materials Engineering and Technical Analysis Group of Mechanical Department (hereinafter – OL Engineer).

C-4.1

Prior to commencement of welding works at potentially hazardous units the contractor shall submit a list of welders to OL Engineer (Attachment 1 to Appendix C). The following documents shall be submitted thereto:

Welder's qualification certificates as per EN ISO 9606

- C-4.2** OL Engineer shall check the list and data therein, and shall indicate the names of welders who must weld respective test samples before work commencement.
- C-4.3** Material of the test sample must be of the same material group (acc. to CEN ISO/TR 15608) as the one that will be welded at OL. Filler materials of the same type as the one to be applied during welding of potentially hazardous units.
- C-4.4** Contractor's welding engineer shall develop WPS for test sample welding.
- C-4.5** Test sample, weld types and positions as well as welding method (to be selected considering work character):
- C-4.5.1** Pipe - butt weld (with full penetration) position H-LO45 (according to EN ISO 6947)
- C-4.5.2** Plates - butt weld (with full penetration) vertical position PF (according to EN ISO 6947)
- C-4.5.3** In cases when only fillet welds are required, the qualification of welder may be certified for welding only fillet welds.
- C-4.5.4** Welding method (EN ISO 4063) as per welder's qualification certificate. In case the qualification testing is only for root weld pass or only for final pass, the qualification will be approved accordingly for that part of welding and for that method.
- C-4.6** A welder must perform a qualitative test sample welding witnessed by OL Engineer.
- C-4.7** Welded joint quality visual testing VT, level B (according to EN ISO 5817). If VT results are positive the radiographic testing RT of test samples shall be carried out (according to EN ISO 10675-1) Level 1.
- C-4.8** The qualification of the welder is approved and he/she is allowed to perform welding works at potentially hazardous units of OL, if the test sample welded joint quality complies with quality requirements and test sample weld is completed within time frame corresponding to the time in normal operating conditions.
- C-4.9** Repeated testing of welder's qualification is allowed; the costs of repeated NDT of test sample shall be covered by Contractor.
- C-4.10** Upon the qualification testing the list of welders shall be approved by OL Engineer for Welding of Materials Engineering and Technical Analysis Group of Mechanical Department.
- C-4.11** Confirmation of welders' qualification at OL shall be effective for 12 months. If no welding works were carried out by the welder at OL facilities neither NDT of his/her welded joints thereof during the abovementioned period, the qualification testing shall be executed.

Prepared by:	Engineer for Welding of Materials Engineering and Technical Analysis Group		Dalia Sadauskienė	
Agreed by:	Chief Mechanical Engineer		Raimundas Šeputis	
	Materials Engineer and Technical Analysis Manager		Vigantas Kumšlytis	
	Job Position	Signature	Full Name	Date

ATTACHMENT 1. TO APPENDIX C.

WELDERS' LIST

Company Name

Date

Item No.	Welder's full name	Welder (ID)	Welder's qualification test certificate No.	Welder's qualification test certificate expiry date	Range of qualification					Qualification testing at OL ⁽⁴⁾	
					Metal groups ⁽¹⁾	Dimensions		Welding process ⁽²⁾	Welding positions ⁽³⁾	Date of testing	Results
						Wall thk., mm	Diameter, mm				

Notes:

- (1) Metal groups according to CEN ISO/TR 15608 grouping system.
- (2) Welding processes marked according to EN ISO 4063.
- (3) Welding positions marked according to EN ISO 6947.
- (4) Results: YES- confirmation that the welder is allowed welding of OL potentially hazardous units within the range of his/her qualification certificate. NO – the welder is not allowed welding of OL potentially hazardous units .

Responsible person of a company

full name, job position, signature

**AB ORLEN LIETUVA
Mechanical Department
Engineer for Welding of Materials Engineering and Technical Analysis Group**

full name, job position, signature, date