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		April 2013
KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	PRESSURE VESSEL WELDING REQUIREMENTS (PROJECT STANDARDS AND SPECIFICATIONS)	

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1.0 SCOPE

- 1.1 This standard specifies the welding, heat treatment, and hardness testing requirements for shop and field fabrication, repair, or modification of pressure vessels and heat exchangers to ASME SEC VIII. These requirements are in addition to the requirements of ASME SEC VIII and ASME SEC IX.
- 1.2 Additional requirements may be contained in Scopes of Work, Drawings, or other Instructions or Specifications pertaining to specific items of work.
- 1.3 This standard is generally not applied retroactively to the maintenance and repair of existing facilities unless there are safety, environmental protection, and health or security concerns.

2.0 CONFLICTS AND DEVIATIONS

- 2.1 Any conflicts between this standard and other applicable Engineering Standards, Materials System Specifications, Standard Drawings, or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the COMPANY Manager.

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3.0 REFERENCES

Unless stated otherwise, all Codes, Standards, and Drawings referenced in this Standard shall be of the latest issue (including revisions, addenda, and supplements) and are considered a part of this Standard.

3.1 Industry Codes and Standards

American Society of Mechanical Engineers

ASME SEC II C Welding Rods, Electrodes and Filler Metals

ASME SEC VIII Rules for Construction of Pressure Vessels

ASME SEC IX Welding and Brazing Qualifications

American Petroleum Institute

API RP 510 Pressure Vessel Inspection Code "Maintenance Inspection, Rating, Repair, and Maintenance"

API RP 582 Welding Guidelines for the Chemical, Oil and Gas Industries

American Society for Testing and Materials

ASTM E92 Vickers Hardness of Metallic Materials

ASTM E140 Hardness Conversion Tables for Metals

American Welding Society, Inc

AWS A2.4 Standard Welding Symbols

AWS A3.0 Standard Terms and Definitions

AWS A4.2 Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Austenitic-Ferritic Stainless Steel Weld Metal

AWS A4.3 Standard Methods for Determination of the Diffusible Hydrogen Content of Martensitic Bainitic, and Ferritic Weld Metal Produced by Arc Welding

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AWS A5.32 Specification for Welding Shielding Gases

AWS D1.1 Structural Welding Code

National Association of Corrosion Engineers

NACE RP0472 Methods and Controls to Prevent In Service Cracking of Carbon Steel Welds in P-1 Material in Corrosive Petroleum Refining Environments

NACE MR0175-2002 Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment

British Standards Institution

BS 7570 Code of Practice for Validation of Arc Welding Equipment

4.0 GENERAL

4.1 AWS A2.4 “Standard Welding Symbols” shall be used for all welding details on all drawings.

4.2 AWS A3.0 “Standard Terms and Definitions” shall be used for all specifications and documents.

4.3 These requirements apply to all sub-contractors or sub-vendors for items within the scope of this standard.

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5.0 APPROVED WELDING PROCESSES

The following processes are approved for use with the restrictions and requirements as listed below:

5.1 Shielded Metal Arc Welding (SMAW)

5.2 Gas Tungsten Arc Welding (GTAW)

5.2.1 Except for ASME P-No. 1 through P-No. 5A/5B/5C base materials, all manual GTAW shall use a high frequency start and post-purge gas flow for the torch. Filler metal must always be added, autogenous welding is not permitted unless specifically approved by COMPANY

5.2.2 The GTAW process shall be used for all passes of piping butt welds and set-in/ on nozzles less than 25.4 mm nominal pipe size (NPS).

5.2.3 The GTAW process shall be used for the root pass of piping butt welds and set-in nozzles (where the back side is not visually inspected) of 50.8 mm nominal pipe size or less.

5.2.4 The GTAW process shall be used for the root pass of single-sided groove welds without backing made with stainless steel or nickel-based consumables.

5.2.5 The use of flux-cored GTAW wires for root pass of single-sided groove welds for base materials of P-No. 8 or higher with or without backing gas is not permitted unless specifically approved by COMPANY.

5.3 Submerged Arc Welding (SAW)

5.4 Gas Metal Arc Welding (GMAW) including Flux Cored Arc Welding (FCAW)

5.4.1 The short-circuiting (dip) mode shall not be used except for:

- a) Structural attachments to the outside surface of the vessel shell, including seal welds.

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- b) Tacking (including continuous tacks) that will be completely removed by back gouging and back welding.

5.4.2 Flux-Cored Arc Welding (FCAW)

- a) The FCAW Gas Shielded process shall not be used for the root pass on full penetration, groove joints that are welded from one side only without backing (backing may be used if it is removed after welding).
- b) Self-shielded FCAW shall not be used without the specific approval of COMPANY.

5.4.3 The STT mode of GMAW may only be used for root pass welding.

- 5.5 Thermit Welding using a copper alloy is permitted for attaching electrical grounding or cathodic protection cables to structural numbers. Thermit welding shall not be used on stainless steel materials.
- 5.6 Stud welding is permitted for attaching insulation fasteners and heat conductors.
- 5.7 Other processes (such as brazing, Electro-Gas, Electro-Slag, Plasma, etc.) may be used only with the approval of COMPANY. Depending upon the process and application proposed, COMPANY may require testing in addition to that specified by the Code. Approval to use other processes shall be obtained through the welding procedure review process.

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6.0 WELDING CONSUMABLES

- 6.1 Electrodes, filler wires, and fluxes shall conform to ASME SEC II C. other consumables may be used only with the approval of COMPANY and, depending upon the process and application proposed, may require testing in addition to that specified by ASME SEC IX. Approval to use other (unlisted to ASME SEC II C) consumables shall be obtained through the welding procedure review process. For unlisted consumables, vendor literature, which shall include intended used and approximate chemistry and mechanical properties, shall be submitted with the procedure.
- 6.2 Electrodes shall be properly stored and segregated in the store, shop or ovens to avoid mix-up. Separate ovens are required for different welding consumable types. The Fabricator shall ensure that adequate inventory control is established to account for all consumables checked-out.
- 6.3 All consumables shall be stored and dried in accordance with the requirements of Attachment 1 for SMAW electrodes and Attachment 2 for other consumables.
- 6.4 GTAW filler metal shall have either the AWS/ ASME identification or the manufacturer's identification marked on each individual rod by the manufacturer with tags ("flags"), stencil, or stamping.
- 6.5 Welding consumables shall be selected based on their mechanical properties, compatibility with the materials to be joined, their suitability for the intended service, and consideration of polarity, position, and direction of welding. Welding consumables not meeting standard industry practice using the above criteria may be rejected by COMPANY. Welding consumables which are being used outside of their rated tensile or impact ranges listed in the manufacturing specs must be batch tested or have COMPANY approval. Batch testing must be in accordance with SFA 5.01 to verify that they will meet the requirements of the base material.
- 6.5.1 Low hydrogen consumables (defined as less than or equal to 8 ml of hydrogen per 100 g of deposited weld metal, measures in accordance with AWS A4.3) shall be used except for:
- i) The root pass of closure seams on P-No. 1 (carbon steel) vessels in non-hydrocarbon service with less than 12.7 mm wall thickness where the inside is not accessible.

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- ii) If approved by COMPANY, the root passes for field repairs of joints accessible from one side only.

6.5.2 Dissimilar Metal Welds (DMW) are defined as:

- i) Any weld joint (excluding weld overlays or strip lining) between ferritic steel and either austenitic stainless steel, duplex stainless steel, or nickel-based alloys, or
- ii) Use of stainless steel or nickel-based filler metals on ferritic steels.

They shall be restricted as follows:

- a) Are not permitted for pressure-containing welds in sour service (welds in clad systems are acceptable if the DMW interface with the ferritic steel is not in contact with the sour fluid).
- b) Are permitted for non-sour hydrocarbon service if made with a nickel-based consumable.
- c) Austenitic stainless steel consumables may be used only for the following applications and if the maximum design temperature is below 300 °C.
 - i) External structural attachments (e.g. name plates)
 - ii) Non-sour, non-hydrocarbon (e.g. water) services.
- d) Nickel-based consumables may not be suitable for direct exposure to sulfur or hydrogen-sulfur reducing environments at temperature exceeding 400 °C due to possible sulfidation attack.

6.5.3 Other than the DMW's listed previously, the selection of filler metal compositions shall be as follows:

- a) For attaching non-pressure parts to pressure parts, the nominal composition of the filler metal shall match the nominal composition of the pressure part.