International Association of Oil & Gas Producers

SPECIFICATION
S-614Q

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2018

Quality Requirements for Shell-and-Tube Heat Exchangers

Revision history

VERSION	DATE	AMENDMENTS
1.0	December 2018	Issued for Publication

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Project 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

Foreword

This specification was prepared under a Joint Industry Project 33 (JIP33) “Standardization of Equipment Specifications for Procurement” organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Ten key oil and gas companies from the IOGP membership participated in developing this specification under JIP33 Phase 2 with the objective to leverage and improve industry level standardization for projects globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, based on the ten participating members’ company specifications, resulting in a common and jointly approved specification, and building on recognized industry and international standards.

This specification has been developed in consultation with a broad user and supplier base to promote the opportunity to realize benefits from standardization and achieve significant cost reductions for upstream project costs. The JIP33 work groups performed their activities in accordance with IOGP’s Competition Law Guidelines (November 2014).

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The vision from the CPC industry is to standardize specifications for global procurement for equipment and packages, facilitating improved standardization of major projects across the globe. While individual oil and gas companies have been improving standardization within their own businesses, this has limited value potential and the industry lags behind other industries and has eroded value by creating bespoke components in projects. This specification aims to significantly reduce this waste, decrease project costs and improve schedule through pre-competitive collaboration on standardization.

Following agreement of the relevant JIP33 work group and approval by the JIP33 Steering Committee, the IOGP Management Committee has agreed to the publication of this specification by IOGP. Where adopted by the individual operating companies, this specification and associated documentation aims to supersede existing company documentation for the purpose of industry-harmonized standardization.

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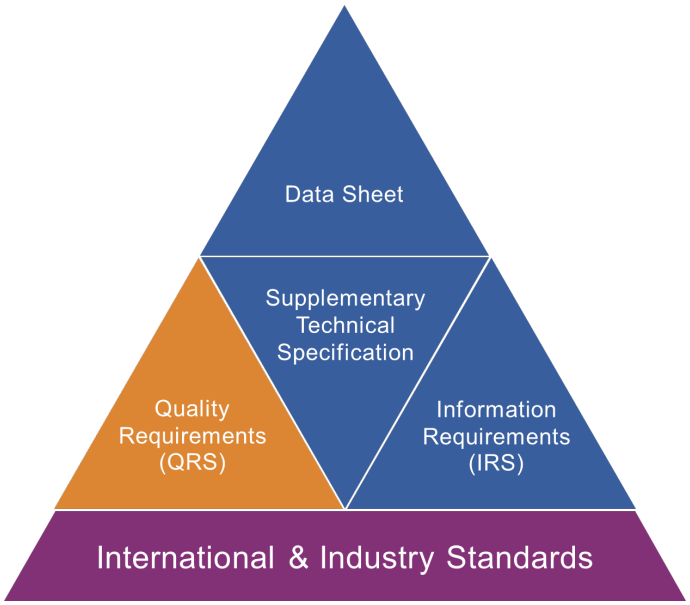
Introduction

The purpose of this quality requirements specification (QRS) is to define quality management requirements for the supply of shell-and-tube heat exchangers in accordance with API Std 660 for application in the petroleum and natural gas industries.

The QRS includes a conformity assessment system (CAS) which specifies standardized purchaser interventions against quality management activities at four different levels. The applicable CAS level is specified by the purchaser in the equipment datasheet.

This QRS shall be used in conjunction with the supplementary requirements specification (S-614), information requirements specification (S-614L) and equipment data sheets which together comprise the full set of specification documents. The Introduction section in the supplementary requirements specification provides further information on the purpose of each of these documents and the order of precedence for their use.



JIP33 Specification for Procurement Documents
Quality Requirements Specification

1 Scope

To specify quality management requirements for the supply of shell-and-tube heat exchangers to S-614, Supplementary Specification to API Standard 660 Shell-and-Tube Heat Exchangers 660 including:

a) vendor quality management system requirements;

b) purchaser conformity assessment (surveillance and inspection) activities;

c) traceability requirements;

d) evidence of conformity.

2 Normative references

For the purpose of this document, the documents referenced in IOGP S-614 and those listed below, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9001:2015	Quality management systems - Requirements
API Specification Q1	Specification for Quality Management System Requirements for Manufacturing Organisations for the Petroleum and Natural Gas Industry
API Std 660 9th Edition	Shell-and-Tube Heat Exchangers
IOGP S-614	Supplement Specification to API Standard 660 Shell-and-Tube Heat Exchangers

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 9000:2015 (normative to ISO 9001:2015) and the following shall apply. To align with the definitions used in API Std 660 the term “purchaser” is used in place of “customer” and the term “vendor” in place of “supplier”:

3.1 Conformity assessment

Demonstration that requirements relating to a product, process, system, person or body are fulfilled.

NOTE 1 Conformity assessment (or assessment) includes but is not limited to review, inspection, verification and validation activities.

NOTE 2 Assessment activities may be undertaken at a vendor or sub-vendor’s premises, virtually by video link, desktop sharing etc. or by review of information formally submitted for acceptance or for information.

3.2 Conformity assessment system (CAS)

Systems providing different levels of assessment of the vendor’s control activities by the purchaser (second party) or independent body (third party) based on evaluation of the vendor’s capability to conform to the product or service specification and obligatory requirements. The applicable CAS level is specified by the purchaser in the data sheet.

NOTE CAS A reflects the highest risk and associated extent of verification. CAS D is the lowest.

3.3 Conformity assessment - hold point (H)

Point in the chain of activities beyond which an activity shall not proceed without the approval of the purchaser or purchaser's representative.

3.4 Conformity assessment - witness point (W)

Point in the chain of activities that the vendor shall notify the purchaser or purchaser's representative before proceeding. The operation or process may proceed without witness if the purchaser or purchaser's representative does not attend after the agreed notice period.

3.5 Conformity assessment – surveillance (S)

Observation, monitoring or review by the purchaser or purchaser's representative of an activity, operation, process or associated information.

3.6 Conformity assessment – review (R)

Review of the vendor's documentation by the purchaser or purchaser's representative to verify conformance to requirements.

NOTE Information review requirements are managed on a surveillance basis, and as such do not impose schedule constraints, unless specified as hold points in Annex A, or as conditions specified in the associated IRS

4 Symbols and abbreviations

For purposes of this document, the following abbreviation applies:

CAS Conformity Assessment System

IRS Information Requirements specification

QRS Quality Requirements Specification (this document)

5 Quality Requirements

5.1 Quality management system

The vendor shall demonstrate that the quality management arrangements established for the supply of products or services conform to ISO 9001:2015, API Specification Q1 or equivalent quality management system standard agreed with the purchaser.

5.2 Conformity assessment

Quality plans or inspection and test plans developed as outputs to operational planning and control for the products or services shall define the specific controls to be implemented by the vendor and when applicable, sub-vendors, to ensure conformity with the specified requirements.

Controls will address both internally and externally sourced processes, products and services

Quality plans and inspection and test plans shall include provisions for the purchaser's CAS; see Annex A, as specified in the data sheet or purchase order.

Vendor performance in meeting the requirements will be routinely assessed during execution of the scope and where appropriate, corrective action requested and the level of conformity assessment increased or decreased consistent with criticality and risk.

NOTE 1 For industrial well proven solutions CAS level D is specified unless risk assessment indicates that a more stringent CAS-level is required.

NOTE 2 Irrespective of the CAS level defined by the purchaser, either, by reference to standard and specification requirements or in the scope, the vendor remains responsible for operational planning and control and demonstration of the conformity of products and services with the requirements (see ISO 9001, 8.1, 8.2).

6 Traceability

Material certification and traceability shall be provided in accordance with Annex B. Material inspection certificates shall be provided in accordance with Table 1 of ISO 10474 or Table A.1 of EN 10204.

7 Control of nonconforming products and services

Nonconformance with specified requirements identified by or to the vendor prior to or during the delivery of the products and services shall be corrected such that the specified requirements are satisfied or the purchaser's acceptance of the nonconformance agreed in accordance with purchase order conditions.

NOTE See ISO 9001, 8.2.3, 8.2.4, 8.5.6 and 8.7

8 Evidence (records)

Plans, procedures, methods, resultant records shall be provided in accordance with the associated IRS.

Annex A Purchaser conformity assessment requirements

This annex defines four CAS or levels of purchaser assessment.

The vendor shall provide for the specified CAS when developing quality plans and inspection and test plans in accordance with Clause 5.

	VENDOR CONTROL ACTIVITIES	CAS			
		A	B	C	D
1	**Planning and Control Activities**				
1.1	Quality plan (ISO 9001,8.1 and ISO 10005)	H	H	R	
1.2	Inspection and test plan (ISO 9001,8.1 and ISO 10005)	H	H	R	R
1.3	Technical kick-off meeting	H	W	W	
1.4	Pre-production meeting and pre-inspection meeting	H	H	W	
2	**Design and Development Activities**				
2.1	Thermal design verification (see IOGP S-614L for scope) (ISO 9001, 8.3)	H	H	H	R
2.2	General arrangement drawing, design calculation and detailed drawings. (ISO 9001, 8.3)	H	H	H	R
2.3	Manufacture and test procedures (forming, tube expansion, pressure testing as indicated in S-614L and applicable code)	H	H	H	R
2.4	Welding book (WPS and WPQR) (code requirement)	H	H	R	
2.5	Non-destructive examination procedures (code requirement)	H	R	R	
2.6	Heat treatment procedures (code requirement)	H	R	R	
3	**Control of External Supply**				
3.1	External supply scope, risk assessment and controls (e.g. tube bending, expansion joints) (ISO 9001, 8.4)	H	R	R	
4	**Materials and Component Manufacturing**				
4.1	Inspection and identification of materials and consumables: certification (including heat treatment certification), chemical and mechanical properties, testing and conformity to code requirements.	H	R	R	
4.2	**Fabrication requirements** (code requirement)				
4.2.1	Cutting and marking of plates (code requirement)	S	S		
4.2.2	Forming of pressure parts: shell, heads (code requirement)	W	S	S	
4.2.3	Forming of pressure parts: tube bending (code requirement)	W	W	S	
4.2.4	Qualification of welders (code requirement)	R	R	R	
4.2.5	Qualification of welders performing tube to tubesheet welds	H	W	R	
4.2.6	Qualification of non-destructive examination personnel (code requirement)	R	R	R	
4.2.7	Qualification of non-destructive examination personnel performing ultrasonic examinations in lieu of radiographic examinations (code requirement)	H	W	R	
4.2.8	Set up, material traceability, tack welding, welding, fabrication and assembly of components (code requirements)	W	S	S	

4.2.9	Visual and dimensional inspection of all components including shell, channel heads, floating heads, body flanges, tubes, tube sheets, covers, baffles, tolerances, permissible out of roundness, etc (code requirement)	W	S	S	
4.2.10	Minor repairs of defects in materials (code requirement;)	H	W	R	R
4.2.11	Major repairs of defects in materials e.g. tubesheets	H	W	W	W
4.2.12	Flatness check of gasket surfaces of all body flanges and tubesheets after completion of all welding, heat treatment (if required) and tube expansion. (API Std 660, 9.8.4, 9.8.6 and 9.8.7 and S-614, 9.8.2 and 9.8.3)	S	S	S	
4.2.13	Heat treatment, including preparation of equipment, attachment of thermocouples and review of charts (code requirement)	W	R	R	
4.2.14	Review of non-destructive examination of cladding and overlay (Code requirement, API Std 660, 10.1.7, 10.1.11, 10.1.12, 10.1.13 and 10.1.18)	H	W	S	
4.2.15	Staged and final assembly including, installation of girth gasket, bolt tensioning	W	W	S	
4.2.16	Bundle insertion including shell inside diameter inspection and verification of complete bundle components	H	H	W	W
4.3	**Inspection, testing and verification activities** (code requirement)				
4.3.1	Non-destructive examination of plate and tube raw materials	W	S	R	
4.3.2	Ferrite testing (API Std 660, 10.1.14 and 10.1.15)	W	S	R	
4.3.3	Production weld hardness testing (code requirement, API Std 660, 10.1.6)	W	S	R	
4.3.4	Inspection and non-destructive examination of longitudinal and circumferential welds, including attachments (code requirement, API Std 660, 10.1 and IOGP S 614,10.1 and 12.3.6)	W	R	R	
4.3.5	Inspection and non-destructive examination of other welds e.g. tube-to-tubesheet (code requirement, API Std 660, 10.1.7)	H	W	R	
4.3.6	Inspection and non-destructive examination of other components e.g. tube-to-tubesheet after tube expansion (code requirement)	S	S		
4.3.7	Destructive test results (when applicable): production test coupon, tube-to-tubesheet joint mock up, tube bending qualification (code requirement, IOGP S 614, 9.7.4)	W	W	S	
4.3.8	Leak test (e.g. helium leak test, if applicable, API Std 660, 10.2.1 and 10.2.2)	H	W	W	
4.3.9	Hydrostatic or pneumatic shell side and tube side testing (code requirement)	H	H	W	
4.3.10	Surface preparation, painting and coating	Refer to purchase order			
4.3.11	Painting, fire protection or lagging	Refer to purchase order			
5	**Release of Product or Service**				
	Verify conformity to purchaser order including as applicable;				
5.1	Final inspection including nameplate and stamping (if applicable)	H	W	R	
5.2	Loose ship item, spares parts, special tools as applicable	W	W	R	
5.3	Preservation, packing and storage (section 3-G6 of TEMA and API Std 660, 11)	H	W	S	
5.4	Final documentation review; as per IOGP S-614L	R	R	R	R
5.5	Release note	H	H	H	H
	H is hold point, R is review, S is surveillance, and W is witness point. Note: Definitions for these terms are provided in Clause 3 to this document.				

Annex B Material traceability and certification requirements

Item		Certificate type	Material traceability level	Additional requirements
Heat Exchanger	Shell and channels	3.1	Level II	Pressure-retaining components for carbon steel in sour or wet hydrogen sulfide service shall be supplied with a certified material test report as defined by NACE MR0175 (all parts) or NACE MR0103. Type 3.2 certification is applicable as per the design and or purchase order requirements
	Heads	3.1	Level II	
	Tubes	3.1	Level II	
	Tubesheet	3.1	Level II	
	Expansion joints	3.1	Level II	
	Pipe, fittings, forged items and blind flanges	3.1	Level II	
	Welded internal and external attachments	3.1	Level II	
	Welding consumables	2.2		
	Baffles and support plates, tie rods and spacers	2.2		
	Saddles	3.1	Level II	

Explanatory notes:

Material Inspection Certificates shall be provided in accordance with ISO 10474 or EN 10204.

A. “2.2” Test Report - A document in which the vendor declares that the products supplied are in compliance with the requirements of the PO, and in which test results are supplied based on non-specific inspection and testing.

B. “3.1” Inspection Certificate - A document with test results based on specific inspection and testing, issued by the vendor and validated by the vendor’s authorised inspection representative independent of the manufacturing department.

C. “3.2” Inspection Certificate - A document prepared by both the vendor’s authorised inspection representative, independent of the manufacturing department, and either the purchaser nominated representative or the inspector designated by the regulations in which they declare that the products supplied are in compliance with the requirements of the order and for which test results are supplied.

D. Additionally, purchaser has specified that all material product testing associated with “3.2” Inspection Certificates be performed in the presence of either a purchaser nominated representative or the inspector designated by the regulations, and the resultant test report stamped as “Witnessed”. Failure to adhere to this requirement may lead to rejection of all material(s) being qualified for production.

E. Level I - Full Traceability - Material is uniquely identified and its history tracked from manufacture through stockist (where applicable) to vendor and to actual position on the equipment with specific location defined on a material placement record. (The traceability to a specific location only applies to skids / packaged equipment, not to bulks)

F. Level II - Type Traceability - vendor maintains a system to identify material throughout manufacture, with traceability to a material certificate.

G. Level III - Compliance Traceability - vendor maintains a system of traceability that enables a Declaration of Compliance to be issued.

Registered Office
City Tower
40 Basinghall Street
14th Floor
London EC2V 5DE
United Kingdom

T +44 (0)20 3763 9700
F +44 (0)20 3763 9701
reception@iogp.org

Brussels Office
Bd du Souverain,165
4th Floor
B-1160 Brussels
Belgium

T +32 (0)2 566 9150
F +32 (0)2 566 9159
reception@iogp.org

Houston Office
10777 Westheimer Road
Suite 1100
Houston, Texas 77042
United States

T +1 (713) 470 0315
reception@iogp.org

www.iogp.org