

Supplementary Specification to API Specification 5CT Casing and Tubing

Revision history

VERSION	DATE	PURPOSE
1.0	April 2022	First Edition

Acknowledgements

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

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Foreword

This specification was prepared under Joint Industry Programme 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). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization 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, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

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 CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

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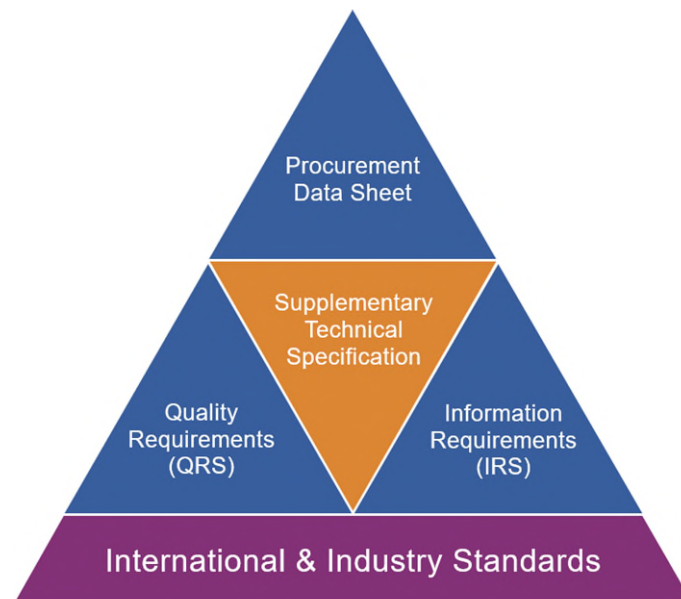
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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of casing and tubing in accordance with API Specification 5CT, Tenth Edition, December 2018, including Errata 3, June 2020 and Addendum 1, January 2021, Casing and Tubing for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.



JIP33 Specification for Procurement Documents Supplementary Technical Specification

This specification is to be applied in conjunction with the supporting procurement data sheet, information requirements specification (IRS) and quality requirements specification (QRS) as follows.

IOGP S-735: Supplementary Specification to API Specification 5CT Casing and Tubing

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to API Specification 5CT following the API Specification 5CT clause structure. Clauses from API Specification 5CT not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to API Specification 5CT defined in this specification are identified as Add (add to clause or add new clause), Replace (part of or entire clause) or Delete.

IOGP S-735D: Procurement Data Sheets for Casing and Tubing (API)

The procurement data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The procurement data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the procurement data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-735L: Information Requirements for Casing and Tubing (API)

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

IOGP S-735Q: Quality Requirements for Casing and Tubing (API)

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS follows that of API Specification 5CT and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The procurement data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The supplementary specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order);
- c) purchaser defined requirements (procurement data sheet, IRS, QRS);
- d) this specification;
- e) API Specification 5CT.

1 Scope

1.1 Coverage

Replace first sentence with

This procurement specification provides the technical delivery conditions for steel pipes (casing, tubing and pup joints), coupling stock, coupling material and accessory material, and establishes requirements for two specification levels (SLs), specification level A (SL-A) and specification level B (SL-B).

Delete last sentence of first paragraph (PSLs)

1.3 Applicability—Grades

Replace section with

The grades to which this specification is applicable are included in Table 18.

Add new Table 18

Table 18—Summary of Applicable Grades

Grade Description		Grade Name	Specification Level	Base Grade
1		2	3	4
API 5CT grades		H40, N80 Type 1, N80Q	SL-B	N/A
		J55, K55, L80 Type 1, L80 Type 13Cr, R95, P110, Q125	SL-A or SL-B	N/A
API 5CT grades with SSC method specified as per IOGP S-735		C90 (A-80 %, A-90 %)	SL-A or SL-B	C90
		C90 (D)	SL-A	C90
		T95 (A-80 %, A-90 %)	SL-A or SL-B	T95
		T95 (D)	SL-A	T95
		C110 (A or D)	SL-A	C110
IOGP S-735 new grade		M125 (A, D or AD)	SL-A	M125
IOGP S-735 variant grades	Chemical composition	L80 Type 1Cr	SL-A	L80 Type 1
	Yield strength	P125	SL-A or SL-B	P110
		Q125RY	SL-A	Q125
		Q130	SL-A	Q125
		Q130RY	SL-A	Q125
		Q140	SL-A	Q125
	Up-rated collapse	P110UC	SL-A or SL-B	P110
		P125UC	SL-A or SL-B	P110
		Q125UC	SL-A	Q125
		Q125UCRY	SL-A	Q125
		Q135UC	SL-A	Q125
		T95UC (A-80 %, A-90 %, D)	SL-A	T95
		C110UC (A or D)	SL-A	C110
		M125UC (A, D or AD)	SL-A	M125

Table 18 (continued)

Grade Description		Grade Name	Specification Level	Base Grade
1		2	3	4
IOGP S-735 variant grades (continued)	LS	R95LS (A or D)	SL-A or SL-B	R95
		P110LS (A or D)	SL-A or SL-B	P110
	EN	T95EN (A, D or AD)	SL-A	T95
		C110EN (A, D or AD)	SL-A	C110
		M125EN (A, D or AD)	SL-A	M125
Key EN = enhanced sour variant grade UC = uprated collapse LS = limited sour variant grade RY = restricted yield strength				
NOTE For grades with SSC testing, the suffix to the grade states the SSC method(s) to be applied for acceptance testing. (A) = SSC test method A only (A-80 %) = SSC test method A - minimum criteria for full sized specimens based on 80 % of YSmin (A-90 %) = SSC test method A - minimum criteria for full sized specimens based on 90 % of YSmin (A or D) = SSC test method A or D (AD) = SSC test method A and D (D) = SSC test method D only				

1.4 Supplementary Requirements

Add after "non-destructive examination."

oblique NDE inspections, tubular categorization based on wall thickness,

2 Normative References

Add to section

ISO 15156-2:2020, *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production — Part 2: Cracking-resistant carbon and low-alloy steels, and the use of cast irons*

3 Terms, Definitions, Symbols, and Abbreviations

3.1 Terms and Definitions

Replace term "3.1.28 linear imperfection" with

3.1.28

linear imperfection

linear indication

Imperfection which includes, but is not limited to, seams, laps, cracks, plug scores, cuts and gouges. Includes linear indications as defined by ASME BPVC, Section VIII, Division 1, Appendix 8.

NOTE See API 5T1 for examples of imperfections.

Replace term "3.1.30 non-linear imperfection" with

3.1.30
non-linear imperfection
rounded indication

Imperfection which includes, but is not limited to, pits and round-bottom die stamping. Includes rounded indications as defined by ASME *BPVC*, Section VIII, Division 1, Appendix 8.

NOTE See API 5T1.

Add new term

3.1.48

K_{LIMIT}

Definition as per NACE TM0177:2016, Appendix E.

[SOURCE: NACE TM0177:2016]

Add new term

3.1.49

validation

Definition as per ISO 9000:2015, 3.8.13.

[SOURCE: ISO 9000:2015, 3.8.13]

Add new term

3.1.50

verification

Definition as per ISO 9000:2015, 3.8.12.

[SOURCE: ISO 9000:2015, 3.8.12]

3.2 Symbols

Replace definition of symbol Ar_3 with

Ar_3 temperature at which austenite begins to transform to ferrite during cooling

Add to section

EN	enhanced sour
UC	uprated collapse
ESTR	end-sizing with or without thermal recovery
LS	limited sour
MPQ	manufacturing procedure qualification
PPQ	product performance qualification
PQP	product quality plan
RY	restricted yield strength
SL	specification level

4 Conformance

4.1 References to Annexes

Replace seventh list item with

- SLs, see Annex H (informative);

Replace ninth list item with

- requirement summary for SLs, see Annex J (informative);

Add new list item

- product performance qualification (PPQ), see Annex L (normative if invoked by purchaser or for validation of performance criteria);

Add new list item

- manufacturing procedure qualification (MPQ), see Annex L (normative if invoked by purchaser);

Add new list item

- validation of NDE and thread Inspections, see Annex M (normative if invoked by purchaser);

Add new list item

- end sizing and thermal recovery process requirements for process validation and production testing, see Annex N (normative);

Add new list item

- uprated collapse products, requirements for PPQ and production testing, see Annex P (normative for UC variant grades).

4.2 Extended Scope

Replace first list section with

- The sets of requirements that define SL-A and SL-B are given in table form in Annex H and summarized in Annex J.

Add new section

4.5 Application of this Specification

When requirements are not explicitly stated in this specification for a variant grade or specified by the purchaser, the requirements of the base grade shall apply.

NOTE 1 Base grades are existing API 5CT grades used as a reference for variant grades. Depending on the nature of the variant grade, it is expected that certain combinations of requirements are purposely enhanced beyond these minimum requirements. For instance, requirements such as SSC testing are specified for some variant grades, while a combination of other features such as chemistry, hardenability, grain size are not specified but expected to be agreed to achieve the SSC criteria.

It may be requested that the product is marked with the API monogram via the purchase agreement or IOGP S-735D.

NOTE 2 It is the intention of this specification, with the exception of Grade M125, that products that conform to this specification can also achieve conformance with API Monogram Program requirements at least to PSL-1 of API 5CT.

Grades that shall be SSC tested are denoted in Table 18.

The purchaser shall specify which of the SSC test conditions from Table 20 or Table 21 are to be utilized.

Up-rated collapse rating shall be qualified in accordance with P.1.

Production testing for UC products shall be in accordance with P.2.

5 Information to be Supplied by the Purchaser

Add new section 5.0 before section 5.1

5.0 General

When ordering products to this specification, conformance with API 5CT, Section 5 requirements may be achieved by using IOGP S-735D (procurement data sheet) as the basis for the purchase agreement.

The procurement data sheet addresses the mandatory requirements of API 5CT along with relevant purchaser options and relevant manufacturer/purchaser agreements.

The manufacturer shall note the following modifications within this specification that affect Table 1, Table 4, and Table 7:

- Mandatory SLs (SL-A or SL-B) replace the optional PSL-2 and PSL-3. Table H.1 summarizes the requirements for SL-A and SL-B.
- Table C.59 and Table E.59 list alternative outside diameter, wall thickness and drift combinations. These are allowed as per API 5CT, 1.1.
- Variant grades are specified with reference to an API Base grade. Table 18 of this specification provides the reference that links each variant grade to a monogramable API grade from Table C.3, Table C.4, and Table C.5 or Table E.3, Table E.4, and Table E.5.
- This specification introduces grade M125 which is not monogramable.

Replace section 5.1 title with

5.1 Grades C90, T95, C110, and M125, and Variant Grades Requiring SSC Testing

In first sentence of first paragraph, replace "Grades C90, T95, and C110" with

Grades C90, T95, C110, M125 and the variant grades requiring SSC testing, listed in Table 18

In second sentence of first paragraph, replace "Grade C110" with

Grades C110 and M125 and their associated variant grades

In second sentence of first paragraph, replace "as this material is not suitable for all sour" with

as these materials may not be suitable for all sour

6 Process of Manufacture

6.1 General

Add after second sentence of second paragraph

Pup joints shall be manufactured in accordance with the SL specified for the casing or tubing.

Add after third paragraph

For grades requiring SSC testing in accordance with Table 20 or Table 21, products shall not be manufactured from bar stock.

Replace fourth paragraph with

Electric-welded tubulars of Grades P110, P125 and Q125 shall only be specified at SL-B and with SR11 included.

Replace fifth paragraph with

Grades C110, M125 and T95EN products shall not be upset, unless PPQ is applied.

Add NOTE

NOTE When the designation "P110" is used alone, it covers Grade P110 and all the variant grades listed in Table 18 as having Grade P110 as the base grade, including the P125 designated variant grades.

6.2 Heat Treatment

6.2.2 Grades J55, K55, N80 (All Types), and R95

In first paragraph, replace "For grades J55 and K55 products," with

For Grades J55 and K55 SL-B products

Add to first paragraph

For Grades J55 and K55 SL-A products, a heat treatment, consistent with Table C.3 footnote b or Table E.3 footnote b, shall be applied.

Delete fourth paragraph (PSLs)

Replace section 6.2.3 title with

6.2.3 Grades L80 (All Types) and all Grades Requiring SSC Testing as per Table 20 or Table 21

In NOTE, replace "Grades L80 Type 1, L80 9Cr, and L80 13Cr" with

Grades L80 Type 1, L80 1Cr and L80 13Cr

6.3 Straightening

Replace section 6.3.1 title with

6.3.1 Grades H40, J55, K55, and N80 (All Types)

Delete second paragraph (PSLs)

Replace section 6.3.2 title with

6.3.2 Grades R95 and P110

Delete second paragraph (PSLs)

Add to section

LS and UC variant products shall have a minimum temperature of 400 °C (750 °F) at the end of hot rotary-straightening.

LS and UC variant products that are cold rotary-straightened shall be stress-relieved at 510 °C (950 °F) or higher.

6.3.4 Grades C90 and T95

Add to beginning of first sentence

For SL-B products,

Add to section

For SL-A products, when straightening is necessary, the product shall be either:

- cold rotary straightened followed by stress relief at 30 °C to 55 °C (50 °F to 100 °F) below the final specified tempering temperature; or
- hot rotary straightened with an exit temperature not more than 165 °C (300 °F) below the tempering temperature.

Delete second paragraph (PSLs)

Add new section

6.3.7 Gag Straightening

When gag straightening is applied, stress relieving subsequent to straightening shall be required when the maximum fiber strain is greater than the value established during process validation (see 6.5).

NOTE When additional heat treatment or stress relieving is performed after straightening, it is acceptable to exceed the validated maximum fiber strain value.

6.4 Traceability

6.4.1 General

In second paragraph, replace "For C110, Q125, and PSL-2 products," with

For Grades C110, M125, and Q125, and SL-A products,

Replace section 6.4.2 title with

6.4.2 Serialization of Grades C90, T95, C110, M125, and Q125

6.5 Processes Requiring Validation

Add new section heading 6.5.1 before first paragraph

6.5.1 General

Add new list item e)

- e) if applicable to the product, end-sizing with or without subsequent thermal recovery;

Add new list item f)

- f) for all products, cold rotary-straightening or gag-press straightening, unless subsequently heat-treated or stress relieved (see 6.5.2).

Add new section

6.5.2 Cold Rotary and Gag Press Straightening Validation

Validation shall cover the cold straightening technique and the stress constraints, i.e. maximum deflection and maximum fiber strain.

Validation shall be based on product size, grade, wall thickness and straightening equipment.

Validation shall be performed on the middle and at both ends of lengths.

Based on the grade and SL, tensile testing and hardness testing (if applicable) shall be performed for validation.

7 Material Requirements

7.1 Chemical Composition

In second paragraph, replace "For Grade C110" with

For Grades C110 and M125

Add to second paragraph

For Grades R95LS and P110LS, the certificate shall include the target concentration and minimum and maximum concentrations for all elements intentionally added to each heat, regardless of the purpose of the addition.

Delete third paragraph (PSLs)

7.2 Tensile Properties

7.2.3 Yield Strength

Delete second paragraph (PSLs)

Replace section 7.2.4 title with

7.2.4 Statistical Tensile Testing—Grades C90, T95, C110, and M125

In first paragraph, replace "Grades C90, T95, and C110" with

Grades C90, T95, C110 and M125

7.3 Charpy V-notch Test—General Requirements

7.3.1 Evaluation of Test Results

In second paragraph, replace "For Grade C110 either:" with

For Grades R95LS, P110LS, C110 and M125, and when SL-A is specified for Grades L80 Type 1, C90, R95, T95, P110, P125 and Q125, either:

Delete last paragraph (PSLs)

7.3.5 Alternative Size Impact Test Specimens

Replace "Tables C.10 to C.15" with

Table C.10

Replace "Tables E.10 to E.15" with

Table E.10

7.3.7 Test Temperature

Replace first paragraph with

The test temperature shall be in accordance with Table 19.

Add new Table 19

Table 19—Charpy Test Temperature

Grades	Test Temperatures		SL-B ^a	SL-A ^a
Grades J55 and K55	Default test temperature		+ 21 °C (+70 °F)	0 °C (+32 °F)
	Alternative test temperatures, if specified ^b	Option 1	0 °C (+32 °F)	-10 °C (+14 °F)
		Option 2	-10 °C (+14 °F)	other
		Option 3	other	other
All grades except J55 and K55	Default test temperature		0 °C (+32 °F)	
	Alternative test temperatures, if specified ^b	Option 1	-10 °C (+ 14 °F)	
		Option 2	other	

^a The temperature tolerance on the specified test temperature shall be ±3 °C (±5 °F) when testing at +21 °C (70 °F) and ±1 °C (±2 °F) for other test temperatures.

^b Alternative test temperatures may be specified in the purchase agreement.

7.4 Charpy V-notch—Absorbed Energy Requirements for Coupling Stock, Coupling Material, Coupling Blanks, and Couplings

Replace section 7.4.3 title with

7.4.3 Grades J55 and K55

Replace first and second sentences with

The full-size absorbed energy requirement C_v shall be equal to or greater than the value in Table C.60 or Table E.60, based on the SL.

Replace section 7.4.4 title with

7.4.4 Grades N80 (All Types), R95, L80 (All Types), C90, T95, P110, C110, M125, P125, and Q125

Delete first paragraph

Replace Table 9 title with

Table 9—Full-size Test Specimen Minimum Absorbed Energy Requirements (Couplings for Grades N80 [All Types], R95, L80 [All Types], C90, T95, P110, C110, P125, M125, and Q125)

Replace Table 9 with

Unit System	Transverse Requirement ^{a, b} C_v	Longitudinal Requirement ^{a, b} C_v
SI units, joules	$YS_{max} \times (0.00118t + 0.01259)$ or Table C.60, whichever is greater	$YS_{max} \times (0.00236t + 0.02518)$ or Table C.60, whichever is greater
USC units, foot-pounds	$YS_{max} \times (0.152t + 0.064)$ or Table E.60, whichever is greater	$YS_{max} \times (0.304t + 0.128)$ or Table E.60, whichever is greater
^a For L80 13Cr products with wall thickness > 35.6 mm (1.4 in.), these minimum absorbed energy criteria shall be by agreement. ^b For products (with the exception of L80 13Cr) with wall thicknesses > 63.5 mm (2.5 in.), these minimum absorbed energy criteria shall be by agreement.		

Delete NOTE

7.5 Charpy V-notch-Absorbed Energy Requirements for Pipe

7.5.1 Grades H40, J55, and K55

Replace first paragraph with

For Grades J55 and K55 at SL-A, Charpy impact testing in accordance with K.9 (SR 16) shall be performed.

The average result from the three impact specimens shall equal or exceed the minimum full size CVN absorbed energy value given in Table C.60 or Table E.60.

Delete second paragraph (PSLs)

Add to beginning of NOTE

For H40 and when SL-B is specified for Grades J55 and K55, there are no mandatory CVN impact requirements.

Replace section 7.5.2 title with

7.5.2 Grades N80 (All Types), R95, L80 (All Types), C90, T95, and P110

Replace first paragraph with

See 7.5.5 for impact testing conditions by grade and SL.

Delete second paragraph (PSLs)

Replace Table 10 title with

**Table 10—Full-size Test Specimen Minimum Absorbed Energy Requirements
(Pipe for Grades N80 [All Types], R95, L80 [All Types], C90, T95, and P110)**

Replace Table 10 with

Unit System	Transverse Requirement ^{a, b} C_v	Longitudinal Requirement ^{a, b} C_v
SI units, joules	$YS_{min} \times (0.00118t + 0.01259)$ or Table C.60, whichever is greater	$YS_{min} \times (0.00236t + 0.02518)$ or Table C.60, whichever is greater
USC units, foot-pounds	$YS_{min} \times (0.152t + 0.064)$ or Table E.60, whichever is greater	$YS_{min} \times (0.304t + 0.128)$ or Table E.60, whichever is greater
^a For L80 13Cr products with wall thickness > 35.6 mm (1.4 in.), these minimum absorbed energy criteria shall be by agreement. ^b For products (with the exception of L80 13Cr) with wall thicknesses > 63.5 mm (2.5 in.), these minimum absorbed energy criteria shall be by agreement.		

Replace section 7.5.3 title with

7.5.3 Grades C110, M125, and Q125, and Variant Grades P125 and P125UC

Replace first paragraph with

See 7.5.5 for impact testing conditions by grade and SL.

Delete second paragraph (PSLs)

Replace Table 11 title with

**Table 11—Full Size Test Specimen Minimum Absorbed Energy Requirements
(Pipe for Grades C110, M125, and Q125, and Variant Grades P125 and P125UC)**

Replace Table 11 with

Unit System	Transverse Requirement ^a C_v	Longitudinal Requirement ^a C_v
SI units, joules	$YS_{max} \times (0.00118t + 0.01259)$ or Table C.60, whichever is greater	$YS_{max} \times (0.00236t + 0.02518)$ or Table C.60, whichever is greater
USC units, foot-pounds	$YS_{max} \times (0.152t + 0.064)$ or Table E.60, whichever is greater	$YS_{max} \times (0.304t + 0.128)$ or Table E.60, whichever is greater
^a For products with wall thicknesses > 63.5 mm (2.5 in.), these minimum absorbed energy criteria shall be by agreement.		

7.5.5 Testing Conditions

In first sentence, replace "For Grades C110 and Q125 pipe" with

For Grades C110, M125, and Q125 pipe

Add after first sentence of first paragraph

For all other SL-A grades, K.9 (SR 16) shall be included with impact testing as specified in 10.7.

Replace second sentence of first paragraph with

When K.9 (SR 16) is specified, for SL-B grades, impact testing shall be in accordance with 10.7.

When K.9 (SR 16) is not specified for SL-B grades, conformance with the requirements of 7.5.2 or 7.5.3 may be qualified by a documented procedure in lieu of testing.

7.7 Maximum Hardness

Replace section 7.7.1 title with

7.7.1 Grades L80 (All Types), C90, R95LS, T95, P110LS, C110, and M125

Replace section 7.7.1 a) title with

a) Grades L80 (all types), C90, R95LS, T95, P110LS, C110, and M125 Through-wall Hardness

Add new section 4) to 7.7.1 a)

- 4) For Grade M125, any mean hardness number not exceeding 34.0 HRC is acceptable. If a hardness number from a single indentation exceeds 36.0 HRC, the length or piece shall be rejected. Products with mean hardness numbers between 34.0 HRC and 36.0 HRC shall be retested.

Add new section 5) to 7.7.1 a)

- 5) For Grades R95LS and P110LS, the mean hardness number and single indentation criteria shall be set through PPQ.

Replace section 7.7.1 b) title with

b) Grades C90, T95, R95LS, C110, P110LS, and M125—Surface Hardness (only if required in accordance with 10.6)

Add to section 7.7.1 b)

For Grade M125, if the Brinell or Rockwell C-scale hardness number does not exceed 319 HBW or 34.0 HRC respectively, the length or piece is acceptable.

If any of the hardness numbers are over 319 HBW or 34.0 HRC, two additional indentations shall be made in the immediate area.

If either of the second test hardness numbers exceeds 319 HBW or 34.0 HRC, the piece shall be rejected.

For Grades R95LS and P110LS, the surface hardness criteria shall be set through PPQ.

Replace section 7.8 title with

7.8 Hardness Variation—Grades C90, T95, C110, M125, and Q125, and Variant Grades R95LS and P110LS

Replace section 7.9 title with

7.9 Process Control—Grades C90, R95LS, T95, P110LS, C110, M125, and Q125

In second sentence, replace "For Grades C90, T95, and C110," with

For Grades C90, T95, C110 and M125,

Delete last sentence

7.10 Hardenability—Minimum Percentage Martensite for Quenched and Tempered Products

Replace section 7.10.1 title with

7.10.1 Grades C90 and T95, and at SL-A for L80 Type 1

Delete third paragraph (PSLs)

Replace section 7.10.2 title with

7.10.2 Grades C110 and M125

Replace section 7.10.3 title with

7.10.3 All Grades Except Grades Requiring SSC Testing as per Table 20 or Table 21 and at SL-A for Grade L80 Type 1

Delete second paragraph (PSLs)

Add new section

7.10.4 LS and E Variant Grades

For each size, mass, chemical composition and austenitize-and-quench combination for the LS variant grades, a through-wall hardness test shall be performed after quenching and prior to tempering as part of a documented procedure to confirm sufficient hardening.

For each size, mass, chemical composition and austenitize-and-quench combination for the E variant grades, a through-wall hardness test shall be performed after quenching and prior to tempering for each production run.

The hardenability acceptance criteria for LS and E variant grades shall be in accordance with the manufacturer's specifications or proposed via MPQ/PPQ.

For the E variant grades, the alternative hardness criteria shall not be less restrictive than the base grade.

For the LS variant grades, the alternative hardness criteria shall be at least those given in 7.10.3.

Replace section 7.11 title with

7.11 Grain Size—Grades Requiring SSC Testing as per Table 20 or Table 21

In first sentence, replace "Grade C110" with

Grades C110 and M125

Add to section

For all other grades requiring SSC testing as per Table 20 or Table 21, the grain size shall be in accordance with the manufacturer's specifications or proposed via PPQ.

Replace section 7.12 title with

7.12 Surface Condition—Grade L80 13Cr

Delete second paragraph (PSLs)

Add to section

For SL-A, pipe shall have the internal surface grit blasted or treated by a method qualified by the manufacturer to meet the requirements for Sa 2½ in accordance with ISO 8501-1.

Grit blasting shall be carried out using blasting medium that does not cause surface iron contamination. Examples of suitable media are stainless steel or aluminium oxide grit.

Replace section 7.14 title with

7.14 Sulfide Stress Cracking Test—for Grades Requiring SSC Testing as per Table 20 or Table 21

7.14.1 General Guidance

Add to section

For LS and E variant grades and M125 grades, the purchaser should refer to ISO 15156-2:2020, Annex B and NACE TM0177:2016 for qualification of the product SSC resistance performance and manufacturing process.

The manufacturer shall perform PPQ or MPQ in accordance with Annex L when specified.

Add NOTE 2

NOTE 2 SSC testing for Grades C90 (A-80 %), T95 (A-80 %), C90 (D), C110 (A or D) and T95 (D) are the existing PSL-1 SSC requirements from API 5CT, the Grades C90 (A-90 %) and T95 (A-90 %) are the PSL-3 SSC requirements, and the E, LS and M125 series of SSC tests are new variant grades for this specification.

7.14.2 Test and Retest Requirements

Add section heading 7.14.2.1 before first paragraph

7.14.2.1 Test Requirements

In first sentence of section 7.14.2.1 a), replace "Grades C90 and T95" with

Grades C90, R95LS, T95 and P110LS

In first sentence of section 7.14.2.1 a), replace "7.14.5" with

Table 20 or Table 21

Replace second sentence of section 7.14.2.1 a) with

Dependent on the grade specified the frequency of testing and number of sets and specimens shall be as per Table 20 or Table 21.

Delete second paragraph of section 7.14.2.1 a) (PSLs)

Replace first paragraph of section 7.14.2.1 b) with

- b) Grades C110 and M125—for each lot, as defined in 10.2, it shall be demonstrated that the product meets or exceeds the minimum SSC requirement using the specified SSC test method per grade suffix, in accordance with Table 20 or Table 21.

For Grade M125 (D or AD), one test condition shall be selected, consisting of test gas H₂S, balance gas, and solution chemistry from the two options given in Table 21.

If Method AD is specified, only one test condition from Table 21 shall be required.

In last sentence of second paragraph of section 7.14.2.1 b), replace "by agreement" with

as amended by this specification

In section 7.14.2.1 c), replace "full size tensile test specimens" with

standard size tensile test specimens in accordance with NACE TM0177:2016

Delete section 7.14.2.1 e)

Add new section 7.14.2.1 f)

- f) The number of sets or specimens required per set may be proposed to be modified as follows:
- For Method A, any grade with the minimum requirement being one specimen per set (see column 9 of Table 20) may have the number of specimens increased to three.
 - For Method A, excluding the E grades and M125, any other grade with the minimum requirement being three specimens per set (see column 9 of Table 20) may be reduced to one specimen per set with a qualified process control that is sufficient to ensure the product performance as described in Table 20.
 - For Grades M125EN (A or AD) and M125EN (D or AD), the number of sets may be reduced to one with a qualified process control that is sufficient to ensure that the product performance is as described in Table 20 or Table 21, based on the SSC method specified.

NOTE MPQ as described in L.4.3 is a method of demonstrating process control.

Add new section

7.14.2.2 Retest Requirements for Method A SSC Testing

- a) For grades with a minimum requirement of one set consisting of one specimen per lot, retesting of a failed NACE TM0177:2016 Method A test is permitted with the following provisions and requirements:
- Retests shall comprise two further test specimens taken from an area of the product adjacent to where the failed test specimen was taken.

- If both retests conform to the requirements of Table 20, the lot may be accepted.
 - If either of the retest specimens fails, the lot shall be rejected.
 - Retesting of retests is not permitted.
- b) For LS variant grades with a minimum requirement of one set consisting of one specimen per every other lot, retesting of a failed NACE TM0177:2016 Method A test is permitted with the following provisions and requirements:
- If a set comprises a single specimen, retesting shall be performed in accordance with the requirements stated in 7.14.2.2 a) for the single specimen taken per lot.
 - Additional test specimens shall be taken from every lot within the heat that failed, in accordance with Table 20.
 - If a set comprises multiple test specimens, retesting shall be performed in accordance with the requirements of 7.14.2.2 c).
- c) For grades with a minimum requirement of one set consisting of three specimens per lot, retesting of a failed NACE TM0177:2016 Method A test is permitted with the following provisions and requirements:
- A retest may be carried out if only one of the initial specimens fails.
 - If more than one of the initial specimens fails, the lot shall be rejected.
 - A retest shall comprise two further test specimens extracted from an area of the product adjacent to where the failed test specimen was taken.
 - If both retests conform to the requirements of Table 20, the lots may be accepted.
 - If either of the retest specimens fail, the lot shall be rejected.
 - Retesting of retests is not permitted.
- d) Rejected lots may be heat-treated again and tested as new lots.

NOTE All failed test specimens that are retested should be investigated as part of the manufacturer's quality management system for continuous improvement.

Add new section

7.14.2.3 Retest Requirements for Method D SSC Testing

Retesting of a failed NACE TM0177:2016 Method D test is permitted with the following provisions and requirements:

- a) If the average K_{ISSC} does not meet the minimum requirement given in Table 21, the following applies:
- Three additional test specimens may be taken from an area of the product adjacent to where the failed test specimens were taken.
 - The average K_{ISSC} value shall be calculated by including the original results of the failed double cantilever beam (DCB) set in addition to the retest specimens.
 - Retest results shall comply with the minimum and the average K_{ISSC} requirement given in Table 21.

- b) If only one specimen K_{ISSC} does not meet the minimum individual requirement given in Table 21, the following applies:
- A retest may be performed on three test specimens taken from an area of the product adjacent to where the failed test specimens were taken.
 - Retest specimens shall comply with the minimum and the average K_{ISSC} requirement given in Table 21.
- c) If retesting fails, the lot shall be rejected.
- d) Rejected lots may be heat treated again and tested as new lots.
- e) If retests conform to the requirements given in Table 21, the lot shall be accepted.

NOTE All failed test specimens that are retested should be investigated as part of the manufacturer's quality management system for continuous improvement.

7.14.3 Test Sample Selection and Location

In first paragraph, replace "length, end, and location" with

length, with approximately 50 % alternate ends, and location

Replace list item a) with

- a) for all test methods, for Grades C90 and T95 a mean hardness of 24.4 HRC or higher or for Grade C110 a mean hardness of 28.0 HRC or higher, or for Grade M125 a mean hardness of 33.0 HRC or higher or for R95LS and P110LS the mean hardness criteria set through PPQ; or

Add to section

When SL-A is specified, the default criteria shall be as per 7.14.3 c) with the option to select criteria 7.14.3 d) either by agreement with the purchaser or where MPQ as per Annex L.4 confirms the manufacturing procedure results in products that consistently meet the SSC requirements as per Table 20 or Table 21.

When SL-B is specified, the default criteria shall be as per 7.14.3 c) or 7.14.3 d).

Replace section 7.14.4 title with

7.14.4 Test Solution Chemistry and Test Gas

Replace first sentence with

The test solution chemistry and test gas used for quality control tests during production of the base or variant grades requiring SSC testing shall be in accordance with the requirements in Table 20 or Table 21.

Add new Table 20

Table 20—Summary of Sulfide Stress Cracking Testing Requirements—Method A

Designation	Base Grade	Specification Level	Test Gas Minimum H ₂ S as per NACE TM0177:2016 (unless modified as per footnote g)	Solution Chemistry as per NACE TM0177:2016 (unless modified as per footnote g)	Minimum Applied Stress for Standard Size Specimens	Minimum Applied Stress for Sub-size specimens	Number of Sets per Lot ^a	Number of Specimens per Set
			kPa (psia)		MPa (psi)	MPa (psi)		
1	2	3	4	5	6	7	8	9
C90 (A-80 %)	C90	SL-A or SL-B	100 (14.5)	A	496 (72,000) 80 % YS _{min}	447 (64,800) 72 % YS _{min}	1	1 ^c
C90 (A-90 %)	C90	SL-A or SL-B	100 (14.5)	A	558 (81,000) 90 % YS _{min}	503 (72,900) 81 % YS _{min}	1	3 ^{b, f}
R95LS (A)	R95	SL-A or SL-B	100 (14.5)	A	As per PPQ	90 % of standard size	One set per every two lots, with at least one set per heat	1 ^c
T95 (A-80 %)	T95	SL-A or SL-B	100 (14.5)	A	524 (76,000) 80 % YS _{min}	472 (68,400)	1	1 ^c
T95 (A-90 %)	T95	SL-A or SL-B	100 (14.5)	A	590 (85,500) 90 % YS _{min}	531 (77,000) 81 % YS _{min}	1	3 ^{b, f}
T95EN (A or AD)	T95	SL-A	100 (14.5)	A	At least T95 (A-90 %) criteria: as per PPQ	90% of standard size	1	3 ^b
P110LS (A)	P110	SL-A or SL-B	6.9 (1.0) with N ₂ balance	D	665 (93,500) 85 % YS _{min}	580 (84,200) 76.5 % YS _{min}	One set per every two lots, with at least one set per heat	1 ^c
C110 (A)	C110	SL-A	100 (14.5)	A	645 (93,500) 85 % YS _{min}	580 (84,200) 76.5 % YS _{min}	1	3 ^{b, f}

Table 20 (continued)

Designation	Base Grade	Specification Level	Test Gas Minimum H ₂ S as per NACE TM0177:2016 (unless modified as per footnote g)	Solution Chemistry as per NACE TM0177:2016 (unless modified as per footnote g)	Minimum Applied Stress for Standard Size Specimens	Minimum Applied Stress for Sub-size specimens	Number of Sets per Lot ^a	Number of Specimens per Set
			kPa (psia)		MPa (psi)	MPa (psi)		
1	2	3	4	5	6	7	8	9
C110EN (A or AD)	C110	SL-A	100 (14.5)	A	At least C110 (A) criteria: as per PPQ	90% of standard size	1	3 ^b
M125 (A or AD) ^e	M125	SL-A	3.0 (0.44) with N ₂ balance ^g	B ^g	733 (106,300) 85 % YS _{min}	659 (95,600) 76.5 % YS _{min}	1	3 ^b
M125EN (A or AD)	M125	SL-A	At least M125 (A or AD) criteria : as per PPQ				2 ^d	3 ^b
NOTE 1 SSC testing for Grades C90 (A-80 %), T95 (A-80 %) and C110 (A) are the existing PSL-1 SSC requirements from API 5CT.								
NOTE 2 SSC testing for Grades C90 (A-90 %) and T95 (A-90 %) are PSL-3 SSC requirements.								
NOTE 3 SSC testing for Grades R95LS (A), T95EN (A or AD), P110LS (A), C110EN (A or AD), M125 (A or AD) and M125EN (A or AD) are new variant grades for this specification.								
^a Applicable to pipe body, coupling stock, coupling material and accessory material. The maximum number of pieces per lot can be found in Table C.37 and Table E.37 for the pipe body, Tables C.38 and Table E.38 for coupling stock and coupling material, and Table C.39 and Table E.39 for accessory material.								
^b Three specimens, one each from the ends of three different products selected from sub-lots composed of the front one third, middle one-third and back one-third of the lot.								
^c One specimen, to be taken at random. The number of specimens per lot may be increased to three.								
^d A second set of specimens shall be taken from different products than the first set. The number of sets may be proposed to be reduced to one with a qualified process control that is sufficient to ensure the product performance as described in Table 20.								
^e When Method AD is specified, solution chemistry should be the same for both for the Method A and Method D tests.								
^f The number of specimens per lot required may be proposed to be reduced to no less than one with a process control that is sufficient to ensure that the length meets or exceeds criteria given for the grade.								
^g The requirements of Solution B defined in TM0177:2016 shall apply except that the test gas be substituted with 3.0 +/- 0.3 % H ₂ S with balance of nitrogen [3.0 kPa (0.44 psia) H ₂ S].								

Add new Table 21

Table 21—Summary of Sulfide Stress Cracking Testing Requirement—Method D

Designation	Base Grade	Specification Level	Test Gas Minimum H ₂ S as per NACE TM0177:2016 (unless modified as per footnote h)	Solution Chemistry as per NACE TM0177:2016 (unless modified as per footnote h)	Minimum Test Duration	Kissc acceptance criteria for Method D standard size specimen 9.53 mm (0.375 in.)		Non Pre- cracked or Pre- cracked Allowed	Max K _I Applicable for Pre-cracking	Arm Displacement ⁱ	Number of Sets ^d of Tests per Lot ^a	Number of Specimens per Set
						Minimum Mean	Minimum Individual					
			kPa (psia)	(days)	MPa·m ^½ (ksi·in. ^½)	MPa·m ^½ (ksi·in. ^½)	mm (in.)					
1	2	3	4	5	6	7	8	9	10	11	12	13
C90 (D)	C90	SL-A	100 (14.5)	A	14	33.0 (30.0)	29.7 (27.0)	Either allowed	29.7 (27.0)	0.76 (0.030)	1	3 valid
R95LS (D)	R95	SL-A or SL-B	100 (14.5)	A	14	Set (Agreed) through PPQ		Either allowed	29.7 (27.0)	0.71 (0.028)	One set per every two lots, with at least one set per heat	3 valid
T95 (D)	T95	SL-A	100 (14.5)	A	14	33.0 (30.0)	29.7 (27.0)	Either allowed	29.7 (27.0)	0.71 (0.028)	1	3 valid
T95EN (D or AD)	T95	SL-A	100 (14.5)	A	14	At least T95 (D) criteria : as per PPQ		Either allowed	29.7 (27.0)	At most the T95 (D) parameter: as per PPQ	1	3 valid
P110LS (D)	P110	SL-A or SL-B	6.9 (1.00) N ₂ balance	D	17	34.1 (31.0)	30.8 (28.0)	Pre- cracked ^b	20.4 (18.6)	0.71 (0.028)	One set per every two lots, with at least one set per heat	3 valid
C110 (D)	C110	SL-A	100 (14.5)	A	14	26.4 (24.0)	23.1 (21.0)	Either allowed	20.4 (18.6)	0.51 (0.020)	1	3 valid
C110EN (D or AD)	C110	SL-A	100 (14.5)	A	14	At least C110 (D) criteria: as per PPQ		Either allowed	20.4 (18.6)	At most the C110 (D) parameter: as per PPQ	1	3 valid

Table 21 (continued)

Designation	Base Grade	Specification Level	Test Gas Minimum H ₂ S as per NACE TM0177:2016 (unless modified as per footnote h)	Solution Chemistry as per NACE TM0177:2016 (unless modified as per footnote h)	Minimum Test Duration	K _{ISSC} acceptance criteria for Method D standard size specimen 9.53 mm (0.375 in.)		Non Pre- cracked or Pre- cracked Allowed	Max K _I Applicable for Pre-cracking	Arm Displacement ⁱ	Number of Sets ^d of Tests per Lot ^a	Number of Specimens per Set	
			kPa (psia)			(days)	Minimum Mean						Minimum Individual
							MPa·m ^½ (ksi·in. ^½)						MPa·m ^½ (ksi·in. ^½)
1	2	3	4	5	6	7	8	9	10	11	12	13	
M125 (D or AD) ^{g, f}	M125	SL-A	6.9 (1.00) N ₂ balance	D	17	28.6 (26.0)	25.3 (23.0)	Pre- cracked ^b	20.4 (18.6)	0.71 (0.028)	1	3 valid	
		SL-A	3.0 (0.44) ^h	B ^h	17	23.1 (21.0)	19.8 (18.0)	Pre- cracked ^b	20.4 (18.6)	0.41 (0.016)	1	3 valid	
M125EN (D or AD)	M125	SL-A	M125 (D) or higher as per PPQ		17	At least M125 (D) criteria: as per PPQ		Pre- cracked ^b	20.4 (18.6)	At most the M125 (D) parameter: as per PPQ	2 ^{c, e}	3 valid	

NOTE 1 SSC testing for Grades C90 (D), T95 (D) and C110 (D) are the existing PSL-1 SSC requirements from API 5CT.

NOTE 2 SSC testing for Grades R95LS (D), T95EN (D or AD), P110LS (D), C110EN (D or AD), M125 (D or AD) and M125EN (D or AD) are new variant grades for this specification.

^a Applicable to pipe body, coupling stock, coupling material and accessory material. The maximum number of pieces per lot can be found in Table C.37 and Table E.37 for the pipe body, Tables C.38 and Table E.38 for coupling stock and coupling material, and Table C.39 and Table E.39 for accessory material.^b Test specimens shall be fatigue pre-cracked unless it has been demonstrated and documented that fatigue pre-cracking is not necessary to avoid test result invalidation.^c The number of sets may be proposed to be reduced to one with a qualified process control that is sufficient to ensure the product performance as described in Table 21.^d Sets selected at random representing the start and one set representing the end of the heat-treat cycle and front and back ends of the lengths. If there is only one lot in the heat treat cycle, only one set per lot is required.^e A second set of specimens shall be taken from different lengths than the first set.^f Only one test condition is required. Manufacturers shall inform purchasers of which of the two test conditions (test gas minimum H₂S, balance gas and solution chemistry) given on Table 21 will be utilized.^g When Method AD is specified, solution chemistry should be the same for both for the Method A and Method D tests.^h The requirements of Solution B defined in TM0177:2016 shall apply except that the test gas be substituted with 3.0 +/- 0.3 % H₂S with balance of nitrogen [3.0 kPa (0.44 psia) H₂S].ⁱ Arm displacement tolerances are +0.03 / -0.05 mm or +0.001 / -0.002 in.

7.14.5 Minimum SSC Requirements

Replace section 7.14.5 a) title with

a) NACE TM0177-2016 Method A, Smooth Tensile

Replace section a) with

Method A test parameters shall be in accordance with Table 20.

c) NACE TM0177-2016 Method D, DCB

Replace section c) with

For Method D, testing parameters and acceptance criteria shall be in accordance with Table 21 except for wall thicknesses greater than 50.8 mm (2.0 in.).

For Method D testing of product with wall thickness greater than 50.8 mm (2.0 in.), the test conditions and acceptance criteria shall be set through PPQ.

7.14.6 Invalidation of Tests

Replace second sentence with

Assignable causes include those explicitly identified in NACE TM0177:2016 Method A and Method D, as applicable, and the following additional points:

Add new list item c)

- c) loss of control of test solution (e.g. pH shift greater than allowed in NACE TM0177:2016, discoloration of the test solution indicative of contamination with oxygen);

Add new list item d)

- d) for Method A tests:

- 1) evidence of specimen overloading, including due to misalignment or torquing;
- 2) circumferential grinding marks on the specimen surface at the crack initiation site(s);
- 3) fracture outside of the test specimen's gauge section.

Add new list item e)

- e) for Method D test results deemed rejected as per the mechanical assurance graph constructed as per NACE TM0177:2016, Appendix D.

7.14.7 Additional Testing Provisions for NACE TM0177-2016 Method D

Add before first paragraph

Method D testing provisions shall be in accordance with Table 21.

Add new section

7.14.8 Additional Testing Provisions for NACE TM0177-2016 Method A

Visual observation of cracks on the gauge section of the tensile test specimen shall be at 40X magnification after completing the 720-hour test duration.

8 Dimensions, Masses, Tolerances, Product Ends, and Defects

8.2 Dimensions and Masses

Add to first paragraph after first sentence

Additional sizes and weights of pipe shall be furnished from Table C.59 or Table E.59.

8.9 Straightness

8.9.2 Coupling Stock, Coupling Material, and Accessory Material

Replace section with

Straightness requirements shall be specified in the manufacturer's internal requirements for coupling material, coupling stock and accessory material.

8.10 Drift Requirements

Replace last sentence of first paragraph with

Drift lengths for API tubulars and non-standard size/wall tubulars shall comply with Table C.28 or Table E.28.

Drift diameter for API pipe shall comply with Table C.23 or Table E.23.

Drift diameter for non-standard size/wall tubulars shall comply with Table C.59 or Table E.59.

8.11 Tolerances on Dimensions and Masses

8.11.1 Outside Diameter

Table 13—Dimension Tolerances (Pipe OD)

Add NOTE

Add footnote a

NOTE	Increasing the plus side OD tolerance ^a may prevent the product from being API monogrammed.
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^a The plus tolerance on OD for casing may be proposed to be increased. This may be applicable for UC variant grade products, alternative wall thickness tolerance orders or when alternative drifts are utilized.
--

Add to section

Outside diameter tolerance for coupling stock, coupling blanks and accessory material shall be agreed.

8.11.2 Wall Thickness

Replace section with

Tolerance for pipe is -12½ % unless a tighter alternative tolerance is agreed.

Alternative wall thickness tolerances for pipe may be specified at -10 %, -7½ % or -5 %.

Wall thickness tolerance for coupling stock, coupling blanks and accessory material shall be agreed.

8.11.3 Mass

Replace second sentence of first paragraph

When the specified minimum wall thickness is equal to or greater than 90 % of the specified wall thickness, or upon agreement, the single length positive mass tolerance shall increase to +10 %.

8.12 Product Ends

8.12.4 Threading

Add to section

If performed, end sizing shall be in accordance with Annex N.

8.12.5 Workmanship of Ends

Delete second paragraph (PSLs)

In third paragraph, replace "For Grade C110," with

For Grades C110, M125 and L80 13Cr,

Add to section

Unless specified, the thread surface treatment shall be at the manufacturer's option.

8.12.6 Special End-finish

Add before first paragraph

If a special end-finish connection is specified, a connection data sheet shall be provided.

Add new section

8.12.7 End-sizing and Thermal Recovery

When pipe ends are subjected to end-sizing, with or without subsequent thermal recovery, as part of the threading process, the process shall be validated in accordance with the requirements of N.1.

When pipe ends are subjected to end-sizing, with or without subsequent thermal recovery, as part of the threading process, process control during production shall be demonstrated by conformance with the testing requirements of N.2.

8.13 Defects

8.13.1 Pipe and Accessory Made from Pipe

In list item c), replace "below 87.5 % of the specified wall thickness" with

below 87.5 % of the specified wall thickness or below the alternative specified minimum wall thickness as defined in 8.11.2

In list item e), replace "below 87.5 % of the specified wall thickness" with

below 87.5 % of the specified wall thickness or below the alternative specified minimum wall thickness as defined in 8.11.2

Add to beginning of list item i)

for SL-B products,

Add new list item j)

- j) for SL-A products, non-linear inside surface breaking imperfection located in the external thread section of the pipe body with a depth greater than 5 % of the specified wall thickness.

Replace section 8.13.2 title with

8.13.2 Coupling Stock, Coupling Material, and Accessory Material Not Made from Pipe

In first paragraph, replace "Accessory material not made from pipe, coupling stock, and coupling material" with

Coupling stock, coupling material and accessory material not made from pipe

8.14 Coupling Make-up and Thread Protection

8.14.1 All Grades Except Q125

Delete "or ISO 13678" from third sentence of second paragraph

Add after third sentence of second paragraph

Unless otherwise specified, surface treatment shall be the manufacturer's default.

Unless otherwise specified, storage compound shall be the manufacturer's default.

9 Couplings

9.1 General Requirements

In first paragraph, replace "PSL" with

SL

In second paragraph, replace "Grades C110 and Q125 couplings" with

Grades C110, M125 and Q125 couplings

In third paragraph, replace "Grade C110" with

Grades C110 and M125

In fourth paragraph, replace "Grades C110 and Q125 coupling blanks." with

Grades C110, M125 and Q125 coupling blanks.

9.2 Alternative Grades or Heat Treatments

9.2.2

Replace section with

When heat treatment is not stipulated, Grade J55 pipe shall be furnished based on the SL specified:

- for SL-B, Grade J55 or K55 couplings which are either as-rolled, normalized, normalized and tempered, or quenched and tempered;
- for SL-A, Grade J55 or K55 couplings which are either normalized, normalized and tempered, or quenched and tempered.

9.2.3

Replace section with

When heat treatment is not stipulated, Grade K55 pipe shall be furnished based on the SL specified:

- for SL-B Grade K55 couplings which are either as-rolled, normalized, normalized and tempered, or quenched and tempered;
- for SL-A Grade K55 couplings which are either normalized, normalized and tempered, or quenched and tempered.

Replace section 9.7 title with

9.7 Combination Couplings and Crossovers

Add to section

When specified, combination coupling or crossovers shall be supplied with dimensional drawings.

9.8 Seal-ring Couplings

Delete second sentence (PSLs)

Replace section 9.9 title with

9.9 Special-bevel Tubing Regular Couplings—All Grades Except C110, M125, and Q125

9.10 Threading

9.10.1 General Requirements

Delete second paragraph (PSLs)

9.11 Surface Inspection

9.11.3

In first sentence, replace "By agreement" with

For SL-B,

In second sentence, replace "shall be free from all visible seams, cracks and porosity" with

be free from visible seams, cracks, porosity, arc burns or inclusions

Add after second sentence

For Grades J55 and K55 at SL-A, coupling NDE shall be performed.

9.11.4

Add to section

The manufacturer shall have quality control provisions related to the prevention of galling.

The quality control provisions shall include acceptance criteria for coating or plating imperfections.

9.11.7

In list item b), replace "C110, P110, and Q125 material" with

C110, P110, M125 and Q125 material

Replace section 9.14 title with

9.14 Thread Surface Treatment

Replace section with

Thread surface treatment shall be as per the manufacturer's option unless otherwise specified.

Replace section 9.15 title with

9.15 Couplings and Coupling Blank Protection—Grades C90, T95, C110, M125, and Q125

10 Inspection and Testing

10.2 Lot Definition for Testing of Mechanical Properties

10.2.3 Coupling Blanks, Pup Joints, or Accessory Material Heat-treated after Cutting to Blank or Individual Length

In second paragraph, replace "for Grades C90, T95, C110, and Q125" with

for Grades C90, T95, C110, M125 and Q125

10.3 Testing of Chemical Composition

10.3.1 Heat Analyses

In second paragraph, replace "Grades C110 and Q125" with

Grades C110, M125 and Q125

10.4 Tensile Tests

10.4.1 Stress-relief Temperature—All Grades

Add to beginning of first sentence of first paragraph

For SL-B and SL-A, products and grades not requiring SSC testing in accordance with Table 20 or Table 21,

In second paragraph, replace "Grades C90 and T95, PSL-2 and PSL-3, and Grade C110" with

grades requiring SSC testing, for the purpose of tensile test frequency,

10.4.3 Frequency of Testing and Location of Test Specimen—Casing and Tubing

Delete second paragraph (PSLs)

10.4.4 Frequency of Testing and Test Specimen Location—Coupling Stock, Coupling Material, Coupling Blanks, Pup Joints, and Accessory Material

In third paragraph, replace "Grades C90, T95, C110, and Q125" with

Grades C90, T95, C110, M125 and Q125

10.4.5 Test Specimens—General

Replace last paragraph with

When tensile testing of the upset or straightening affected area is required, the tensile test specimen from the upset or area of highest induced fiber strain should be the largest specimen feasible in accordance with API 5CT or ASTM A370.

The type and size of test specimen shall be included in the product quality plan (PQP).

Replace section 10.4.6 title with

10.4.6 Test Specimens—Additional Requirements for Coupling Blanks, Coupling Stock, Coupling Material, Pup Joints, and Accessory Materials—Grades C110, M125, and Q125

10.4.7 Test Method

In first paragraph, replace "Grades C110 and Q125" with

Grades C110, M125 and Q125

Replace section 10.4.9 title with

10.4.9 Retests—All Products (Except Coupling blanks, Coupling Stock, Coupling Material, Pup Joints, or Accessory Material—Grades C90, T95, C110, M125, and Q125)

Add to first paragraph

For Grades C90, T95, C110, M125 and Q125, one of the three retest lengths shall be adjacent to the length that failed, with respect to the sequence of the heat treat cycle.

Replace section 10.4.10 title with

10.4.10 Retests—Coupling Blanks, Coupling Stock, Coupling Material, Pup Joints or Accessory Material in Grades C90, T95, C110, M125, and Q125

10.6 Hardness Test

10.6.1 PSL Requirements

Delete section 10.6.1

10.6.2 Frequency of Testing—General

In third paragraph, replace "Grades L80, C90, T95, C110, or Q125" with

Grades L80 or Q125 and grades requiring SSC testing in accordance with Table 20 or Table 21

10.6.4 Frequency of Testing—Grade L80

In first sentence, replace "as tensile testing for each of these products" with

as detailed in Table C.40 or Table E.40

Delete second sentence of first paragraph (PSLs)

Replace section 10.6.5 title

10.6.5 Frequency of Testing and Test Specimen Location—Non-upset Pipe—Grades Requiring SSC Testing as per Table 20 or Table 21

In 10.6.5 section b), replace "For Grade C110," with

For Grades C110 and M125

Add new section 10.6.5 c)

- c) For Grades R95LS and P110LS, one through-wall hardness test in one quadrant shall be made for each lot based on the lot size in Table C.40 or Table E.40.

Test rings shall be taken on alternating ends of the pipe for the lots within the heat.

Delete third paragraph (PSLs)

Replace section 10.6.6 title with

10.6.6 Frequency of Testing and Test Specimen Location—Upset Pipe—Grades Requiring SSC Testing as per Table 20 or Table 21—Except Grades T95EN, C110, and M125

Add new section heading 10.6.6.1 before first paragraph

10.6.6.1 Grades Requiring SSC Testing as per Table 20 or Table 21—Except Grades T95EN, C110, and M125

In first sentence, replace "conformance to the requirements" with

conformance to the criteria given in Table C.5 or Table E.5

In second sentence, replace "one in every 20 lengths within each lot." with

in accordance with Table C.40 or Table E.40.

Add new section 10.6.6.2

10.6.6.2 Grades T95EN, C110, and M125—Including Variant Grades

The frequency of hardness testing and the test specimen location for Variant Grades T95EN and M125 and Grade C110 shall be set through PPQ.

The test frequency and location of the specimens shall not be lower than those set out in Table C.40 or Table E.40 until the application of a process control plan has demonstrated that the upset area has consistent hardness properties within the criteria in Table C.5 or Table E.5.

Replace 10.6.7 section title with

10.6.7 Frequency of Testing and Test Specimen Location—Coupling Blanks, Coupling Stock, Coupling Material, Pup Joints, and Accessory Material—Grades Requiring SSC Testing as per Table 20 or Table 21

Add new section heading 10.6.7.1 before first paragraph

10.6.7.1 Grades C90, T95, C110, and M125

Add new section

10.6.7.2 LS Variant Grades

For thick-wall tube used for making more than one coupling blank, pup joint or accessory, on a per lot basis in accordance with Table C.40 or Table E.40, one test ring cut from each end shall be through-wall hardness tested in four quadrants.

For individually heat-treated coupling blanks, the hardness test ring shall be removed from the piece as shown in Figure D.9.

The hardness test ring shall be removed at the mid-length position of individually heat-treated coupling blanks.

For individually heat-treated pup joints and accessory material, the hardness test ring shall be removed from the mid-length as shown in Figure D.9 or from a prolongation.

Through-wall hardness tests shall be made in four quadrants.

10.6.8 Frequency of Testing—Grade Q125

Delete last paragraph (PSLs)

10.6.10 Test Method

In fifth paragraph, replace "Grades L80, C90, T95, and C110" with

Grades L80, C90, R95LS, T95, P110LS, C110 and M125

Add to end of last sentence of fifteenth paragraph

or over 36.0 HRC for Grade M125.

Add to fifteenth paragraph

For LS variant grades, additional indentations shall not be made if any measured Rockwell hardness number is greater than the maximum hardness number established during PPQ.

10.6.12 Periodic Checks of Hardness-testing Machines

In second paragraph, replace "Grades L80, C90, T95, and C110" with

Grades L80, C90, T95, C110 and M125, and Variant Grades R95LS and P110 LS

In third paragraph, replace "Grades L80, C90, T95, and C110" with

Grades L80, C90, T95, C110 and M125, and Variant Grades R95LS and P110LS

In list item a), replace "Grades L80 (all types), C90, T95:" with

Grades L80 (all types), C90 and T95, and Variant Grade R95LS:

In list item b), replace "Grade C110:" with

Grade C110 and Variant Grade P110LS:

In list item c), replace "Grade Q125:" with

Grades M125 and Q125:

In sixth paragraph, replace "for Grades C90, T95, and C110" with

for Grades C90, T95, C110 and M125, and Variant Grades R95LS and P110LS

Replace section 10.6.14 title with

10.6.14 Retests—Grade L80, R95LS, and P110LS

In first paragraph, replace "For Grade L80 products," with

For Grade L80 and Variant Grades R95LS and P110LS products,

Replace section 10.6.15 title with

10.6.15 Retests—Grades C90, T95, C110, and M125 Products—Except for Coupling Blanks, Pup Joints, or Accessory Material Heat-treated after Cutting to Individual Lengths

Add to section

For Grade M125, if any mean hardness number falls between 34.0 HRC and 36.0 HRC inclusive, three additional indentations shall be made in the immediate area to determine a new mean hardness number.

If the new mean hardness number does not exceed 34.0 HRC, the piece shall be accepted.

If the new mean hardness number exceeds 34.0 HRC, the piece shall be rejected.

Replace section 10.6.16 title with

10.6.16 Retests—Grades C90, T95, C110, and M125 Coupling Blanks, Pup Joints, or Accessory Material Heat-treated after Cutting to Individual Lengths

Replace section 10.6.20 title with

10.6.20 Rejected Lots—Grades L80 (All Types), C90, R95LS, T95, P110LS, C110, M125, and Q125

10.7 Impact Test

10.7.5 Test Method

Replace second paragraph with

For the grades and SL combinations listed in 7.3.1, the shear area shall be measured and reported in accordance with ASTM E23.

Replace last sentence of last paragraph with

Rounding shall be in accordance with the rounding method of ISO 80000-1 or ASTM E29 and follow the example detailed in G.8.4.

Replace section 10.8 title with

10.8 Grain Size Determination—Grades Requiring SSC Testing as per Table 20 or Table 21

Replace section 10.10 title with

10.10 Sulfide Stress-cracking Test—Grades Requiring SSC Testing as per Table 20 or Table 21

10.10.1

Replace "Grades C90, T95, and C110 products" with

Grades C90, T95, C110 and M125, and the variant grades listed in Table 20 or Table 21 that require SSC testing

Replace sections 10.10.2 and 10.10.3 with

10.10.2

For grades requiring SSC testing in accordance with 4.5, the level of resistance to sulfide stress cracking shall be evaluated with the requirements in 7.14 using one or more of the following methods as specified:

- a) tensile method (Method A) detailed in Table 20;
- b) bent-beam method (Method B);
- c) DCB method (Method D) detailed in Table 21.

10.10.4

Delete section 10.10.4

Replace section 10.11 title with

10.11 Metallographic Evaluation—EW Products

In first sentence, replace "A metallographic evaluation" with

For welded tubulars of Grades P110, P125 and Q125, and at SL-A for Grades J55, K55, L80-1 and R95 products, a metallographic evaluation

Delete fourth sentence (PSLs)

10.12 Hydrostatic Tests

10.12.2 Hydrostatic Test Requirements

Delete second paragraph (PSLs) with

Add before third paragraph

For Grades J55 and K55 products specified as SL-A, alternative test pressures shall be used for sizes above Label 1: 9 ⁵/₈.

In fourth paragraph, replace "except Grade Q125" with

except Grades P125, M125 and Q125

In fifth paragraph, replace "Grade Q125" with

Grades P125, M125 and Q125

In last paragraph, replace "Grade Q125 pup joints" with

Grades P125, M125 and Q125 pup joints

10.13 Dimensional Testing

10.13.4 Wall Thickness Measurement

Delete second paragraph (PSLs)

Replace first sentence of fourth paragraph with

To ensure conformance with wall thickness requirements, all seamless pipe, coupling stock, and accessory material requiring electromagnetic or ultrasonic inspection as specified in Table C.42 or Table E.42 shall have the wall thickness verified over the full length of the pipe or coupling stock in accordance with a documented procedure.

Add to fourth paragraph

The minimum wall thickness coverage of the automated wall systems shall be in accordance with Table C.42 or Table E.42.

Delete first sentence of fifth paragraph

Replace second sentence of fifth paragraph with

For Grades C110 and M125, the minimum measured wall thickness for each pipe shall be reported.

Replace last paragraph with

Accessory material shall have the automated wall thickness verified in accordance with Table C.42 or Table E.42 requirements if specified.

10.13.5 Drift Test

In first paragraph, replace "shown in Tables C.28 and C.29, or Tables E.28 and E.29 as applicable" with

shown in 8.10

Add to section

The mandrel diameter shall be verified at the start and end of production, on both ends, in four evenly spaced locations around the circumference.

10.13.6 Length Measurement

Replace first paragraph with

For plain-end pipe, loose couplings and other products as specified by the purchaser, the length shall be measured from end-to-end.

Add to section

For all products, except loose couplings, length measurement shall be included on the packing list.

10.13.8 Straightness Evaluation

In first paragraph, replace "visually examined" with

visually examined for straightness of the full length and end straightness.

10.14 Visual Inspection

10.14.1 General

In last paragraph, replace "to a repeat internal surface inspection as previously performed" with

to an internal surface inspection in accordance with 10.14.3

10.15 Non-destructive Examination (NDE)

10.15.1 General

Replace second sentence of second paragraph with

However, if alternative NDE methods or techniques are applied, it shall be demonstrated that the equipment has capability for detection of defects in accordance with 8.13.

NDE methods and procedures shall address the possibility of coincidental defects in the affected area, e.g. defects located on the inside and outside at the same location.

Add after third paragraph

The purchaser may request SR 41.2 for additional inspections.

In fourth paragraph, replace "in accordance with Annex B" with

in accordance with Annex B and IOGP S-735Q

In fifth paragraph, replace "material" with

defect

10.15.3 Reference Standards

In first paragraph, replace "pipe body of electric welded pipe" with

pipe body and weld seam of electric-welded pipe

Replace second sentence of second paragraph with

A documented procedure shall be in place, based on the equipment design and set up, to ensure the weld line remains centered with the correct transducer aligned during inspection.

10.15.4 NDE System Capability Records

10.15.4.2

Replace list item e) with

- e) documentation demonstrating that longitudinal, transverse, and oblique defects typical of the manufacturing process (as applicable) are detected using the NDE methods in Table C.42 or Table E.42, and

10.15.4.3

Replace list item d) with

- d) dynamic test data demonstrating the NDE system/operation capabilities under production test conditions with longitudinal, transverse and oblique defects, including weld line centering for weld line inspection systems in accordance with M.2,

Add new list item e)

- e) frequency of verification, including maximum period between reviews of capability,

Add new list item f)

- f) recalibration records and schedules.

10.15.5 Pipe Body or Coupling Stock Inspection—General

Delete second paragraph (PSLs)

Replace section 10.15.6 title with

10.15.6 Full-body, Full-length NDE of Casing and Tubing

Replace sections 10.15.6 to 10.15.9 with

Pipe shall be inspected for detection of imperfections in accordance with Table C.43 or Table E.43, utilizing one or more methods in accordance with Table C.42 or Table E.42.

10.15.7 Full-body, Full-length NDE of Casing and Tubing—Grade P110 to K.9 (SR 16)

Delete section (see 10.15.6)

10.15.8 Full-body, Full-length NDE of Casing and Tubing-grade P110 and Grade P110 to K.9 (SR 16) and K.3 (SR 2)

Delete section (see 10.15.6)

Pipe shall be inspected for detection of imperfections in accordance with Table C.43 or Table E.43, utilizing one or more methods in accordance with Table C.42 or Table E.42.

10.15.9 Full-body, Full-length NDE of Casing and Tubing-grades C90, T95, C110, and Q125

Delete section (see 10.15.6)

10.15.10 NDE of the Weld Seam of Welded Pipe

Replace first paragraph with

The weld seam inspection shall take place after final heat treatment and rotary straightening operations.

Add to second paragraph

A documented procedure shall be prepared to verify weld line centering during inspection.

The NDE methods shall detect mid wall defects parallel to the fusion line.

Replace fourth paragraph (including list) with

The weld seam shall be inspected for detection of longitudinal imperfections to the acceptance level given in Table C.43 and Table E.43 by one or more methods in accordance with Table C.42 and Table E.42.

Add before fifth paragraph

For Grade K-55 SL-A, the weld seam inspection shall be performed after the hydrostatic test.

Delete first sentence of sixth paragraph (PSLs)

Replace section 10.15.11 title with

10.15.11 NDE of Coupling Stock and Accessory Material for Grades N80, L80 (Type 1), and R95, and Specification Level B for Grades L80 13Cr, C90, T95, P110 and Q125 and Specification Level A for Grades J55 and K55 and Pup Joints (All Grades)**10.15.11.1**

Replace first paragraph including list items a) to d) with

Coupling stock and accessory material shall be inspected for detection of imperfections in accordance with Table C.43 and Table E.43, utilizing one or more methods in accordance with Table C.42 and Table E.42.

Add to section

The final machined surfaces of couplings shall meet the specified dimensions and the surface inspection criteria of 9.11.

NOTE Coupling stock for couplings that has imperfections on the unmachined surfaces is permitted.

10.15.11.2

Replace first sentence with

Pup joints shall be inspected at the specified SL and meet the same requirements as casing and tubing.

Delete second paragraph (PSLs)

Replace section 10.15.12 title with

10.15.12 NDE of Coupling Stock and Accessory Material—SL-A for Grades L80 13Cr, C90, T95, P110, C110, M125, and Q125**10.15.12.1 General**

Replace first paragraph including list items a) to d) with

Coupling stock and accessory material shall be inspected for detection of imperfections in accordance with Table C.43 and Table E.43, utilizing one or more methods in accordance with Table C.42 and Table E.42.

10.15.12.4 Ultrasonic Testing—Through-wall

Replace second sentence with

The reference indicator shall be an L2 flat-bottomed round hole from the inside surface as shown in Figure D.16 item d), and Tables C.44 or Table E.44.

10.15.12.5 Ultrasonic Testing—Inside Surface

Replace section with

Coupling stock and accessory material, shall be inspected for longitudinal and transverse imperfections on the inside surface using ultrasonic shear-wave techniques in accordance with ISO 10893-10 or ASTM E213 to acceptance level L3 as listed in Table C.44 or Table E.44.

Alternative NDE methods listed in Table C.42 or Table E.42 which demonstrate the capability to detect the reference indicators may be used.

If an alternative NDE method is proposed, it shall be qualified in accordance with M.2.

10.15.13 Untested Pipe Ends, Coupling Stock Ends, and Accessory Material Ends

Replace second sentence of second paragraph with

Untested ends of grade pipe to SL-B and grade pipe to SL-A except L80 13Cr, C90, T95, Q125, C110 and M125 shall be:

Replace third paragraph with

Untested ends of Grades L80 13Cr, C90, T95, M125 and Q125 pipe to SL-A shall be:

- a) treated in accordance with 10.15.13 a) or 10.15.13 c); or
- b) inspected after end finishing, and before coupling installation for threaded and coupled tubulars, using the wet magnetic-particle method.

Delete fifth paragraph (PSLs)

Replace section 10.15.14 title with

10.15.14 Upset and Expanded Pipe Ends

Add new section heading 10.15.14.1 before first paragraph

10.15.14.1 Pipe Upsets

Add new section

10.15.14.2 Expanded Pipe Ends

When specified, expanded ends including the run-out interval, shall be inspected on the outside surfaces after stress relieving operations.

The external inspection shall detect longitudinal surface imperfections using:

- the wet fluorescent magnetic particle method in accordance with ISO 10893-5 or ASTM E709, with a circumferentially oriented magnetic field; or
- another NDE method of equal sensitivity.

NOTE Expanded ends are defined as end sizing via expansion in accordance with Annex N. Inspection may be performed after final machining.

10.15.16 Evaluation of Indications (Prove-up)

In 10.15.16 a), add after "87.5 % of the specified wall thickness"

or the alternative specified minimum wall thickness

10.15.17 Disposition of Pipe Containing Defects

a) Grinding or Machining

In fourth sentence of first paragraph, replace "10 % of the specified wall thickness" with

10 % of the specified wall thickness for SL-B product or 5 % of the specified wall thickness for SL-A product

In fifth sentence of first paragraph, replace "10 % of the specified wall thickness" with

10 % of the specified wall thickness for SL-B product or 5 % of the specified wall thickness for SL-A product

10.15.18 Disposition of Coupling Stock and Accessory Material Containing Defects

a) Grinding or Machining

In third sentence of second paragraph, replace "10 % of the specified wall thickness" with

10 % of the specified wall thickness for SL-B product or 5 % of the specified wall thickness for SL-A product

11 Marking

11.1 General

11.1.6

Add to section

If the product complies with the requirements of this specification, the pipe shall be marked with "S735A" for SL-A or "S735B" for SL-B.

11.1.10

Add before first sentence

Variant grades specified in Table 18 shall be marked in accordance with Table C.48 or Table E.48.

The collapse rating shall be marked on the pipe for UC tubulars.

Except for couplings or coupling blanks, the finished individual dimension length shall be marked on the tubular in accordance with Table C.48 or Table E.48.

When specified, the purchase order number shall be marked in accordance with Table C.48 or Table E.48.

11.2 Stamp Marking Requirements

11.2.1 Methods

In first sentence of second paragraph, replace "Grades R95, L80 (all types), C90, T95, C110, and Q125 products" with

Grades R95, L80 (all types) and Q125, and grades requiring SSC testing,

Replace section 11.2.5 title with

11.2.5 Grades R95, L80 (All Types), Q125, and Grades Requiring SSC Testing

In list item 11.2.5 b), replace "Grades C90, T95, C110, and Q125" with

Grades Q125 and grades requiring SSC testing

11.5 Thread and End-finish Marking

11.5.1 API Thread Marking

Replace first sentence with

For manufacturers, thread identification shall be stencilled on casing and tubing.

13 Documents

13.2 Certification Requirements

Add to section

If this specification has been invoked, the certificate shall state that IOGP S-735 (revision number) has been met and to which SL the product has been manufactured and inspected.

13.3 Certification Content

Add to list item b)

and applicable SL;

Add to list item g)

For LS variant grades, report the minimum and maximum criteria and mass fractions in % for all elements intentionally added.

Replace last sentence of list item i) with

The percent shear area shall be reported for the products tested as per 7.3.1;

Replace list item l) with

- l) For grades that require SSC testing, a statement specifying which solution the test was performed in and if the specimens were pre-cracked or sub-sized;

In list item n), replace "shall be provided;" with

with supplemental information comprising the mechanical assurance curve as per NACE TM0177:2016, Appendix D, the occurrence of dry cracks, and the reason for invalidations for each specimen shall be provided;

In list item q), replace "and orientation of the reference indicator used," with

orientation, and oblique angles (when specified through SR 41.2 or if inspected by the manufacturer) of the reference indicator(s) used,

In list item s), replace "When agreed between the manufacturer and purchaser," with

For SL-A products or when specified,

Add new list item u)

- u) Manufacturer mill identification and location;

Add new list item v)

- v) For UC tubulars, the results of the required collapse to failure tests, i.e. collapse value, along with the claimed minimum rating;

Add new list item w)

- w) Date of certification of conformity;

Add new list item x)

- x) Reduced testing frequency, if applicable.

13.4 Retention of Records

In second sentence, replace "three" with

five

Add new section

13.5 Additional Reports and Documents

As listed and described in IOGP S-735L (IRS), additional documentation required includes:

- a) Packing list;
- b) Report of PQP testing conducted according to the requirements of L.3;
- c) Report of MPQ testing conducted according to the requirements of L.4;
- d) When NDE equipment has been validated according to Annex M, the report of the demonstration conducted according to the requirements of M.1 or M.2;
- e) Report(s) on validation or PPQ activity according to Annex M, Annex N or Annex P.
- f) When a concession for a product that does not conform to SL-A or SL-B has been agreed, documentation of the non-conformance shall be provided.
- g) When the test frequency is proposed to be modified, the technical justification shall be included in the proposal.

Annex B **(normative)**

Purchaser Inspection

Add new section

B.5 Documents and Records

Documents and records associated with the product ordered by the purchaser shall be made available upon request.

Annex C (normative)

Tables in SI Units

Table C.1—API Casing List (sizes, masses, wall thickness, grade, and applicable end-finish)

In column 11 heading, replace "M125" with "C110 M125"

Labels ^a		Outside Diameter	Nominal Linear Mass ^{b, c} T&C	Wall Thickness	Type of End-finish ^d							
1	2	<i>D</i> mm	kg/m	<i>t</i> mm	H40	J55 K55	L80 R95	N80 Type 1, Q	C90 T95	C110 M125	P110	Q125
1	2	3	4	5	6	7	8	9	10	11	12	13

Table C.3—Process of Manufacture and Heat Treatment

Add column 2a "Specification Level" to Grades "H40, Type —", "J55, Type —", "K55, Type —", "N80, Type 1", "N80, Type Q", "R95, Type —", "L80, Type 1", "L80, Type 9Cr", "L80, Type 13Cr", "C90, Type 1", "T95, Type 1", and "C110, Type —"

Replace row Grade "P110, Type —" with rows Grades "P110, P125, Type —, SL-A" and "P110, P125, Type —, SL-B"

Replace row Grade "Q125, Type 1" with rows Grades "Q125, Type 1, SL-A" and "Q125, Type 1, SL-B"

Add rows Grades "R95LS, Type —", "L80, Type 1Cr", "P110LS, Type —", and "M125, Type —"

Replace footnote b

Add footnote j

Grade	Type	Specification Level	Manufacturing Process ^a	Heat Treatment ^e	Tempering Temperature °C min
1	2	2a	3	4	5
H40	—	SL-B	S or EW	—	—
J55 ⁱ	—	SL-A or SL-B	S or EW	— ^b	—
K55	—	SL-A or SL-B	S or EW	— ^b	—
N80	1 ⁱ	SL-B	S or EW	c	—
N80	Q	SL-B	S or EW	Q ^d	—
R95 ⁱ	—	SL-A or SL-B	S or EW	Q	538
L80	1	SL-A or SL-B	S or EW	Q	566
L80	9Cr ⁱ	SL-B	S	Q ^f	593
L80	13Cr	SL-A or SL-B	S	Q ^f	593
C90	1	SL-A or SL-B	S	Q	621
T95	1	SL-A or SL-B	S	Q	649
C110	—	SL-A	S	Q	649
P110, P125	—	SL-A	S	Q	—
P110, P125	—	SL-B	S or EW ^{g, h, j}	Q	—
Q125	1	SL-A	S	Q	—
Q125	1	SL-B	S or EW ^{h, j}	Q	—
R95LS ⁱ	—	SL-A or SL-B	S	Q	649
L80	1Cr	SL-A	S	Q	566
P110LS	—	SL-A or SL-B	S	Q	593
M125	—	SL-A	S	Q	649

^b Full-body, full-length normalized, normalized and tempered or quenched and tempered at the manufacturer's option for SL-B products or shall be applied when SL-A is specified (see 6.2.2).

^j Electric welded tubulars of grade P110, P125 and Q125 shall be manufactured at SL-B with SR11 included.

Table C.4—Chemical Composition, Mass Fraction (%)

Add rows Grades "R95LS, Type —", "L80, Type 1Cr", "P110LS, Type —", and "M125, Type —"

Add footnote f

Add footnote g

Grade ^f	Type	C		Mn		Mo		Cr		Ni	Cu	P	S	Si
		min	max	min	max	min	max	min	max	max	max	max	max	max
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R95LS	—	—	g	—	g	g	g	g	g	g	—	0.020	0.010	0.45
L80	1Cr	—	0.43 ^a	—	1.90	—	—	0.80	1.20	0.25	0.35	0.030	0.030	0.45
P110LS	—	—	g	—	g	g	g	g	g	g	—	0.020	0.010	—
M125	—	—	0.45	—	1.20	0.25	1.90	0.40	1.50	0.99	0.15	0.020	0.010	0.40

^f For variant grades that require SSC testing, where the chemical composition is not fully specified in Table C.4 or Table E.4, the chemical composition shall be in accordance with the manufacturer's specifications to achieve the SSC criteria in Table 20 or Table 21 or set through MPQ/PPQ.

^g These specific elements shall be reported for variant grades requiring SSC testing.

Table C.5—Tensile and Hardness Requirements*Replace column 7 heading**Replace column 8 heading**Replace row Grade "L80, Type 1"*

Add rows "L80, Type 1Cr", "R95LS, Type —", "P110LS, Type —", "P110UC, Type —", "P125 and P125UC, Type —", "M125 and M125UC, Type —", "Q125RY, —", "Q125UC, Type —", "Q125UCRY, Type —", "Q130, Type —", "Q130RY, Type —", "Q135UC, Type —", and "Q140, Type —"

Replace footnote c

Grade	Type	Total Elongation Under Load %	Yield Strength MPa		Tensile Strength MPa	Hardness ^a		Specified Wall Thickness	Allowable Hardness Variation ^b
			min	max	min	Max Single Indentation HRC	Max Mean ^c HRC (HBW)	mm	HRC
1	2	3	4	5	6	7	8	9	10
L80	1	0.5	552	655	655	24.0	23.0 (241)	—	—
L80	1Cr	0.5	552	655	655	24.0	23.0 (241)	—	—
R95LS	—	0.5	655	758	724	as per PPQ	as per PPQ	≤ 12.70 12.71 to 19.04 19.05 to 25.39 ≥ 25.40	3.0 4.0 5.0 6.0
P110LS	—	0.6	758	862	862	as per PPQ	as per PPQ	≤ 12.70 12.71 to 19.04 19.05 to 25.39 ≥ 25.40	3.0 4.0 5.0 6.0
P110UC	—	0.6	758	965	862	—	—	—	—
P125 and P125UC	—	0.6	862	965	931	—	—	—	—
M125 and M125UC	—	0.8	862	931	896	36.0	34.0 (319)	≤ 12.70 12.71 to 19.04 19.05 to 25.39 ≥ 25.40	3.0 4.0 5.0 6.0
Q125RY	—	0.65	862	965	931	b	b	≤ 12.70 12.71 to 19.04 ≥ 19.05	3.0 4.0 5.0
Q125UC	—	0.65	862	1034	931	b	b	≤ 12.70 12.71 to 19.04 ≥ 19.05	3.0 4.0 5.0
Q125UC RY	—	0.65	862	965	931	b	b	≤ 12.70 12.71 to 19.04 ≥ 19.05	3.0 4.0 5.0

Table C.5 (amendments—continued)

Grade	Type	Total Elongation Under Load %	Yield Strength MPa		Tensile Strength MPa	Hardness ^a		Specified Wall Thickness mm	Allowable Hardness Variation ^b HRC
			min	max		Max Single Indentation HRC	Max Mean HRC (HBW)		
1	2	3	4	5	6	7	8	9	10
Q130	—	0.65	896	1034	965	b	b	≤ 12.70 12.71 to 19.04 ≥ 19.05	3.0 4.0 5.0
Q130RY	—	0.65	896	965	965	b	b	≤ 12.70 12.71 to 19.04 ≥ 19.05	3.0 4.0 5.0
Q135UC	—	0.65	931	1034	1000	b	b	≤ 12.70 12.71 to 19.04 ≥ 19.05	3.0 4.0 5.0
Q140	—	0.65	965	1034	1034	b	b	≤ 12.70 12.71 to 19.04 ≥ 19.05	3.0 4.0 5.0

^c For through-wall hardness tests of Grades L80 (all types), C90, R95LS, T95, P110LS, C110 and M125, the requirements stated in HRC scale are for maximum mean hardness number.

Table C.6—Elongation TableAdd column 13 Grade "M125"

Tensile Test Specimen				Minimum Elongation in 50.8 mm %
				Grade
				M125
Specimen Area mm ²	Specified Wall Thickness mm			Specified Minimum Tensile Strength MPa
	Specimen Width 19 mm	Specimen Width 25 mm	Specimen Width 38 mm	
1	2	3	4	
490	≥ 25.53	≥ 19.41	≥ 12.77	13
480	25.00-25.52	19.00-19.40	12.51-12.76	15
470	24.48-24.99	18.61-18.99	12.24-12.50	15
460	23.95-24.47	18.20-18.60	11.98-12.23	15
450	23.43-23.94	17.81-18.19	11.72-11.97	15
440	22.90-23.42	17.40-17.80	11.45-11.71	14
430	22.37-22.89	17.01-17.39	11.19-11.44	14
420	21.85-22.36	16.60-17.00	10.93-11.18	14
410	21.32-21.84	16.21-16.59	10.66-10.92	14
400	20.79-21.31	15.80-16.20	10.40-10.65	14
390	20.27-20.78	15.41-15.79	10.14-10.39	14
380	19.74-20.26	15.00-15.40	9.87-10.13	14
370	19.22-19.73	14.61-14.99	9.61-9.86	14
360	18.69-19.21	14.20-14.60	9.35-9.60	14
350	18.16-18.68	13.81-14.19	9.08-9.34	14
340	17.64-18.15	13.40-13.80	8.82-9.07	14
330	17.11-17.63	13.01-13.39	8.56-8.81	14
320	16.58-17.10	12.60-13.00	8.29-8.55	14
310	16.06-16.57	12.21-12.59	8.03-8.28	13
300	15.53-16.05	11.80-12.20	7.77-8.02	13
290	15.01-15.52	11.41-11.79	7.51-7.76	13
280	14.48-15.00	11.00-11.40	7.24-7.50	13
270	13.95-14.47	10.61-10.99	6.98-7.23	13
260	13.43-13.94	10.20-10.60	6.72-6.97	13
250	12.90-13.42	9.81-10.19	6.45-6.71	13
240	12.37-12.89	9.40-9.80	6.19-6.44	13
230	11.85-12.36	9.01-9.39	5.93-6.18	13
220	11.32-11.84	8.60-9.00	5.66-5.92	13
210	10.79-11.31	8.21-8.59	5.40-5.65	12
200	10.27-10.78	7.80-8.20	5.14-5.39	12

Table C.6 (amendment—continued)

Tensile Test Specimen				Minimum Elongation in 50.8 mm %
				Grade
				M125
Specimen Area mm ²	Specified Wall Thickness mm			Specified Minimum Tensile Strength MPa
	Specimen Width 19 mm	Specimen Width 25 mm	Specimen Width 38 mm	896
190	9.74-10.26	7.41-7.79	4.87-5.13	12
180	9.22-9.73	7.00-7.40	4.61-4.86	12
170	8.69-9.21	6.61-6.99	4.35-4.60	12
160	8.16-8.68	6.20-6.60	4.08-4.34	12
150	7.64-8.15	5.81-6.19	3.82-4.07	12
140	7.11-7.63	5.40-5.80	3.56-3.81	11
130	6.58-7.10	5.01-5.39	3.29-3.55	11
120	6.06-6.57	4.60-5.00	3.03-3.28	11
110	5.53-6.05	4.21-4.59	2.77-3.02	11
100	5.01-5.52	3.80-4.20	2.51-2.76	11
90	4.48-5.00	3.41-3.79	2.24-2.50	11
80	3.95-4.47	3.00-3.40	1.98-2.23	10
70	3.43-3.94	2.61-2.99	1.72-1.97	10
60	2.90-3.42	2.20-2.60	1.45-1.71	10
50	2.37-2.89	1.81-2.19	1.19-1.44	9.5

Table C.11—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grade L80 (All Types)

Delete Table C.11

Table C.12—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grade C90

Delete Table C.12

Table C.13—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grades N80 Type 1, N80Q, R95, and T95

Delete Table C.13

Table C.14—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grade P110

Delete Table C.14

Table C.15—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grade Q125

Delete Table C.15

Table C.16—Transverse Charpy Absorbed Energy Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material

Delete Table C.16

Table C.17—Longitudinal Charpy Absorbed Energy Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material

Delete Table C.17

Table C.18—Transverse Charpy Absorbed Energy Requirements for Pipe

Delete Table C.18

Table C.19—Longitudinal Charpy Absorbed Energy Requirements for Pipe

Delete Table C.19

Table C.23—Dimensions and Masses for Standard Casing and for Casing Threaded with API Round Thread and Buttress Thread

Delete rows shown with strikethrough font (standard drift diameters for Labels "7, 23.00", "7, 32.00", "9 5/8, 53.50", "11 3/4, 60.00", "11 3/4, 65.00", and "13 3/8, 72.00")

In column 7, replace reference to footnote e with reference to footnote h (alternative drift diameter for Labels "7, 23.00", "7, 32.00", "9 5/8, 53.50", "11 3/4, 60.00", "11 3/4, 65.00", and "13 3/8, 72.00")

Add rows Labels "7, 29.00", "7, 38.00", "7 5/8, 45.30", "9 5/8, 43.50", and "10 3/4, 65.70" (new alternative drift diameters)

Add footnote h

Labels ^a		Outside Diameter	Nominal Linear Mass T&C ^{b, c}	Wall Thickness	Inside Diameter	Drift Diameter	Calculated Mass ^c				
							Plain-end	e_m , Mass Gain or Loss Due to End Finishing ^d kg			
								Round Thread		Buttress Thread	
		<i>D</i> mm	kg/m	<i>t</i> mm	<i>d</i> mm	mm	<i>W_{pe}</i> kg/m	Short	Long	RC	SCC
1	2	3	4	5	6	7	8	9	10	11	12
7	23.00	177.80	34.67	8.05	161.70	158.52	33.70	6.26	7.94	8.28	0.58
7	23.00	177.80	34.67	8.05	161.70	158.75 ^h	33.70	6.26	7.94	8.28	0.58
7	32.00	177.80	47.62	11.51	154.78	151.60	47.20	—	6.23	6.40	-1.31
7	32.00	177.80	47.92	11.51	154.78	152.40 ^h	47.20	—	6.23	6.40	-1.31
9 5/8	53.50	244.48	79.62	13.84	216.80	212.83	78.72	—	10.57	9.92	-1.22
9 5/8	53.50	244.48	79.62	13.84	216.80	215.90 ^h	78.72	—	10.57 10.63 ^f	9.92	-1.22
11 3/4	60.00	298.45	89.29	12.42	273.60	269.65	87.61	9.77	—	13.12	—
11 3/4	60.00	298.45	89.29	12.42	273.60	269.88 ^h	87.61	10.17	—	13.12	—
11 3/4	65.00	298.45	96.73	13.56	271.30	267.36	95.27	—	—	—	—
11 3/4	65.00	298.45	96.73	13.56	271.30	269.88 ^h	95.27	—	—	—	—
13 3/8	72.00	339.72	107.15	13.06	313.60	309.63	105.21	10.98	—	14.33	—
13 3/8	72.00	339.72	107.15	13.06	313.60	311.15 ^h	105.21	10.98 10.91 ^f	—	14.33 13.98	—
7	29.00	177.80	43.60	10.36	157.08	155.58	42.78	—	6.79	7.13	-0.69
7	38.00	177.80	56.10	13.72	150.36	149.22	55.52	—	5.18	5.24	-2.47
7 5/8	45.30	193.68	67.41	15.11	163.46	161.92	66.54	—	4.87	5.01	-1.52
9 5/8	43.50	244.48	64.74	11.05	222.40	219.08	63.61	—	12.78 12.84 ^f	12.15	1.01
10 3/4	65.70	273.05	97.77	15.11	242.80	241.30 ^h	96.12	7.54 7.60 ^f	—	9.98 9.74	—

^h Unless otherwise specified, these tubulars shall be provided with the drift diameters indicated and the alternative drift diameter marked on the pipe.

Table C.28—Standard Drift Size*Add footnote c*
^c "Alternative" or "Standard" drift shall be specified. See 8.10 for drift requirements.
Table C.29—Alternative Drift Size*Add rows Labels "7, 29.00", "7, 38.00", "7 5/8, 45.30", "9 5/8, 43.50", and "10 3/4, 65.70"*

Labels		Pipe Outside Diameter D	Nominal Linear Mass, T&C	Alternative Drift Mandrel Size mm min	
1	2	mm	kg/m	Length	Diameter
1	2	3	4	5	6
7	29.00	177.80	43.60	305	155.58
7	38.00	177.80	56.10	305	149.22
7 5/8	45.30	193.68	67.41	305	161.92
9 5/8	43.50	244.48	64.74	305	219.08
10 3/4	65.70	273.05	97.77	305	241.30

Table C.30—Maximum Permissible Depth of Linear Imperfections*Replace Table C.30 with*

Grade	Depth as % of Specified Wall Thickness	
	External Imperfections	Internal Imperfections
N80 Type 1	10.0 %	10.0 %
Grade H40, J55, K55 and N80Q	12.5 %	12.5 %
SL-B: Grades L80 Type 1, L80 1Cr and R95 (excluding R95LS)		
SL-A: Grades L80 Type 1, L80 1Cr and R95	Linear imperfection shall be ≤ Notch Depth given on Table C.44 based on the applicable acceptance (inspection) level for the grade and SL in Table C.43.	Linear imperfection shall be ≤ Notch Depth given on Table C.44 based on the applicable acceptance (inspection) level for the grade and SL in Table C.43.
Grades C90, T95, P110, C110, M125, Q125 and variant grades		

Table C.31—Upset Products—Maximum Permissible Depth of Imperfections

Replace rows A.1 and A.2 with

	Specification Level	Surface	Depth	Measurement Notes
A Integral Joint and External Upset Tubing (see Figure D.5 and Figure D.7)				
A.1	SL-B	When SL-B is specified, all surfaces of upset and upset runout interval, except as stated in row A.2	12.5 % t	Percentage of specified pipe body wall thickness t , for nonlinear imperfections; for all grades of pipe.
			12.5 % t	Percentage of specified pipe body wall thickness t , for linear imperfections; for Grades H40, J55, K55, L80 (all types), N80 (all types) and R95.
			5 % t	Percentage of specified pipe body wall thickness t , for linear imperfections; for all grades except base grades H40, J55, K55, L80 (all types), N80 (all types) and R95.
	SL-A	When SL-A is specified, all surfaces of upset and upset runout interval, except as stated in row A.2	12.5 % t	Percentage of specified pipe body wall thickness t , for nonlinear imperfections; for all grades of pipe.
			5 % t	For all grades, percentage of specified pipe body wall thickness t , for linear imperfections.
A.2 The minimum wall thickness in the upset runout interval, and the maximum combined effect of coincident internal and external imperfections in all areas, shall not result in net wall thickness less than the minimum allowable pipe body wall thickness, which is 87.5 % of the specified wall thickness or below the alternative specified minimum wall thickness, as per 8.11.2.				

Table C.36—Permissible Depth of External Imperfections on Coupling

In column 5 heading, replace "Grades C90, T95, C110, and Q125" with "Grades C90, T95, C110, M125, and Q125"

Add footnote b

Coupling for Label 1		Grades H40, J55, K55, N80 (All Types), R95, L80 (All Types), and P110		Grades ^b C90, T95, C110, M125, and Q125
		Pits and Round-bottom Gouges mm	Grip Marks and Sharp-bottom Gouges mm	Pits, Round-bottom Gouges, Sharp-bottom Gouges, Grip Marks mm
1	2	3	4	5

^b Variant Grades R95LS and P110LS are categorized within this grouping.

Table C.37—Frequency of Tensile Tests—Casing and Tubing

In column 1, replace "C110" with "C110, M125"

Grade ^e	Label 1	Maximum Number of Pieces in a Lot	Number of Tests	
			per Lot	per Heat
1	2	3	4	5
C110, M125	All sizes	100 ^{b, d}	1	—

Table C.38—Frequency of Tensile Tests—Coupling Stock, Coupling Material, and Coupling Blanks

In column 1, replace "C110 and Q125" with "C110, M125 and Q125"

Grade	Material	Condition when Heat-treated	Maximum Number of Pieces in a Lot	Number of Tests	
				per Lot	per Heat
1	2	3	4	5	6
C110, M125 and Q125	Coupling stock and coupling material	Coupling stock and coupling material for pipe Label 1: All sizes	1 ^b	1	—
		Coupling blank	Label 1: < 9 5/8: 50 ^c Label 1: ≥ 9 5/8: 30 ^c	1	—

Table C.39—Frequency of Tensile Testing—Pup Joints and Accessory Material

In column 1, replace "C110 and Q125" with "C110, M125 and Q125"

In footnote c, add "and M125" after "Q125"

Grade	Material and Heat Treatment Conditions ^a		Maximum Number of Pieces in a Lot	Number of Tests	
				per Lot	per Heat
1	2	3	4	5	6
C110, M125 and Q125	Full-length standard tubing or casing from one or more heats		In accordance with 10.2.3	3 ^{a, b}	—
	Thick-wall mechanical tube or bar stock from a single heat		1	1 ^a	—
	Heat-treated in individual lengths or hot forgings	Batch heat treatment	Label 1: < 9 5/8: 50 ^c Label 1: ≥ 9 5/8: 30 ^c	1	—
		Heat-treated in sequential loads or continuous heat treatment	Label 1: < 9 5/8: 50 ^c Label 1: ≥ 9 5/8: 30 ^c	1	—

^c Each lot shall be from the same heat of steel for Grades L80 9Cr, L80 13Cr, C90, T95, C110, Q125 and M125. See 10.2.3.

Table C.40—Frequency of Hardness Testing

In column 1, replace Grade "C110" with "C110 and M125"

Add row Grades "C110 and M125, Material Upset pipe"

Add row "Variant Grades R95LS and P110LS"

Add footnote e

Add footnote f

Add footnote g

Add footnote h

Grade ^f	Material		Number of Tests per Lot	Maximum Number of Pieces in a Lot	Type of Test	Location
1	2		3	4	5	6
Variant Grades ^f R95LS and P110LS	Non-upset pipe Grade R95LS		1	50	Through-wall, 1 quadrant	Approximately 50 % from each end ^h
	Non-upset pipe Grade P110LS		1	25	Through-wall, 1 quadrant	Approximately 50 % from each end ^h
	Coupling blanks, coupling stock, coupling material, pup joints and accessory material	Tube-length heat treatment	2 ^a	10	Through-wall, 4 quadrants	One from each end
		Individual heat treatment	1	10	Surface—HRC or HBW	Each piece
			1	Label 1: < 9 5/8: 50 ^c Label 1: ≥ 9 5/8: 30 ^c	Through-wall, 4 quadrants	From a piece with the highest surface hardness number in the lot
Grades C110 ^e and M125 ^e	Upset pipe ^g		1 ^g	Each length	Surface—HRC or HBW	Pipe body and one upset ^d
			1 ^g	20 ^c	Through-wall, 4 quadrants	One upset
			1 ^g	Label 1: ≥ 4 1/2: 100	Through-wall, 4 quadrants	Pipe body tensile test

^e If a process control plan has been applied which has demonstrated that it ensures that the entire length of the pipe has homogeneous hardness properties, the testing frequency for Grades C110 and M125 may be reduced to the frequency applicable for Grades C90 and T95.

^f When a variant grade requiring SSC testing has been specified, the hardness testing is as per the base grade given in Table 18, with the exception of the R95LS (A or D) and the P110LS (A or D) that are given in this table.

^g Upset pipe in T95EN, C110 or M125 grade requires PPQ completion; the number of tests per lot shall be as agreed as an output of PPQ but no fewer than one per lot.

^h For single specimens on a per lot frequency, alternating ends through the heat shall be sampled.

Table C.41—Frequency of Flattening Tests

In column 1 "Casing and Tubing" and "Pup Joints" sections, replace "H40, J55, K55, N80 (all types), L80 Type 1, R95, P110" with "H40, J55, K55, N80 (all types), L80 Type 1, R95"

In column 1, "Casing and Tubing" and "Pup Joints" sections, replace "Q125" with "P110, Q125"

Casing and Tubing
Grade
1
H40, J55, K55, N80 (all types), L80 Type 1, R95
P110, Q125
Pup Joints
Grade
1
H40, J55, K55, N80 (all types), L80 Type 1, R95
P110, Q125

Table C.42—Summary of NDE Methods for Seamless Pipe, Coupling Stock, Body of Welded Pipe, and Accessory Material (In Accordance with 10.15.11)*Replace Table C.42 with*

Product	Grade	Specification Level ^e	Requirement						
			Visual Inspection (see 10.14)	Wall Thickness		Ultrasonic Inspection	Electromagnetic Inspection Methods		Magnetic Particle Inspection ^a
				Manual Point Inspection (see 10.13.4)	Coverage of Automated Equipment		Flux Leakage Inspection	Eddy Current Inspection	
1	2	2a	3	4a	4b	5	6	7	8
Pipe	H40	SL-B	R	P	N	N	N	N	N
	J55, K55	SL-B		P	N	N	N	N	N
		SL-A		N	25 %	A	A	A	A
	N80 (all types)	SL-B			HL	A	A	A	A
	L80 Type 1, L80 1Cr, R95	SL-B			HL	A	A	A	A
		SL-A			100 %				
	R95LS	SL-B			25 %	A	A	A	NA
		SL-A			100 %	C	N	N	N
	L80 13Cr, P110	SL-B for L80 13Cr and P110			25 %	A	A	A	NA
		SL-B for P110LS and P125			25 %	A	A	A	NA
		SL-B for P110UC and P125UC			100 %	C	N	N	NA
		SL-A			100 %	C	B	B	B
	C90, T95, Q125	SL-B			25 %	C	B	B	B
		SL-A			100 %				
	C110, M125	SL-A			100 %	C	B	B	B

Table C.42 (continued)

Product	Grade	Specification Level ^e	Requirement						
			Visual Inspection (see 10.14)	Wall Thickness		Ultrasonic Inspection	Electromagnetic Inspection Methods		Magnetic Particle Inspection ^a
				Manual Point Inspection (see 10.13.4)	Coverage of Automated Equipment ^b		Flux Leakage Inspection	Eddy Current Inspection	
1	2	2a	3	4a	4b	5	6	7	8
Coupling stock and accessory material	H40	SL-B	R	P	N	N	N	N	N
	J55, K55	SL-B		P	N	N	N	N	N
		SL-A		N ^c	HL ^{c, d}	A	A	A	A
	N80 all types, L80 Type 1, L80 1Cr, R95	SL-B			HL ^{c, d}	A	A	A	A
		SL-A				A	A	A	A
	L80 13Cr, C90, R95LS, T95, P110, Q125, C110, M125	SL-B ^c			HL ^{c, d}	A	A	A	A
		SL-A				C	A	A	A
Weld seam	H40, J55, K55, N80 (all types), L80 Type 1, R95	SL-B and SL-A – J55, K55	R	N	N	A	A	A	NA
		SL-A – L80 Type 1, R95			N	C	N	N	NA
	P110 ^b , P125 ^b , Q125 ^b	SL-B	R	N	N	C	N	N	NA

Table C.42 (continued)

Product	Grade	Specification Level ^e	Requirement						
			Visual Inspection (see 10.14)	Wall Thickness		Ultrasonic Inspection	Electromagnetic Inspection Methods		Magnetic Particle Inspection ^a
				Manual Point Inspection (see 10.13.4)	Coverage of Automated Equipment ^b		Flux Leakage Inspection	Eddy Current Inspection	
						ISO 10893-10 or ASTM E213	ISO 10893-3 or ASTM E570	ISO 10893-2 or ASTM E309	ISO 10893-5 or ASTM E709
1	2	2a	3	4a	4b	5	6	7	8
Key N = Not required NA = Technique not applicable R = Required A = One method or any combination of methods shall be used B = At least one method shall be used in addition to ultrasonic inspection in accordance with Table C.43 and Table E.43. C = Ultrasonic inspection shall be used in accordance with Table C.43 and Table E.43. HL = Wall thickness verified in a helical or longitudinal path over the full length, excluding end areas not covered by automated systems P = Wall thickness measurement at discrete point(s) in alignment with 10.13.14									
^a MPI is permitted for end-area inspection; MPI is permitted for pipe-body outside-surface inspection in combination with other methods of pipe body inspection; MPI is permitted for coupling stock outside surface inspection; coupling stock receiving full-length MPI does not require full-length wall thickness verification, however, mechanical wall thickness measurement of each end is required. ^b Electric welded tubulars of Grade P110, P125 and Q125 shall only be specified at SL-B with SR11 included. ^c For accessory material, wall thickness shall be measured at discrete point(s) in alignment with 10.13.4 unless full length wall thickness verification is specified. If wall thickness verification is specified, accessory material shall have the wall thickness verified in a helical or longitudinal path over the full length, excluding end areas not covered by automated systems. ^d Coupling stock requires HL wall thickness verification by the automated system. For wall ultrasonic inspection, minimum of 25 % coverage for Grades L80 13Cr, C90, R95LS, T95, P110 and Q125 at SL-A, and 100 % coverage for Grades C110 and M125. ^e Not all grades are available at both SLs and the presence of the SL in this table does not imply that the products are available through IOGP S-735D.									

Table C.43—Acceptance (Inspection) Levels*Replace Table C.43 with*

Material	Grade	Specification Level ^f	Method	External Imperfections ^{d, e}		Internal Imperfections ^{d, e}		Through Wall
				Longitudinal	Transverse	Longitudinal	Transverse	
1	2	2a	4	5	6	7	8	9
Pipe body ^{a, c}	H40	SL-B	—	—	—	—	—	—
	J55, K55	SL-B	—	—	—	—	—	—
		SL-A	A	L4	—	L4	—	—
	N80 Type 1	SL-B	A	L3	—	L3	—	—
	N80 Q		A	L4	—	L4	—	—
	L80 Type 1, L80 1Cr, R95	SL-B	A	L4	—	L4	—	—
		SL-A	A	L2	L2	L2	L2	—
	R95LS	SL-B	A	L2	L2	L2	L2	—
		SL-A	C	L2	L2	L2	L2	—
	L80 13Cr, P110	SL-B excludes P110UC and P125UC	A	L2	L2	L2	L2	—
		SL-B - P110UC, P125UC	C	L2	L2	L2	L2	—
		SL-A	C	L2	L2	L2	L2	—
			B	L2	L2	—	—	—
	C90, T95	SL-B or SL-A	C	L2	L2	L2	L2	—
			B	L2	L2	—	—	—
	C110, M125	SL-A	C	L2	L2	L2	L2	—
			B	L2	L2	—	—	—
	Q125	SL-A or SL-B	C	L2	L2	L2	L2	—
			B	L2	L2	—	—	—

Table C.43 (continued)

Material	Grade	Specification Level ^f	Method	External Imperfections ^{d, e}		Internal Imperfections ^{d, e}		Through Wall
				Longitudinal	Transverse	Longitudinal	Transverse	
1	2	2a	4	5	6	7	8	9
Coupling stock ^c and accessory material ^c	H40	SL-B	—	—	—	—	—	—
	J55, K55	SL-B	—	—	—	—	—	—
		SL-A	A	L4	—	—	—	—
	N80 all types, L80 Type 1, L80 1Cr, R95	SL-B	A	L2	L2	—	—	—
		SL-A	A	L2	L2	—	—	—
	L80 13Cr, C90, R95LS, T95, P110, Q125	SL-B	A	L2	L2	—	—	—
		SL-A	A	L2	L2	—	—	—
			C	—	—	L3	L3	L2 ^g
	C110, M125	SL-A	A	L2	L2	—	—	—
			C	—	—	L3	L3	L2 ^g
Weld seam	H40, J55, K55, N80 (all types), L80 Type 1, R95	SL-B and SL-A – J55 and K55	A	L3	—	L3	—	—
		SL-A – L80 Type 1, R95	C	L2	—	L2	—	—
	P110 ^b , P125 ^b , Q125 ^b	SL-B	C	L2	—	L2	—	—

Key

— = Not applicable

L_x = Acceptance (inspection) level

A = One method or any combination of methods shall be used in accordance with Table C.42 and Table E.42.

B = At least one method shall be used in addition to ultrasonic inspection in accordance with Table C.42 and Table E.42.

C = Ultrasonic inspection shall be used in accordance with Table C.42 and Table E.42.

Table C.43 (continued)

Material	Grade	Specification Level ^f	Method	External Imperfections ^{d, e}		Internal Imperfections ^{d, e}		Through Wall
				Longitudinal	Transverse	Longitudinal	Transverse	
1	2	2a	4	5	6	7	8	9
^a Pup joints shall be inspected like pipe body. ^b Electric welded tubulars of grade P110, P125 and Q125 shall only be specified at SL-B with SR11 included. ^c Oblique inspection to acceptance level L2 when the manufacturer determines their products require this inspection in accordance with 10.15.4.2 e) or when SR 41.2 is specified. ^d When alternative wall tolerance for pipe of 10 % has been specified, acceptance (inspection) level L4 shall be replaced with L3 for internal and external imperfections. ^e When alternative wall tolerance for pipe of 7.5 % or 5 % has been specified, acceptance (inspection) level L2 shall be used for internal and external imperfections. ^f Not all grades are available at both SLs and the presence of the SL in this table does not imply that the products are available through IOGP S-735D. ^g For wall ultrasonic inspection, minimum of 25 % coverage for grades L80 13Cr, C90, R95LS, T95, P110 and Q125 at SL-A, and 100 % coverage for grades C110 and M125.								

Table C.44—Artificial Reference IndicatorsAdd column 1a "Specification Level"Replace column 3 "Notch Length Maximum at Full Depth"Add column 6 "Flat Bottom Hole Diameter"Replace footnote bAdd footnote cAdd footnote dAdd footnote eDelete NOTE

Acceptance (Inspection) Level	Specification Level	Notch Depth ^a Maximum %	Notch Length ^d Maximum at Full Depth mm	Notch Width Maximum mm	Radially Drilled Hole Diameter ^b mm	Flat Bottom Hole Diameter ^c mm
1	1a	2	3	4	5	6
L2	SL-B	5	50	1.0	1.6	6.4
	SL-A		25			
L3	SL-B	10	50	1.0	3.2	NA
	SL-A		25			
L4	SL-B	12.5	50	1.0	3.2	NA
	SL-A		25 ^e			

^b Radially drilled hole diameter (through the pipe wall), as shown on Figure D.16 c), shall be based on the drill bit size.^c Flat bottom hole shall be of a dimension such that a minimum of 90 % of specified wall thickness remains below with a tolerance of ± 1.5 %. See 10.15.12.4 and Figure D.16.^d For SL-B eddy current, 38.10 mm maximum total length.^e For J55 and K55, when specified as SL-A, notch length may be extended to 50 mm.

Table C.46 —Grade Color Codes

Add rows Grades "L80, Type 1Cr" and "M125, Type —"

Add footnote d

Add footnote e

Grade	Grade Type	Number and Color of Bands for Product ^{a, d, e} with Length ≥ 1.8 m	Color(s) for Couplings	
			Entire Coupling	Band(s) ^{b, c, e}
1	2	3	4	5
L80	1Cr	One red, one brown, two orange	Red	One brown, two orange
M125	—	One orange, one brown	Orange	Brown

^d UC grades shall also have two blue bands on the product body.

^e Variant grade color bands shall be applied on product body and couplings as follows:

- LS variant grades- in addition to the base grade banding, an additional purple band shall be applied.
- E variant grades- in addition to the base grade banding, an additional yellow band shall be applied.
- RY variant grades- in addition to the base grade banding, an additional pink band shall be applied.
- If multiple variant grades apply, apply all the bands stated above (e.g. UCRY).

Table C.48—Marking Requirements and Sequence

Delete footnote g

In heading row, replace "Grades L80 (All Types), C90, T95, C110, and Q125" with "Grades L80 (All Types), C90, T95, C110, Q125, and M125"

In row 4, add "or C.59" after "Table C.1, C.2"

In row 5, add "or C.59" after "Table C.1, C.2"

In row Marking Sequence "11, — K.14 (SR 41)", add Mark "S41.3"

Add rows 18, 19, 20, 21, 22 and 23

Replace footnote f

Marking Sequence		Mark or Symbol ^b	Stencil and/or Stamp Marking Requirements ^a				
			Grades H40, J55, K55, N80 (All Types), R95, and P110		Grades L80 (All Types), C90, T95, C110, M125, and Q125		All Grades
			Pipe	Couplings and Accessories	Pipe	Couplings and Accessories	Coupling Stock and Accessory Materials
1	2	3	4	5	6	7	8
4	Size designation (fill in Label 1 designation from Column 1 of Table C.1, C.2 or C.59)	«...»	P		P		
	Specified diameter for coupling stock and other products with no mass designation						P
5	Mass designation (fill in Label 2 designation from Table C.1, C.2 or C.59)	«...»	D or P		P		
	Specified wall thickness for coupling stock and other products with no mass designation						P

Table C.48 (amendments — continued)

Marking Sequence		Mark or Symbol ^b	Stencil and/or Stamp Marking Requirements ^a				
			Grades H40, J55, K55, N80 (All Types), R95, and P110		Grades L80 (All Types), C90, T95, C110, M125, and Q125		All Grades
			Pipe	Couplings and Accessories	Pipe	Couplings and Accessories	Coupling Stock and Accessory Materials
1	2	3	4	5	6	7	8
11	— K.14 (SR 41)	S41.1 S41.2 S41.3	P P P		P P P		
18	— Annex P uprated collapse variant grade (fill in claimed rating in MPa)	UC <<---->>	P		P		
19	IOGP S-735 product designation (specification level)	S735A or S735B	P	D or P	P	P	P
20	Alternative wall thickness tolerance	BW10, BW7.5 BW5	P P P		P P P		
21	Variant grade of product and sulfide cracking test ^f (if applicable):		D or P	D or P	P	P	P
	Variant grades of R95 — R95LS (A or D)	R95LS-A or R95LS-D					
	Variant grades of L80 Type 1 — L80 Type 1Cr	L1CR					
	Variant grades of C90 Type 1 — C90 (A-80 %) — C90 (A-90 %) — C90 (D)	C90-A80 C90-A90 C90-D					

Table C.48 (amendments — continued)

Marking Sequence		Mark or Symbol ^b	Stencil and/or Stamp Marking Requirements ^a				
			Grades H40, J55, K55, N80 (All Types), R95, and P110		Grades L80 (All Types), C90, T95, C110, M125, and Q125		All Grades
			Pipe	Couplings and Accessories	Pipe	Couplings and Accessories	Coupling Stock and Accessory Materials
1	2	3	4	5	6	7	8
21 (continued)	Variant grades of T95 Type 1 — T95UC (A-80 %, A-90 %, or D) — T95 (A-80 %) — T95 (A-90 %) — T95 (D) — T95EN (A, D or AD)	T95UC-A80 or T95UC-A90 or T95UC-D T95-A80 T95-A90 T95-D T95EN-A or T95EN-D or T95EN-AD	D or P	D or P	P	P	P
	Variant grades of C110 — C110UC (A, D) — C110 (A, D) — C110EN (A, D or AD)	C110UC-A or C110UC-D C110-A or C110-D C110EN-A or C110EN-D or C110EN-AD					
	Variant grades of P110 — P110LS (A or D) — P110UC — P125 — P125UC	P110LS-A or P110LS-D P110UC P125 P125UC					
	Variant grades of M125 — M125 (A, D or AD) — M125EN (A, D or AD) — M125UC (A, D or AD)	M125-A or M125-D or M125-AD M125EN-A or M125EN-D or M125EN-AD M125UC-A or M125UC-D or M125UC-AD					

Table C.48 (amendments — continued)

Marking Sequence		Mark or Symbol ^b	Stencil and/or Stamp Marking Requirements ^a				
			Grades H40, J55, K55, N80 (All Types), R95, and P110		Grades L80 (All Types), C90, T95, C110, M125, and Q125		All Grades
			Pipe	Couplings and Accessories	Pipe	Couplings and Accessories	Coupling Stock and Accessory Materials
1	2	3	4	5	6	7	8
21	Variant grades of Q125 Type 1	Q125RY Q125UC Q125UCRY Q130 Q130RY Q135UC Q140	D or P	D or P	P	P	P
(continued)	— Q125RY — Q125UC — Q125UCRY — Q130 — Q130RY — Q135UC — Q140						
	All grade designations						
22	Length of finished tubular	<<X.xx>> m	P		P		P
23	Purchaser's purchase order number	PO <<xxxxxx>>	P	D or P	P	P	P
^f In alignment with Table 20 "(A)" when tested using Method A (smooth tensile), in alignment with Table 21 "D" when tested using Method D (DCB) and in alignment with Table 20 and Table 21 "(AD)" when tested using both Method A and Method D.							

Table C.49—Retention of Records

In "Mechanical Properties" section, replace "Grain size (Grades C90, T95 and C110)" with "Grain size (Grades that require SSC testing in accordance with Table 20 or Table 21)"

In "Mechanical Properties" section, add row "Uprated collapse testing"

Replace section title "Hydrostatic Tests" with "Hydrostatic and Other Tests"

In "Hydrostatic and other Tests" section, add new rows for supplemental inspections

In "Manufacturer Certification" section, replace "Sulfide stress-cracking test (Grades C90, T95 and C110)" with "Sulfide stress-cracking test (Grades requiring SSC test in accordance with Table 20 or Table 21)"

Requirement	Sub-section Reference
Mechanical Properties	
Grain size (Grades requiring SSC test in accordance with Table 20 or Table 21)	7.11, 10.8
Uprated collapse testing	P.2
Hydrostatic and other Tests	
Supplemental inspection(s) when hydrostatic test pressure is limited, if applicable	
— when the purchaser specifies SR 41.1 for wall thickness verification to 100 %	K.14.1 (SR 41.1)
— when oblique notches/inspection is specified via SR 41.2	K.14.2 (SR 41.2)
— when additional hardness testing is specified via SR 41.3	K.14.3 (SR 41.3)
Manufacturer Certification	
Sulfide stress-cracking test (Grades requiring SSC test in accordance with Table 20 or Table 21)	7.14, 10.10

Add new Table C.59**Table C.59—Non-Standard Size or Wall Tubulars**

OD ^d / Label 1	Nominal Linear Mass ^{a, b} T&C kg/m	Wall Thickness <i>t</i> mm	Drift Diameter ^c mm
1	2	3	4
4.500	38.84	16.00	79.12
5.500	38.69	12.09	112.34
6.000	37.35	10.54	128.14
6.625	51.34	13.33	138.43
7.000	61.01	14.99	144.65
7.625	88.10	20.62	149.25
8.625	65.48	12.70	190.50
9.375	58.04	10.16	215.90
9.875	93.46	15.87	215.90
9.875	97.18	16.51	215.90
9.875	99.56	17.48	215.90
9.875	100.45	17.22	215.90
9.875	102.53	17.78	215.90
10.000	102.24	17.48	215.90
10.125	118.68	20.32	215.90
10.175	120.54	20.32	215.90
10.750	126.94	20.24	228.60
10.875	107.15	16.66	241.30
11.875	106.85	14.78	269.87
13.625	131.26	15.87	311.15
13.875	157.74	19.18	311.15
14.000	122.77	14.27	322.30
14.000	157.74	19.05	312.75
14.000	168.16	20.24	311.15
14.000	169.65	20.32	311.15
14.000	171.14	20.62	311.15
14.000	172.63	20.83	311.15
16.000	141.38	14.38	374.65
16.000	144.35	14.60	374.65
16.000	154.77	15.87	369.87
16.000	175.60	18.16	365.30
16.100	164.44	16.94	370.84
16.150	179.32	18.36	371.47
16.150	190.48	19.61	368.93

Table C.59 (continued)

OD^d / Label 1	Nominal Linear Mass^{a, b} T&C kg/m	Wall Thickness <i>t</i> mm	Drift Diameter^c mm
1	2	3	4
18.000	139.89	12.70	427.05
18.000	156.26	14.27	423.90
18.000	174.11	15.87	420.70
18.000	189.00	17.48	417.47
18.625	140.63	11.89	444.96
18.625	143.61	12.32	444.50
18.625	145.39	12.34	443.64
18.625	169.65	14.71	438.91
18.625	202.39	17.60	433.12

^a Nominal linear masses (Column 2) are shown for information only.

^b The densities of martensitic chromium steels (L80 Type 13Cr) are different from carbon steels. The masses shown are therefore not accurate for martensitic chromium steels. A mass correction factor of 0.989 may be used.

^c Drift lengths shall be as per Table C.28 based on casing or tubing service.

^d In accordance with Table 13, the plus tolerance on OD for casing may be proposed to be increased.

Add new Table C.60**Table C.60—Charpy V-Notch Testing Minimum Absorbed Energy Values—Full Size 10 mm x 10 mm Specimen**

Grade	Average Minimum ^{a, b} Absorbed Energy Requirement ^{c, e} for SL-B products for Coupling Stock, Coupling Material, Coupling Blanks, and Couplings (pipe)		Average Minimum ^{a, b} Absorbed Energy Requirement ^{c, e} for SL-A ^g products
	(Joules)		(Joules)
	Transverse	Longitudinal	Transverse and Longitudinal
1	2	3	4
J55 ^f	20 (20 SR16 only)	27 (27 SR16 only)	41
K55 ^f	20 (20 SR16 only)	27 (27 SR16 only)	41
N80 (all types)	20 (20)	41 (40)	-
L80 (all types except 13Cr)	27 (20)	54 (40)	60 ^h
L80 13Cr ^d	27 (20)	54 (40)	35 or SL-B value, whichever is greater
C90	27 (20)	54 (40)	60 ^h
T95, R95	27 (20)	54 (40)	60 ^h
P110	27 (27)	54 (52)	60 ^h
C110	-	-	60 ^h
M125	-	-	60 ^h
P125, Q125	34 (34)	68 (54)	68 ^h

^a Values given in this table are the average minimums. Minimum individual values shall be at least $\frac{2}{3}$ of the average value as per 7.3.1.
^b Hierarchy for impact specimen size, reduction factors and specimen orientation shall be in accordance with Table C.8 and Table C.9.
^c For products (with the exception of L80 13Cr) with wall thicknesses > 63.5 mm, these minimum absorbed energy criteria shall be by agreement.
^d For L80 13Cr products with wall thickness > 35.6 mm, these minimum absorbed energy criteria shall be by agreement.
^e Test temperatures shall be specified in accordance with Table 19.
^f Temperature reduction factors in accordance with Table C.10 may be applied.
^g For SL-A grades, SR 16 applies.
^h 75 % minimum shear area applies for SL-A grades except for J55, K55 and L80 13Cr.

Annex D **(normative)**

Figures in SI (USC) Units

Figure D.10—Through-wall Hardness Test

Replace footnote a with

- ^a Indentations at the outside-wall and inside-wall locations shall be made between 2.54 mm (0.10 in.) and 3.81 mm (0.15 in.) from the applicable outer or inner surface, but not closer than 2 ½ indentation diameters from the center of an indentation to the edge of the surface or three diameters from another indentation measured center-to-center.

Annex E (normative)

Tables in USC Units

Table E.1—API Casing List (sizes, masses, wall thickness, grade, and applicable end-finish)

In column 11 heading, replace "M125" with "C110 M125"

Labels ^a		Outside Diameter	Nominal Linear Mass ^{b, c} T&C	Wall Thickness	Type of End-finish ^d							
1	2	<i>D</i> in.	lb/ft	<i>t</i> in.	H40	J55 K55	L80 R95	N80 Type 1, Q	C90 T95	C110 M125	P110	Q125
1	2	3	4	5	6	7	8	9	10	11	12	13

Table E.3—Process of Manufacture and Heat Treatment

Add column 2a "Specification Level" to Grades "H40, Type —", "J55, Type —", "K55, Type —", "N80, Type 1", "N80, Type Q", "R95, Type —", "L80, Type 1", "L80, Type 9Cr", "L80, Type 13Cr", "C90, Type 1", "T95, Type 1", and "C110, Type —"

Replace row Grade "P110, Type —" with rows Grades "P110, P125, Type —, SL-A" and "P110, P125, Type —, SL-B"

Replace row Grade "Q125, Type 1" with rows Grades "Q125, Type 1, SL-A", and "Q125, Type 1, SL-B"

Add rows Grades "R95LS, Type —", "L80, Type 1Cr", "P110LS, Type —", and "M125, Type —"

Replace footnote b

Add footnote j

Grade	Type	Specification Level	Manufacturing Process ^a	Heat Treatment ^e	Tempering Temperature °F min
1	2	2a	3	4	5
H40	—	SL-B	S or EW	—	—
J55 ⁱ	—	SL-A or SL-B	S or EW	— ^b	—
K55	—	SL-A or SL-B	S or EW	— ^b	—
N80	1 ⁱ	SL-B	S or EW	c	—
N80	Q	SL-B	S or EW	Q ^d	—
R95 ⁱ	—	SL-A or SL-B	S or EW	Q	1000
L80	1	SL-A or SL-B	S or EW	Q	1050
L80	9Cr ⁱ	SL-B	S	Q ^f	1100
L80	13Cr	SL-A or SL-B	S	Q ^f	1100
C90	1	SL-A or SL-B	S	Q	1150
T95	1	SL-A or SL-B	S	Q	1200
C110	—	SL-A	S	Q	1200
P110, P125	—	SL-A	S	Q	—
P110, P125	—	SL-B	S or EW ^{g, h, j}	Q	—
Q125	1	SL-A	S	Q	—
Q125	1	SL-B	S or EW ^{h, j}	Q	—
R95LS ⁱ	—	SL-A or SL-B	S	Q	1200
L80	1Cr	SL-A	S	Q	1050
P110LS	—	SL-A or SL-B	S	Q	1100
M125	—	SL-A	S	Q	1200

^b Full-body, full-length normalized, normalized and tempered or quenched and tempered at the manufacturer's option for SL-B products or shall be applied when SL-A is specified (see 6.2.2).

^j Electric welded tubulars of grade P110, P125 and Q125 shall be manufactured at SL-B with SR11 included.

Table E.4—Chemical Composition, Mass Fraction (%)

Add rows Grades "R95LS, Type —", "L80, Type 1Cr", "P110LS, Type —", and "M125, Type —"

Add footnote f

Add footnote g

Grade ^f	Type	C		Mn		Mo		Cr		Ni	Cu	P	S	Si
		min	max	min	max	min	max	min	max	max	max	max	max	max
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R95LS	—	—	g	—	g	g	g	g	g	g	—	0.020	0.010	0.45
L80	1Cr	—	0.43 ^a	—	1.90	—	—	0.80	1.20	0.25	0.35	0.030	0.030	0.45
P110LS	—	—	g	—	g	g	g	g	g	g	—	0.020	0.010	—
M125	—	—	0.45	—	1.20	0.25	1.90	0.40	1.50	0.99	0.15	0.020	0.010	0.40

^f For variant grades that require SSC testing, where the chemical composition is not fully specified in Table C.4 or Table E.4, the chemical composition shall be in accordance with the manufacturer's specifications to achieve the SSC criteria in Table 20 or Table 21 or set through MPQ/PPQ.

^g These specific elements shall be reported for variant grades requiring SSC testing.

Table E.5—Tensile and Hardness Requirements*Replace column 7 heading**Replace column 8 heading**Replace row Grade "L80, Type 1"*

Add rows "L80, Type 1Cr", "R95LS, Type —", "P110LS, Type —", "P110UC, Type —", "P125 and P125UC, Type —", "M125 and M125UC, Type —", "Q125RY, —", "Q125UC, Type —", "Q125UCRY, Type —", "Q130, Type —", "Q130RY, Type —", "Q135UC, Type —", and "Q140, Type —"

Replace footnote c

Grade	Type	Total Elongation Under Load %	Yield Strength ksi		Tensile Strength ksi	Hardness ^a		Specified Wall Thickness	Allowable Hardness Variation ^b
			min	max	min	Max Single Indentation HRC	Max Mean ^c HRC (HBW)	in.	HRC
1	2	3	4	5	6	7	8	9	10
L80	1	0.5	80	95	95	24.0	23.0 (241)	—	—
L80	1Cr	0.5	80	95	95	24.0	23.0 (241)	—	—
R95LS	—	0.5	95	110	105	as per PPQ	as per PPQ	≤ 0.500 0.501 to 0.749 0.750 to 0.999 ≥ 1.000	3.0 4.0 5.0 6.0
P110LS	—	0.6	110	125	125	as per PPQ	as per PPQ	≤ 0.500 0.501 to 0.749 0.750 to 0.999 ≥ 1.000	3.0 4.0 5.0 6.0
P110UC	—	0.6	110	140	125	—	—	—	—
P125 and P125UC	—	0.6	125	140	135	—	—	—	—
M125 and M125UC	—	0.8	125	135	130	36.0	34.0 (319)	≤ 0.500 0.501 to 0.749 0.750 to 0.999 ≥ 1.000	3.0 4.0 5.0 6.0
Q125RY	—	0.65	125	140	135	b	b	≤ 0.500 0.501 to 0.749 ≥ 0.750	3.0 4.0 5.0
Q125UC	—	0.65	125	150	135	b	b	≤ 0.500 0.501 to 0.749 ≥ 0.750	3.0 4.0 5.0
Q125UCRY	—	0.65	125	140	135	b	b	≤ 0.500 0.501 to 0.749 ≥ 0.750	3.0 4.0 5.0

Table E.5 (amendments—continued)

Grade	Type	Total Elongation Under Load %	Yield Strength ksi		Tensile Strength ksi	Hardness ^a		Specified Wall Thickness	Allowable Hardness Variation ^b
			min	max	min	Max Single Indentation HRC	Max Mean ^c HRC (HBW)	mm	HRC
1	2	3	4	5	6	7	8	9	10
Q130	—	0.65	130	150	140	b	b	≤ 0.500 0.501 to 0.749 ≥ 0.750	3.0 4.0 5.0
Q130RY	—	0.65	130	140	140	b	b	≤ 0.500 0.501 to 0.749 ≥ 0.750	3.0 4.0 5.0
Q135UC	—	0.65	135	150	145	b	b	≤ 0.500 0.501 to 0.749 ≥ 0.750	3.0 4.0 5.0
Q140	—	0.65	140	150	150	b	b	≤ 0.500 0.501 to 0.749 ≥ 0.750	3.0 4.0 5.0

^c For through-wall hardness tests of Grades L80 (all types), C90, R95LS, T95, P110LS, C110 and M125, the requirements stated in HRC scale are for maximum mean hardness number.

Table E.6 —Elongation TableAdd column 13 Grade "M125"

Tensile Test Specimen				Minimum Elongation in 2.0 in. %
Specimen Area in. ²				Grade
Specified Wall Thickness mm				M125
Specimen Area in. ²	Specified Wall Thickness mm			Specified Minimum Tensile Strength ksi
	Specimen Width ¾ in.	Specimen Width 1 in.	Specimen Width 1½ in.	
1	2	3	4	130
0.750	≥ 0.994	≥ 0.746	≥ 0.497	13
0.740	0.980-0.993	0.735-0.745	0.490-0.496	15
0.730	0.967-0.979	0.726-0.734	0.484-0.489	15
0.720	0.954-0.966	0.715-0.725	0.477-0.483	15
0.710	0.941-0.953	0.706-0.714	0.471-0.476	15
0.700	0.927-0.940	0.695-0.705	0.464-0.470	15
0.690	0.914-0.926	0.686-0.694	0.457-0.463	15
0.680	0.900-0.913	0.675-0.685	0.450-0.456	15
0.670	0.887-0.899	0.666-0.674	0.444-0.449	15
0.660	0.861-0.873	0.646-0.654	0.431-0.436	15
0.650	0.847-0.860	0.635-0.645	0.424-0.430	15
0.640	0.847-0.860	0.635-0.645	0.424-0.430	14
0.630	0.834-0.846	0.626-0.634	0.417-0.423	14
0.620	0.820-0.833	0.615-0.625	0.410-0.416	14
0.610	0.807-0.819	0.606-0.614	0.404-0.409	14
0.600	0.794-0.806	0.595-0.605	0.397-0.403	14
0.590	0.781-0.793	0.586-0.594	0.391-0.396	14
0.580	0.767-0.780	0.575-0.585	0.384-0.390	14
0.570	0.754-0.766	0.566-0.574	0.377-0.383	14
0.560	0.740-0.753	0.555-0.565	0.370-0.376	14
0.550	0.727-0.739	0.546-0.554	0.364-0.369	14
0.540	0.714-0.726	0.535-0.545	0.357-0.363	14
0.530	0.701-0.713	0.526-0.534	0.351-0.356	14
0.520	0.687-0.700	0.515-0.525	0.344-0.350	14
0.510	0.674-0.686	0.506-0.514	0.337-0.343	14
0.500	0.660-0.673	0.495-0.505	0.330-0.336	14
0.490	0.647-0.659	0.486-0.494	0.324-0.329	14
0.480	0.634-0.646	0.475-0.485	0.317-0.323	14
0.470	0.621-0.633	0.466-0.474	0.311-0.316	14

Table E.6 (amendment—continued)

Tensile Test Specimen				Minimum Elongation in 2.0 in. %
				Grade
				M125
Specimen Area in. ²	Specified Wall Thickness mm			Specified Minimum Tensile Strength ksi
	Specimen Width ¾ in.	Specimen Width 1 in.	Specimen Width 1½ in.	
1	2	3	4	130
0.460	0.607-0.620	0.455-0.465	0.304-0.310	13
0.450	0.594-0.606	0.446-0.454	0.297-0.303	13
0.440	0.580-0.593	0.435-0.445	0.290-0.296	13
0.430	0.567-0.579	0.426-0.434	0.284-0.289	13
0.420	0.554-0.566	0.415-0.425	0.277-0.283	13
0.410	0.541-0.553	0.406-0.414	0.271-0.276	13
0.400	0.527-0.540	0.395-0.405	0.264-0.270	13
0.390	0.514-0.526	0.386-0.394	0.257-0.263	13
0.380	0.500-0.513	0.375-0.385	0.250-0.256	13
0.370	0.487-0.499	0.366-0.374	0.244-0.249	13
0.360	0.474-0.486	0.355-0.365	0.237-0.243	13
0.350	0.461-0.473	0.346-0.354	0.231-0.236	13
0.340	0.447-0.460	0.335-0.345	0.224-0.230	13
0.330	0.420-0.433	0.315-0.325	0.210-0.216	13
0.320	0.420-0.433	0.315-0.325	0.210-0.216	13
0.310	0.407-0.419	0.306-0.314	0.204-0.209	13
0.300	0.394-0.406	0.295-0.305	0.197-0.203	12
0.290	0.381-0.393	0.286-0.294	0.191-0.196	12
0.280	0.367-0.380	0.275-0.285	0.184-0.190	12
0.270	0.354-0.366	0.266-0.274	0.177-0.183	12
0.260	0.340-0.353	0.255-0.265	0.170-0.176	12
0.250	0.327-0.339	0.246-0.254	0.164-0.169	12
0.240	0.314-0.326	0.235-0.245	0.157-0.163	12
0.230	0.301-0.313	0.226-0.234	0.151-0.156	12
0.220	0.287-0.300	0.215-0.225	0.144-0.150	12
0.210	0.274-0.286	0.206-0.214	0.137-0.143	12
0.200	0.260-0.273	0.195-0.205	0.130-0.136	11
0.190	0.247-0.259	0.186-0.194	0.124-0.129	11
0.180	0.234-0.246	0.175-0.185	0.117-0.123	11
0.170	0.221-0.233	0.166-0.174	0.111-0.116	11
0.160	0.207-0.220	0.155-0.165	0.104-0.110	11

Table E.6 (amendment—continued)

Tensile Test Specimen				Minimum Elongation in 2.0 in. %
				Grade
				M125
Specimen Area in. ²	Specified Wall Thickness mm			Specified Minimum Tensile Strength ksi
	Specimen Width $\frac{3}{4}$ in.	Specimen Width 1 in.	Specimen Width $1\frac{1}{2}$ in.	
1	2	3	4	
0.150	0.194-0.206	0.146-0.154	0.097-0.103	130
0.140	0.180-0.193	0.135-0.145	0.090-0.096	13
0.130	0.167-0.179	0.126-0.134	0.084-0.089	11
0.120	0.154-0.166	0.115-0.125	0.077-0.083	11
0.110	0.141-0.153	0.106-0.114	0.071-0.076	10
0.100	0.127-0.140	0.095-0.105	0.064-0.070	10
0.090	0.114-0.126	0.086-0.094	0.057-0.063	9.5
0.080	0.100-0.113	0.075-0.085	0.050-0.056	9.5

Table E.11—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grade L80 (All Types)

Delete Table E.11

Table E.12—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grade C90

Delete Table E.12

Table E.13—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grades N80 Type 1, N80Q, R95, and T95

Delete Table E.13

Table E.14—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grade P110

Delete Table E.14

Table E.15—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grade Q125

Delete Table E.15

Table E.16—Transverse Charpy Absorbed Energy Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material

Delete Table E.16

Table E.17—Longitudinal Charpy Absorbed Energy Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material

Delete Table E.17

Table E.18—Transverse Charpy Absorbed Energy Requirements for Pipe

Delete Table E.18

Table E.19—Longitudinal Charpy Absorbed Energy Requirements for Pipe

Delete Table E.19

Table E.23—Dimensions and Masses for Standard Casing and for Casing Threaded with API Round Thread and Buttress Thread

Delete rows shown with strikethrough font (standard drift diameters for Labels "7, 23.00", "7, 32.00", "9 5/8, 53.50", "11 3/4, 60.00", "11 3/4, 65.00", and "13 3/8, 72.00")

In column 7, replace reference to footnote e with reference to footnote h (alternative drift diameter for Labels "7, 23.00", "7, 32.00", "9 5/8, 53.50", "11 3/4, 60.00", "11 3/4, 65.00", and "13 3/8, 72.00")

Add rows Labels "7, 29.00", "7, 38.00", "7 5/8, 45.30", "9 5/8, 43.50", and "10 3/4, 65.70" (new alternative drift diameters)

Add footnote h

Labels ^a		Outside Diameter	Nominal Linear Mass T&C ^{b, c}	Wall Thickness	Inside Diameter	Drift Diameter	Calculated Mass ^c				
							Plain-end	e_m , Mass Gain or Loss Due to End Finishing ^d			
								Round Thread		Buttress Thread	
		<i>D</i> in.	lb/ft	<i>t</i> in.	<i>d</i> in.	in.	<i>W_{pe}</i> lb/ft	Short	Long	RC	SCC
1	2	3	4	5	6	7	8	9	10	11	12
7	23.00	7	23.30	0.317	6.366	6.241	22.65	13.80	17.51	18.26	1.27
7	32.00	7	32.20	0.453	6.094	5.969	31.70	—	13.74	14.11	-2.88
9 5/8	53.50	9.625	53.50	0.545	8.535	8.379	52.90	—	23.30	21.86	-2.70
11 3/4	60.00	11.750	60.00	0.489	10.772	10.616	58.87	22.42	—	28.93	—
11 3/4	65.00	11.750	65.00	0.534	10.682	10.526	64.03	—	—	—	—
13 3/8	72.00	13.375	72.00	0.514	12.347	12.191	70.67	23.91	—	30.83	—
7	23.00	7.00	23.30	0.317	6.366	6.250 ^h	22.65	13.80	17.51	18.26	1.27
7	32.00	7.00	32.20	0.453	6.094	6.000 ^h	31.70	—	13.74	14.11	-2.88
9 5/8	53.50	9.625	53.50	0.545	8.535	8.500 ^h	52.90	—	23.30 23.44 ^f	21.86	-2.70
11 3/4	60.00	11.750	60.00	0.489	10.772	10.625 ^h	58.87	21.54	—	28.93	—
11 3/4	65.00	11.750	65.00	0.534	10.682	10.625 ^h	64.03	—	—	—	—
13 3/8	72.00	13.375	72.00	0.514	12.347	12.250 ^h	70.67	23.91 24.05 ^f	—	30.83	—
7	29.00	7.00	29.30	0.408	6.184	6.150	28.75	—	14.97	15.46	-1.52
7	38.00	7.00	37.70	0.540	5.920	5.875	37.29	—	11.41	11.55	-5.44
7 5/8	45.30	7.625	45.30	0.595	6.435	6.375	44.71	—	10.74	11.05	-3.36
9 5/8	43.50	9.625	43.50	0.435	8.755	8.625	42.73	—	28.17 28.31 ^f	26.78	2.23
10 3/4	65.70	10.750	65.70	0.595	9.560	9.500 ^h	64.59	16.63 16.75 ^f	—	21.47 21.47	—

^h Unless otherwise specified, these tubulars shall be provided with the drift diameters indicated and the alternative drift diameter marked on the pipe.

Table E.28—Standard Drift SizeAdd footnote c
^c "Alternative" or "Standard" drift shall be specified. See 8.10 for drift requirements.
Table E.29—Alternative Drift SizeAdd rows Labels "7, 29.00", "7, 38.00", "7 5/8, 45.30", "9 5/8, 43.50", and "10 3/4, 65.70"

Labels		Pipe Outside Diameter D in.	Nominal Linear Mass, T&C lb/ft	Alternative Drift Mandrel Size in. min	
1	2			Length	Diameter
1	2	3	4	5	6
7	29.00	7.00	29.30	12	6.125
7	38.00	7.00	37.70	12	5.875
7 5/8	45.30	7.625	45.30	12	6.375
9 5/8	43.50	9.625	43.50	12	8.625
10 3/4	65.70	10.750	65.70	12	9.500

Table E.30—Maximum Permissible Depth of Linear ImperfectionsReplace Table E.30 with

Grade	Depth as % of Specified Wall Thickness	
	External Imperfections	Internal Imperfections
N80 Type 1	10.0 %	10.0 %
Grade H40, J55, K55 and N80Q	12.5 %	12.5 %
SL-B: Grades L80 Type 1, L80 1Cr and R95 (excluding R95LS)		
SL-A: Grades L80 Type 1, L80 1Cr and R95	Linear imperfection shall be ≤ Notch Depth given on Table E.44 based on the applicable acceptance (inspection) level for the grade and SL in Table E.43.	Linear imperfection shall be ≤ Notch Depth given on Table E.44 based on the applicable acceptance (inspection) level for the grade and SL in Table E.43.
Grades C90, T95, P110, C110, M125, Q125 and variant grades		

Table E.31—Upset Products—Maximum Permissible Depth of Imperfections

Replace rows A.1 and A.2 with

	Specification Level	Surface	Depth	Measurement Notes
A Integral Joint and External Upset Tubing (see Figure D.5 and Figure D.7)				
A.1	SL-B	When SL-B is specified, all surfaces of upset and upset runout interval, except as stated in row A.2	12.5 % t	Percentage of specified pipe body wall thickness t ; for nonlinear imperfections; for all grades of pipe.
			12.5 % t	Percentage of specified pipe body wall thickness t ; for linear imperfections; for Grades H40, J55, K55, L80 (all types), N80 (all types) and R95.
			5 % t	Percentage of specified pipe body wall thickness t ; for linear imperfections; for all grades except base grades H40, J55, K55, L80 (all types), N80 (all types) and R95.
	SL-A	When SL-A is specified, all surfaces of upset and upset runout interval, except as stated in row A.2	12.5 % t	Percentage of specified pipe body wall thickness t ; for nonlinear imperfections; for all grades of pipe.
			5 % t	For all grades, percentage of specified pipe body wall thickness t ; for linear imperfections.
A.2 The minimum wall thickness in the upset run-out interval, and the maximum combined effect of coincident internal and external imperfections in all areas, shall not result in net wall thickness less than the minimum allowable pipe body wall thickness, which is 87.5 % of the specified wall thickness or below the alternative specified minimum wall thickness, as per 8.11.2				

Table E.36—Permissible Depth of External Imperfections on Coupling

In column 5 heading, replace "Grades C90, T95, C110, and Q125" with "Grades C90, T95, C110, M125, and Q125"

Add footnote b

Coupling for Label 1		Grades H40, J55, K55, N80 (All Types), R95, L80 (All Types), and P110		Grades ^b C90, T95, C110, M125, and Q125
		Pits and Round-bottom Gouges in.	Grip Marks and Sharp-bottom Gouges in.	Pits, Round-bottom Gouges, Sharp-bottom Gouges, Grip Marks in.
1	2	3	4	5

^b Variant Grades R95LS and P110LS are categorized within this grouping.

Table E.37—Frequency of Tensile Tests—Casing and Tubing

In column 1, replace "C110" with "C110, M125"

Grade ^e	Label 1	Maximum Number of Pieces in a Lot	Number of Tests	
			per Lot	per Heat
1	2	3	4	5
C110, M125	All sizes	100 ^{b, d}	1	—

Table E.38—Frequency of Tensile Tests—Coupling Stock, Coupling Material, and Coupling Blanks

In column 1, replace "C110 and Q125" with "C110, M125 and Q125"

Grade	Material	Condition when Heat-treated	Maximum Number of Pieces in a Lot	Number of Tests	
				per Lot	per Heat
1	2	3	4	5	6
C110, M125 and Q125	Coupling stock and coupling material	Coupling stock and coupling material for pipe Label 1: All sizes	1 ^b	1	—
		Coupling blank	Label 1: < 9 5/8: 50 ^c Label 1: ≥ 9 5/8: 30 ^c	1	—

Table E.39—Frequency of Tensile Testing—Pup Joints and Accessory Material

In column 1, replace "C110 and Q125" with "C110, M125 and Q125"

In footnote c, add "and M125" after "Q125"

Grade	Material and Heat Treatment Conditions ^a		Maximum Number of Pieces in a Lot	Number of Tests	
				per Lot	per Heat
1	2	3	4	5	6
C110, M125 and Q125	Full-length standard tubing or casing from one or more heats		In accordance with 10.2.3	3 ^{a, b}	—
	Thick-wall mechanical tube or bar stock from a single heat		1	1 ^a	—
	Heat-treated in individual lengths or hot forgings	Batch heat treatment	Label 1: < 9 5/8: 50 ^c Label 1: ≥ 9 5/8: 30 ^c	1	—
		Heat-treated in sequential loads or continuous heat treatment	Label 1: < 9 5/8: 50 ^c Label 1: ≥ 9 5/8: 30 ^c	1	—

^c Each lot shall be from the same heat of steel for Grades L80 9Cr, L80 13Cr, C90, T95, C110, Q125 and M125. See 10.2.3.

Table E.40—Frequency of Hardness Testing

In column 1, replace Grade "C110" with "C110 and M125"

Add row Grades "C110 and M125, Material Upset pipe"

Add row "Variant Grades R95LS and P110LS"

Add footnote e

Add footnote f

Add footnote g

Add footnote h

Grade ^f	Material		Number of Tests per Lot	Maximum Number of Pieces in a Lot	Type of Test	Location
1	2		3	4	5	6
Variant Grades ^f R95LS and P110LS	Non-upset pipe Grade R95LS		1	50	Through-wall, 1 quadrant	Approximately 50 % from each end ^h
	Non-upset pipe Grade P110LS		1	25	Through-wall, 1 quadrant	Approximately 50 % from each end ^h
	Coupling blanks, coupling stock, coupling material, pup joints and accessory material	Tube-length heat treatment	2 ^a	10	Through-wall, 4 quadrants	One from each end
		Individual heat treatment	1	10	Surface—HRC or HBW	Each piece
			1	Label 1: < 9 5/8: 50 ^c Label 1: ≥ 9 5/8: 30 ^c	Through-wall, 4 quadrants	From a piece with the highest surface hardness number in the lot
Grades C110 ^e and M125 ^e	Upset pipe ^g		1 ^g	Each length	Surface—HRC or HBW	Pipe body and one upset ^d
			1 ^g	20 ^c	Through-wall, 4 quadrants	One upset
			1 ^g	Label 1: ≥ 4 1/2: 100	Through-wall, 4 quadrants	Pipe body tensile test

^e If a process control plan has been applied which has demonstrated that it ensures that the entire length of the pipe has homogeneous hardness properties, the testing frequency for Grades C110 and M125 may be reduced to the frequency applicable for Grades C90 and T95.

^f When a variant grade requiring SSC testing has been specified, the hardness testing is as per the base grade given in Table 18, with the exception of the R95LS (A or D) and the P110LS (A or D) that are given in this table.

^g Upset pipe in T95EN, C110 or M125 grade requires PPQ completion; the number of tests per lot shall be as agreed as an output of PPQ but no fewer than one per lot.

^h For single specimens on a per lot frequency, alternating ends through the heat shall be sampled.

Table E.41—Frequency of Flattening Tests

In column 1 "Casing and Tubing" and "Pup Joints" sections, replace "H40, J55, K55, N80 (all types), L80 Type 1, R95, P110" with "H40, J55, K55, N80 (all types), L80 Type 1, R95"

In column 1, "Casing and Tubing" and "Pup Joints" sections, replace "Q125" with "P110, Q125"

Casing and Tubing
Grade
1
H40, J55, K55, N80 (all types), L80 Type 1, R95
P110, Q125
Pup Joints
Grade
1
H40, J55, K55, N80 (all types), L80 Type 1, R95
P110, Q125

Table E.42—Summary of NDE Methods for Seamless Pipe, Coupling Stock, Body of Welded Pipe, and Accessory Material (In Accordance with 10.15.11)*Replace Table E.42 with*

Product	Grade	Specification Level ^e	Requirement						
			Visual Inspection (see 10.14)	Wall Thickness		Ultrasonic Inspection	Electromagnetic Inspection Methods		Magnetic Particle Inspection ^a
				Manual Point Inspection (see 10.13.4)	Coverage of Automated Equipment		Flux Leakage Inspection	Eddy Current Inspection	
1	2	2a	3	4a	4b	ISO 10893-10 or ASTM E213	ISO 10893-3 or ASTM E570	ISO 10893-2 or ASTM E309	ISO 10893-5 or ASTM E709
Pipe	H40	SL-B	R	P	N	N	N	N	N
	J55, K55	SL-B		P	N	N	N	N	N
		SL-A		N	25 %	A	A	A	A
	N80 (all types)	SL-B			HL	A	A	A	A
		SL-B			HL	A	A	A	A
	L80 Type 1, L80 1Cr, R95	SL-A			100 %				
	R95LS	SL-B			25 %	A	A	A	NA
		SL-A			100 %	C	N	N	N
	L80 13Cr, P110	SL-B for L80 13Cr and P110			25 %	A	A	A	NA
		SL-B for P110LS and P125			25 %	A	A	A	NA
		SL-B for P110UC and P125UC			100 %	C	N	N	NA
		SL-A			100 %	C	B	B	B
	C90, T95, Q125	SL-B			25 %	C	B	B	B
		SL-A			100 %				
	C110, M125	SL-A			100 %	C	B	B	B

Table E.42 (continued)

Product	Grade	Specification Level ^e	Requirement						
			Visual Inspection (see 10.14)	Wall Thickness		Ultrasonic Inspection	Electromagnetic Inspection Methods		Magnetic Particle Inspection ^a
				Manual Point Inspection (see 10.13.4)	Coverage of Automated Equipment		Flux Leakage Inspection	Eddy Current Inspection	
1	2	2a	3	4a	4b	5	6	7	8
Coupling stock and accessory material	H40	SL-B	R	P	N	N	N	N	N
	J55, K55	SL-B		P	N	N	N	N	N
		SL-A		N ^c	HL ^{c, d}	A	A	A	A
	N80 all types, L80 Type 1, L80 1Cr, R95	SL-B			HL ^{c, d}	A	A	A	A
		SL-A				A	A	A	A
	L80 13Cr, C90, R95LS, T95, P110, Q125, C110, M125	SL-B ^c			HL ^{c, d}	A	A	A	A
		SL-A				C	A	A	A
Weld seam	H40, J55, K55, N80 (all types), L80 Type 1, R95	SL-B and SL-A – J55, K55	R	N	N	A	A	A	NA
		SL-A – L80 Type 1, R95			N	C	N	N	NA
	P110 ^b , P125 ^b , Q125 ^b	SL-B	R	N	N	C	N	N	NA

Table E.42 (continued)

Product	Grade	Specification Level ^e	Requirement						
			Visual Inspection (see 10.14)	Wall Thickness		Ultrasonic Inspection	Electromagnetic Inspection Methods		Magnetic Particle Inspection ^a
				Manual Point Inspection (see 10.13.4)	Coverage of Automated Equipment		Flux Leakage Inspection	Eddy Current Inspection	
						ISO 10893-10 or ASTM E213	ISO 10893-3 or ASTM E570	ISO 10893-2 or ASTM E309	ISO 10893-5 or ASTM E709
1	2	2a	3	4a	4b	5	6	7	8
Key N = Not required NA = Technique not applicable R = Required A = One method or any combination of methods shall be used. B = At least one method shall be used in addition to ultrasonic inspection in accordance with Table C.43 and Table E.43. C = Ultrasonic inspection shall be used in accordance with Table C.43 and Table E.43. HL = Wall thickness verified in a helical or longitudinal path over the full length, excluding end areas not covered by automated systems P = Wall thickness measurement at discrete point(s) in alignment with 10.13.14									
^a MPI is permitted for end-area inspection; MPI is permitted for pipe-body outside-surface inspection in combination with other methods of pipe body inspection; MPI is permitted for coupling stock outside surface inspection; coupling stock receiving full-length MPI does not require full-length wall thickness verification, however, mechanical wall thickness measurement of each end is required. ^b Electric welded tubulars of Grade P110, P125 and Q125 shall only be specified at SL-B with SR11 included. ^c For accessory material, wall thickness shall be measured at discrete point(s) in alignment with 10.13.4 unless full length wall thickness verification is specified. If wall thickness verification is specified, accessory material shall have the wall thickness verified in a helical or longitudinal path over the full length, excluding end areas not covered by automated systems. ^d Coupling stock requires HL wall thickness verification by the automated system. For wall ultrasonic inspection, minimum of 25 % coverage for Grades L80 13Cr, C90, R95LS, T95, P110 and Q125 at SL-A, and 100 % coverage for Grades C110 and M125. ^e Not all grades are available at both SLs and the presence of the SL in this table does not imply that the products are available through IOGP S-735D.									

Table E.43—Acceptance (Inspection) Levels*Replace Table E.43 with*

Material	Grade	Specification Level ^f	Method	External Imperfections ^{d, e}		Internal Imperfections ^{d, e}		Through Wall
				Longitudinal	Transverse	Longitudinal	Transverse	
1	2	2a	4	5	6	7	8	9
Pipe body ^{a, c}	H40	SL-B	—	—	—	—	—	—
	J55, K55	SL-B	—	—	—	—	—	—
		SL-A	A	L4	—	L4	—	—
	N80 Type 1	SL-B	A	L3	—	L3	—	—
	N80 Q		A	L4	—	L4	—	—
	L80 Type 1, L80 1Cr, R95	SL-B	A	L4	—	L4	—	—
		SL-A	A	L2	L2	L2	L2	—
	R95LS	SL-B	A	L2	L2	L2	L2	—
		SL-A	C	L2	L2	L2	L2	—
	L80 13Cr, P110	SL-B excludes P110UC and P125UC	A	L2	L2	L2	L2	—
		SL-B - P110UC, P125UC	C	L2	L2	L2	L2	—
		SL-A	C	L2	L2	L2	L2	—
			B	L2	L2	—	—	—
	C90, T95	SL-B or SL-A	C	L2	L2	L2	L2	—
			B	L2	L2	—	—	—
	C110, M125	SL-A	C	L2	L2	L2	L2	—
			B	L2	L2	—	—	—
	Q125	SL-A or SL-B	C	L2	L2	L2	L2	—
			B	L2	L2	—	—	—

Table E.43 (continued)

Material	Grade	Specification Level ^f	Method	External Imperfections ^{d, e}		Internal Imperfections ^{d, e}		Through Wall
				Longitudinal	Transverse	Longitudinal	Transverse	
1	2	2a	4	5	6	7	8	9
Coupling stock ^c and accessory material ^c	H40	SL-B	—	—	—	—	—	—
	J55, K55	SL-B	—	—	—	—	—	—
		SL-A	A	L4	—	—	—	—
	N80 all types, L80 Type 1, L80 1Cr, R95	SL-B	A	L2	L2	—	—	—
		SL-A	A	L2	L2	—	—	—
	L80 13Cr, C90, R95LS, T95, P110, Q125	SL-B	A	L2	L2	—	—	—
		SL-A	A	L2	L2	—	—	—
			C	—	—	L3	L3	L2 ^g
	C110, M125	SL-A	A	L2	L2	—	—	—
			C	—	—	L3	L3	L2 ^g
Weld seam	H40, J55, K55, N80 (all types), L80 Type 1, R95	SL-B and SL-A – J55 and K55	A	L3	—	L3	—	—
		SL-A – L80 Type 1, R95	C	L2	—	L2	—	—
	P110 ^b , P125 ^b , Q125 ^b	SL-B	C	L2	—	L2	—	—

Key

— = Not applicable

L_x = Acceptance (inspection) level

A = One method or any combination of methods shall be used in accordance with Table C.42 and Table E.42.

B = At least one method shall be used in addition to ultrasonic inspection in accordance with Table C.42 and Table E.42.

C = Ultrasonic inspection shall be used in accordance with Table C.42 and Table E.42.

Table E.43 (continued)

Material	Grade	Specification Level ^f	Method	External Imperfections ^{d, e}		Internal Imperfections ^{d, e}		Through Wall
				Longitudinal	Transverse	Longitudinal	Transverse	
1	2	2a	4	5	6	7	8	9
^a Pup joints shall be inspected like pipe body. ^b Electric welded tubulars of grade P110, P125 and Q125 shall only be specified at SL-B with SR11 included. ^c Oblique inspection to acceptance level L2 when the manufacturer determines their products require this inspection in accordance with 10.15.4.2 e) or when SR 41.2 is specified. ^d When alternative wall tolerance for pipe of 10 % has been specified, acceptance (inspection) level L4 shall be replaced with L3 for internal and external imperfections. ^e When alternative wall tolerance for pipe of 7.5 % or 5 % has been specified, acceptance (inspection) level L2 shall be used for internal and external imperfections. ^f Not all grades are available at both SLs and the presence of the SL in this table does not imply that the products are available through IOGP S-735D. ^g For wall ultrasonic inspection, minimum of 25 % coverage for grades L80 13Cr, C90, R95LS, T95, P110 and Q125 at SL-A, and 100 % coverage for grades C110 and M125.								

Table E.44—Artificial Reference IndicatorsAdd column 1a "Specification Level"Replace column 3 "Notch Length Maximum at Full Depth"Add column 6 "Flat Bottom Hole Diameter"Replace footnote bAdd footnote cAdd footnote dAdd footnote eDelete NOTE

Acceptance (Inspection) Level	Specification Level	Notch Depth ^a Maximum %	Notch Length ^d Maximum at Full Depth in.	Notch Width Maximum in.	Radially Drilled Hole Diameter ^b in.	Flat Bottom Hole Diameter ^c in.
1	1a	2	3	4	5	6
L2	SL-B	5	2.0	0.040	1/16	1/4
	SL-A		1.0			
L3	SL-B	10	2.0	0.040	1/8	NA
	SL-A		1.0			
L4	SL-B	12.5	2.0	0.040	1/8	NA
	SL-A		1.0 ^e			

^b Radially drilled hole diameter (through the pipe wall), as shown on Figure D.16 c), shall be based on the drill bit size.^c Flat bottom hole shall be of a dimension such that a minimum of 90 % of specified wall thickness remains below with a tolerance of ± 1.5 %. See 10.15.12.4 and Figure D.16.^d For SL-B eddy current, 1.5 in. maximum total length.^e For J55 and K55, when specified as SL-A, notch length may be extended to 2.0 in.

Table E.46—Grade Color Codes

Add rows Grades "L80, Type 1Cr" and "M125, Type —"

Add footnote d

Add footnote e

Grade	Grade Type	Number and Color of Bands for Product ^{a, d, e} with Length ≥ 1.8 m	Color(s) for Couplings	
			Entire Coupling	Band(s) ^{b, c, e}
1	2	3	4	5
L80	1Cr	One red, one brown, two orange	Red	One brown, two orange
M125	—	One orange, one brown	Orange	Brown

^d UC grades shall also have two blue bands on the product body.

^e Variant grade color bands shall be applied on product body and couplings as follows:

- LS variant grades- in addition to the base grade banding, an additional purple band shall be applied.
- E variant grades- in addition to the base grade banding, an additional yellow band shall be applied.
- RY variant grades- in addition to the base grade banding, an additional pink band shall be applied.
- If multiple variant grades apply, apply all the bands stated above (e.g. UCRY).

Table E.48—Marking Requirements and Sequence

Delete footnote g

In heading row, replace "Grades L80 (All Types), C90, T95, C110, and Q125" with "Grades L80 (All Types), C90, T95, C110, Q125, and M125"

In row 4, add "or E.59" after "Table E.1, E.2"

In row 5, add "or E.59" after "Table E.1, E.2"

In row Marking Sequence "11, — K.14 (SR 41)", add Mark "S41.3"

Add rows 18, 19, 20, 21, 22 and 23

Replace footnote f

Marking Sequence		Mark or Symbol ^b	Stencil and/or Stamp Marking Requirements ^a				
			Grades H40, J55, K55, N80 (All Types), R95, and P110		Grades L80 (All Types), C90, T95, C110, M125, and Q125		All Grades
			Pipe	Couplings and Accessories	Pipe	Couplings and Accessories	Coupling Stock and Accessory Materials
1	2	3	4	5	6	7	8
4	Size designation (fill in Label 1 designation from Column 1 of Table E.1, E.2 or E.59)	«....»	P		P		
	Specified diameter for coupling stock and other products with no mass designation						P
5	Mass designation (fill in Label 2 designation from Table E.1, E.2 or E.59)	«....»	D or P		P		
	Specified wall thickness for coupling stock and other products with no mass designation						P

Table E.48 (amendments—continued)

Marking Sequence		Mark or Symbol ^b	Stencil and/or Stamp Marking Requirements ^a				
			Grades H40, J55, K55, N80 (All Types), R95, and P110		Grades L80 (All Types), C90, T95, C110, M125, and Q125		All Grades
			Pipe	Couplings and Accessories	Pipe	Couplings and Accessories	Coupling Stock and Accessory Materials
1	2	3	4	5	6	7	8
11	— K.14 (SR 41)	S41.1 S41.2 S41.3	P P P		P P P		
18	— Annex P uprated collapse variant grade (fill in claimed rating in psi)	UC <----->	P		P		
19	IOGP S-735 product designation (specification level)	S735A or S735B	P	D or P	P	P	P
20	Alternative wall thickness tolerance	BW10 BW7.5 BW5	P P P		P P P		
21	Variant grade of product and sulfide cracking test ^f (if applicable):		D or P	D or P	P	P	P
	Variant grades of R95 — R95LS (A or D)	R95LS-A or R95LS-D					
	Variant grades of L80 Type 1 — L80 Type 1Cr	L1CR					
	Variant grades of C90 Type 1 — C90 (A-80 %) — C90 (A-90 %) — C90 (D)	C90-A80 C90-A90 C90-D					

Table E.48 (amendments—continued)

Marking Sequence		Mark or Symbol ^b	Stencil and/or Stamp Marking Requirements ^a				
			Grades H40, J55, K55, N80 (All Types), R95, and P110		Grades L80 (All Types), C90, T95, C110, M125, and Q125		All Grades
			Pipe	Couplings and Accessories	Pipe	Couplings and Accessories	Coupling Stock and Accessory Materials
1	2	3	4	5	6	7	8
21 (continued)	Variant grades of T95 Type 1 — T95UC — T95 (A-80 %) — T95 (A-90 %) — T95 (D) — T95EN (A, D or AD)	T95UC-A80 or T95UC-A90 or T95UC-D T95-A80 T95-A90 T95-D T95EN-A or T95EN-D or T95EN-AD	D or P	D or P	P	P	P
	Variant grades of C110 — C110UC (A, D) — C110 (A, D) — C110EN (A, D or AD)	C110UC-A or C110UC-D C110-A or C110-D C110EN-A or C110EN-D or C110EN-AD					
	Variant grades of P110 — P110LS (A or D) — P110UC — P125 — P125UC	P110LS-A or P110LS-D P110UC P125 P125UC					
	Variant grades of M125 — M125 (A, D or AD) — M125EN (A, D or AD) — M125UC (A, D or AD)	M125-A or M125-D or M125-AD M125EN-A or M125EN-D or M125EN-AD M125UC-A or M125UC-D or M125UC-AD					

Table E.48 (amendments—continued)

Marking Sequence		Mark or Symbol ^b	Stencil and/or Stamp Marking Requirements ^a				
			Grades H40, J55, K55, N80 (All Types), R95, and P110		Grades L80 (All Types), C90, T95, C110, M125, and Q125		All Grades
			Pipe	Couplings and Accessories	Pipe	Couplings and Accessories	Coupling Stock and Accessory Materials
1	2	3	4	5	6	7	8
21 (continued)	Variant grades of Q125 Type 1 — Q125RY — Q125UC — Q125UCRY — Q130 — Q130RY — Q135UC — Q140	Q125RY Q125UC Q125UCRY Q130 Q130RY Q135UC Q140	D or P	D or P	P	P	P
	All grade designations						
22	Length of finished tubular	<<X.xx>> ft	P		P		P
23	Purchaser's purchase order number	PO <<xxxxxx>>	P	D or P	P	P	P
^f In alignment with Table 20 "(A)" when tested using Method A (smooth tensile), in alignment with Table 21 "D" when tested using Method D (DCB) and in alignment with Table 20 and Table 21 "(AD)" when tested using both Method A and Method D.							

Table E.49—Retention of Records

In "Mechanical Properties" section, replace "Grain size (Grades C90, T95 and C110)" with "Grain size (Grades that require SSC testing in accordance with Table 20 or Table 21) "

In "Mechanical Properties" section, add row "Up-rated collapse testing"

Replace section title "Hydrostatic Tests" with "Hydrostatic and Other Tests"

In "Hydrostatic and other Tests" section, add new rows for supplemental inspections

In "Manufacturer Certification" section, replace "Sulfide stress-cracking test (Grades C90, T95 and C110)" with "Sulfide stress-cracking test (Grades requiring SSC test in accordance with Table 20 or Table 21)"

Requirement	Sub-section Reference
Mechanical Properties	
Grain size (Grades requiring SSC test in accordance with Table 20 or Table 21)	7.11, 10.8
Up-rated collapse testing	P.2
Hydrostatic and other Tests	
Supplemental inspection(s) when hydrostatic test pressure is limited, if applicable	
— when the purchaser specifies SR 41.1 for wall thickness verification to 100 %	K.14.1 (SR 41.1)
— when oblique notches/inspection is specified via SR 41.2	K.14.2 (SR 41.2)
— when additional hardness testing is specified via SR 41.3	K.14.3 (SR 41.3)
Manufacturer Certification	
Sulfide stress-cracking test (Grades requiring SSC test in accordance with Table 20 or Table 21)	7.14, 10.10

Add new Table E.59

Table E.59—Non-Standard Size or Wall Tubulars

OD^d / Label 1	Nominal Linear Mass^{a, b} T&C lb/ft	Wall Thickness <i>t</i> in.	Drift Diameter^c in.
1	2	3	4
4.500	26.10	0.630	3.115
5.500	26.00	0.476	4.423
6.000	25.10	0.415	5.045
6.625	34.50	0.525	5.450
7.000	41.00	0.590	5.695
7.625	59.20	0.812	5.876
8.625	44.00	0.500	7.500
9.375	39.00	0.400	8.500
9.875	62.80	0.625	8.500
9.875	65.30	0.650	8.500
9.875	66.90	0.688	8.500
9.875	67.50	0.678	8.500
9.875	68.90	0.700	8.500
10.000	68.70	0.688	8.500
10.125	79.75	0.800	8.500
10.175	81.00	0.800	8.500
10.750	85.30	0.797	9.000
10.875	72.00	0.656	9.500
11.875	71.80	0.582	10.625
13.625	88.20	0.625	12.250
13.875	106.00	0.755	12.250
14.000	82.50	0.562	12.689
14.000	106.00	0.750	12.313
14.000	113.00	0.797	12.250
14.000	114.00	0.800	12.250
14.000	115.00	0.812	12.250
14.000	116.00	0.820	12.250
16.000	95.00	0.566	14.750
16.000	97.00	0.575	14.750
16.000	104.00	0.625	14.562
16.000	118.00	0.715	14.382
16.100	110.50	0.667	14.600
16.150	120.50	0.723	14.625
16.150	128.00	0.772	14.525

Table E.59 (continued)

OD ^d / Label 1	Nominal Linear Mass ^{a, b} T&C lb/ft	Wall Thickness <i>t</i> in.	Drift Diameter ^c in.
1	2	3	4
18.000	94.00	0.500	16.813
18.000	105.00	0.562	16.689
18.000	117.00	0.625	16.563
18.000	127.00	0.688	16.436
18.625	94.50	0.468	17.518
18.625	96.50	0.485	17.500
18.625	97.70	0.486	17.466
18.625	114.00	0.579	17.280
18.625	136.00	0.693	17.052

^a Nominal linear masses (Column 2) are shown for information only.

^b The densities of martensitic chromium steels (L80 Type 13Cr) are different from carbon steels. The masses shown are therefore not accurate for martensitic chromium steels. A mass correction factor of 0.989 may be used.

^c Drift lengths shall be as per Table E.28 based on casing or tubing service.

^d In accordance with Table 13, the plus tolerance on OD for casing may be proposed to be increased.

Add new Table E.60**Table E.60—Charpy V-Notch Testing Minimum Absorbed Energy Values—Full Size 0.4 in. x 0.4 in. Specimen**

Grade	Average Minimum ^{a, b} Absorbed Energy Requirement ^{c, e} for SL-B products for Coupling Stock, Coupling Material, Coupling Blanks, and Couplings (pipe)		Average Minimum ^{a, b} Absorbed Energy Requirement ^{c, e} for SL-A ^g products
	(ft pounds)		(ft pounds)
	Transverse	Longitudinal	Transverse and Longitudinal
1	2	3	4
J55 ^f	15 (15 SR16 only)	20 (20 SR16 only)	30
K55 ^f	15 (15 SR16 only)	20 (20 SR16 only)	30
N80 (all types)	15 (15)	30 (30)	-
L80 (all types except 13Cr)	20 (15)	40 (30)	44 ^h
L80 13Cr ^d	20 (15)	40 (30)	26 or SL-B value, whichever is greater
C90	20 (15)	40 (30)	44 ^h
T95, R95	20 (15)	40 (30)	44 ^h
P110	20 (20)	40 (38)	44 ^h
C110	-	-	44 ^h
M125	-	-	44 ^h
P125, Q125	25 (25)	50 (40)	50 ^h

^a Values given in this table are the average minimums. Minimum individual values shall be at least $\frac{2}{3}$ of the average value as per 7.3.1.
^b Hierarchy for impact specimen size, reduction factors and specimen orientation shall be in accordance with Table E.8 and Table E.9.
^c For products (with the exception of L80 13Cr) with wall thicknesses > 2.5 in., these minimum absorbed energy criteria shall be by agreement.
^d For L80 13Cr products with wall thickness > 1.4 in. these minimum absorbed energy criteria shall be by agreement.
^e Test temperatures shall be specified in accordance with Table 19.
^f Temperature reduction factors in accordance with Table E.10 may be applied.
^g For SL-A grades, SR 16 applies.
^h 75 % minimum shear area applies for SL-A grades except for J55, K55 and L80 13Cr.

In Annex H heading, replace "normative" with "informative"

Replace Annex H title with

Annex H **(informative)**

Summary of Specification Level A and B Requirements above PSL-1

Replace Annex H with

H.1 General

Table H.1 is a reference for SL-A and SL-B requirements that exceed the requirements of API 5CT PSL1.

These incremental requirements are found in the sections or tables of this specification in accordance with the references listed.

Table H.1—Reference Table for Specification Level A and B Requirements*Replace Table H.1 with*

Requirement Description	IOGP S-735 Reference	Grades													
		H40	J55, K55	N80-1, N80-Q	L80-1	L80-1Cr	L80-13Cr	R95	P110, P110UC, P125, P125UC	C90, T95, T95UC, T95EN	C110, C110EN, C110UC	P110LS, R95LS	M125, M125EN, M125UC	Q125	Q125RY, Q125UC, Q125UCRY, Q130, Q130RY, Q135UC, Q140
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Seamless or electric-welded pipe body	C.3 or E.3	S/EW	S/EW	S/EW	S/EW	S	S	S/EW	S/EW	S	S	S	S	S/EW	S
Specification levels offered at grade		B	A/B	B	A/B	A	A/B	A/B	A (S only), B (S/EW)	A/B, T95EN (A only), T95UC (A only)	A	A/B	A	A (S only), B (S/EW)	A
EW tubulars (SR11 included)	6.1 and K.6 (SR11)								B-EW					B-EW	
Heat treatment	6.2.2		A												
Straightening	6.3.2 and 6.3.4								UC A/B	A		A/B			
Traceability/Serialization	6.4.1		A		A	A	A	A	A	1	1	A	1	1	1
Chemical composition reporting	7.1											A/B			
Yield strength limit	7.2.3 and Table C.5 or Table E.5														RY, or > 862 MPa (125 ksi)
Mandatory Charpy testing of pipe	SL-A : 7.5 and K.9 (SR16)		A	*	A	A	A	A	A	A	1	A	1	1	1
Minimum shear area of 75 %	7.3.1				A	A		A	A	A	1	A/B	1	A	A
Charpy test temperature	7.3.7 and Table 19		A												
Charpy values for couplings	Table C.60 or Table E.60		A	1	A/B	A	A/B	A/B	A/B	A/B	A	A/B	A	A/B	A
Charpy values for pipe	Table C.60 or Table E.60		A	B	A/B	A	A/B	A/B	A/B	A/B	A	A/B	1	A/B	A
Statistical impact testing	7.5.5 and K.7 (SR12)													*	*
Maximum hardness	7.7.1.a and Table C.5 or Table E.5				1	1	1			1	1	A/B	1		
Surface hardness	7.7.1.b									1	1	A/B	1		
Harness variation	7.8 and Table C.5 or Table E.5									1	1	A/B	1	1	1
Hardenability for C90, T95, and L80@SL-A	7.10.1 and 10.9				A					1					
Hardenability for C110 and M125	7.10.2										1		1		
Hardenability for LS and EN	7.10.4									T95EN A	C110EN A	A/B	M125EN A		
Grain size	7.11 and 10.8									1	1	A/B	1		
Surface condition for Grade L80 13Cr	7.12						A								

Table H.1 (continued)

Requirement Description	IOGP S-735 Reference	Grades													
		H40	J55 K55	N80-1 N80-Q	L80-1	L80 1Cr	L80-13Cr	R95	P110, P110UC, P125, P125UC	C90, T95, T95UC, T95EN	C110, C110EN, C110UC	P110LS, R95LS	M125, M125EN, M125UC	Q125	Q125RY, Q125UC, Q125UCRY, Q130, Q130RY, Q135UC, Q140
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SSC test and re-test provisions	7.14.2, 10.10, Table 20 and Table 21							*			See Table 20 or Table 21				
Thread surface treatment	8.12.5							A/B				1		1	
Coupling heat treatment	9.2.2 and 9.2.3		A												
Stress-relief temperature	10.4.1									A/B	1	A/B	1		
Hardness testing frequency	10.6.5			*	*			*	*	A	1	A/B	1	*	
Hardness testing of upset pipe	10.6.6.1									1	A	A/B	A		
Hardness testing of non-pipe	10.6.7									1	1	A/B	1		
Metallographic evaluation	10.11		A-EW	*	A-EW			A-EW	1-EW					1-EW	
Alternative hydrostatic test pressures	10.12.2		A												
Wall thickness measurement	10.13.4 and Table C.42 or Table E.42	See Table C.42 or Table E.42													
NDE for imperfections	Table C.43 or Table E.43	See Table C.42 or Table E.42 and Table C.43 or Table E.43													
NDE notch geometry	Table C.44 or Table E.44		A	*	A	A	A	A	A	A	A	A	A	A	A
Inspect weld seam after hydrotest	10.15.10		K55 A-EW												
Magnetic particle inspection of untested ends	10.15.13						A			A	1		1	A	A
Grinding or machining depth for defect removal (5 or 10 %)	10.15.17		A	*	A	A	A	A	A	A	A	A	A	A	A
Stamp marking	11.2				1	1	1	1		1	1	A/B	1	1	1
NOTE End-sizing with or without subsequent thermal recovery and cold rotary or gag press straightening have been added to 6.5.															
Key S = Seamless EW = Welded A = Included within the package of inspection and testing requirements to deliver the SL-A product B = Included within the package of inspection and testing requirements to deliver the SL-B product A-EW = SL-A welded tubular body B-EW = SL-B welded tubular body 1 = Requirement in the body of API 5CT (i.e. PSL-1 requirement) 1-EW = Requirement in the body of API 5CT for welded pipe * = Requirement was in PSL-2 or PSL-3 groupings but is not included within SL-A or SL-B.															

Replace Annex J title with

Annex J **(informative)**

Summary of Specification Level Requirements

Replace Annex J with

J.1 General

This informative annex is provided for the convenience of the user of this specification and identifies the places where additional requirements are detailed when the product is ordered to SL-A or SL-B.

In addition, the following tables are to be cross-referenced:

- Table 20 and Table 21;
- Table C.3, Table C.30, Table C.31, Table C.42, Table C.43, Table C.44 and Table C.60; or
- Table E.3, Table E.30, Table E.31, Table E.42, Table E.43, Table E.44 and Table E.60.

Detailed requirements are given in the sub-sections indicated in square brackets after each item, e.g. "[6.2.2]".

The requirements for SL-A are not additive to the requirements for SL-B.

Requirements apply to the base grade and its variant grades at that SL unless requirements for the variant grade are specifically defined.

Grades H40 and N80 (all types) are only offered at SL-B. See Table 18 for complete list of SL-B grades.

Grades L80 1Cr, and C110, M125 and Q125 variant grades are only offered at SL-A. See Table 18 for complete list of SL-A grades.

J.2 Grades J55 and K55

J.2.1 SL-B

SL-B is equivalent to PSL-1.

J.2.2 SL-A

The following requirements are to be satisfied:

- a) Full-body, full-length heat treatment (after upsetting if applicable) [6.2.2].
- b) Traceability of heat and lot for test results [6.4.1].
- c) Mandatory Charpy V-notch impact testing and requirements [7.4, 7.5, K.9 SR 16, Table C.60 or Table E.60].
- d) Charpy test temperature of 0 °C (+32 °F) [7.3.7].
- e) Mandatory heat treatment of couplings [9.2.2, 9.2.3].

- f) Metallographic examination of the weld zone (EW only) [10.11].
- g) Grade K55 only: inspection of weld seam after hydrotest [10.15.10].
- h) Alternative hydrostatic test pressures for sizes above Label 1: $9 \frac{5}{8}$ [10.12.2].
- i) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- j) Grinding or machining depth for defect removal [10.15.17, 10.15.18].

J.3 Grade N80 - All Types

J.3.1 SL-B

The following requirements are to be satisfied:

- a) Charpy impact value for pipe [7.5.2, Table C.60 or Table E.60].
- b) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].

J.3.2 SL-A

SL-A requirements are not applicable for Grade N80 (all types).

J.4 Grade L80 Type 1 and Associated Variant Grade L80 1Cr

J.4.1 SL-B

The following requirements are to be satisfied:

- a) Charpy impact value (if tested) [7.4.4, 7.5.2, 7.6, Table C.60 or Table E.60].
- b) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].

J.4.2 SL-A

The following requirements are to be satisfied:

- a) L80 1Cr supplied at SL-A [Table 18].
- b) L80 1Cr supplied seamless [Table C.3 or Table E.3].
- c) Traceability of heat and lot for test results [6.4.1].
- d) Charpy V-notch impact shear area minimum of 75 % [7.3.1].
- e) Mandatory Charpy V-notch impact testing and requirements [7.4.4, 7.5, K.9 (SR 16), Table C.60 or Table E.60].
- f) For L80 Type 1, minimum martensite content of 90 % [7.10.1].
- g) For L80 Type 1, metallographic examination of the weld zone (EW only) [10.11].

- h) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- i) Grinding or machining depth for defect removal [10.15.17, 10.15.18].

J.5 Grade L80 13Cr

J.5.1 SL-B

The following requirements are to be satisfied:

- a) Charpy impact value (if tested) [7.4.4, 7.5.2, 7.6, Table C.60 or Table E.60].
- b) No product susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].
- c) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].

J.5.2 SL-A

The following requirements are to be satisfied:

- a) Traceability of heat and lot for test results [6.4.1].
- b) Mandatory Charpy V-notch impact testing and requirements [7.5, K.9 (SR 16), Table C.60 or Table E.60].
- c) No product susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].
- d) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- e) Magnetic particle inspection of untested ends [10.15.13].
- f) Grinding or machining depth for defect removal [10.15.17, 10.15.18].
- g) Surface condition [7.12].

J.6 Grades C90 and T95, and Associated Variant Grades T95EN and T95UC

J.6.1 SL-B

The following requirements are to be satisfied:

- a) Charpy impact value (if tested) [7.4.4, 7.5.2, 7.6, Table C.60 or Table E.60].
- b) SSC testing [Table 20, Table 21, 7.14.2].
- c) Control of stress-relief temperature [10.4.1].
- d) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].

J.6.2 SL-A

The following requirements are to be satisfied:

- a) Grades C90 (D) and T95 (D) and Variant Grades T95EN and T95UC are supplied at SL-A [Table 18].
- b) Control of straightening process [6.3.4].
- c) Charpy V-notch impact shear area minimum of 75 % [7.3.1].
- d) Mandatory Charpy V-notch impact testing and requirements [7.4.4, 7.5, K.9 (SR 16), Table C.60 or Table E.60].
- e) SSC testing [Table 20, Table 21, 7.14.2].
- f) Control of stress-relief temperature [10.4.1].
- g) Wall thickness measurement and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- h) Magnetic particle inspection of untested ends [10.15.13].
- i) Grinding or machining depth for defect removal [10.15.17, 10.15.18].
- j) For Variant Grade T95UC, collapse testing [P.2].

J.7 Grade R95

See J.10 for Variant Grade R95LS.

J.7.1 SL-B

The following requirements are to be satisfied:

- a) Charpy impact value (if tested) [7.4.4, 7.5.2, 7.6, Table C.60 or Table E.60].
- b) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].

J.7.2 SL-A

The following requirements are to be satisfied:

- a) Traceability of heat and lot for test results [6.4.1].
- b) Charpy V-notch impact shear area minimum of 75 % [7.3.1].
- c) Mandatory Charpy V-notch impact testing and requirements [7.4.4, 7.5, K.9 (SR 16), Table C.60 or Table E.60].
- d) Metallographic examination of the weld zone (EW only) [10.11].
- e) Wall thickness measurement and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- f) Grinding or machining depth for defect removal [10.15.17, 10.15.18].

J.8 Grade P110 and Associated Variant Grades P110UC, P125, and P125UC

See J.10 for Variant Grade P110LS.

J.8.1 SL-B

The following requirements are to be satisfied:

- a) Electric-welded Grades P110, P110UC, P125 and P125UC are only supplied at SL-B, incorporating the requirements of K.6 (SR 11) [6.1].
- b) Yield strength ranges of Grades P125 and P125UC [Table C.5 or Table E.5].
- c) Charpy impact value (if tested) [7.4.4, 7.5.2, 7.6, Table C.60 or Table E.60].

NOTE For Grades P125 and P125UC, the impact energy requirement calculation is modified.

- d) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- e) For UC variant grades, collapse testing [N.2].

J.8.2 SL-A

The following requirements are to be satisfied:

- a) SL-A Grade P110 and associated variant grades are supplied seamless [Table C.3 or Table E.3].
- b) Yield strength range of variant grades [Table C.5 or Table E.5].
- c) Traceability of heat and lot for test results [6.4.1].
- d) Charpy V-notch impact shear area minimum of 75 % [7.3.1].
- e) Mandatory Charpy V-notch impact testing and requirements [7.4.4, 7.5, K.9 (SR 16), Table C.60 or Table E.60].
- f) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- g) Grinding or machining depth for defect removal [10.15.17, 10.15.18].
- h) For UC variant grades, collapse testing [P.2].

J.9 Grade Q125 and Associated Variant Grades

J.9.1 SL-B—Grade Q125

The following requirements are to be satisfied:

- a) Electric-welded Grade Q125 is only supplied at SL-B, incorporating the requirements of K.6 (SR 11) [6.1].
- b) Charpy impact value (if tested) [7.4, 7.5, 7.6, Table C.60 or Table E.60].
- c) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].

J.9.2 SL-A—Grade Q125, Q125UC, Q125RY, Q125UCRY, Q130, Q130RY, Q135UC, and Q140

The following requirements are to be satisfied:

- a) Grade Q125 and associated variant grades are supplied at SL-A [Table 18].
- b) Grade Q125 and associated variant grades are supplied seamless [Table C.3 or Table E.3].
- c) Yield strength ranges of variant grades are defined in [Table C.5 or E.5].
- d) Charpy V-notch impact shear area minimum of 75 % [7.3.1].
- e) Charpy impact value (if tested) [7.4.4, 7.5.2, 7.6, Table C.60 or Table E.60].
- f) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- g) Grinding or machining depth for defect removal [10.15.17, 10.15.18].
- h) For UC variant grades, collapse testing [P.2].

J.10 Grades R95LS and P110LS

Grades R95LS and P110LS are seamless products [Table C.3 or Table E.3].

J.10.1 SL-B

The following requirements are to be satisfied:

- a) Control of straightening process [6.3.2].
- b) Report chemical composition on the certificate [7.1, 13.3].
- c) Charpy V-notch impact shear area minimum of 75 % [7.3.1].
- d) Hardness testing [7.7.1 and 10.6].
- e) Minimum martensite content [7.10.4].
- f) Grain size requirements [7.11].
- g) SSC testing [Table 20, Table 21, 7.14.2].
- h) Control of stress-relief temperature [10.4.1].
- i) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- j) Grinding or machining depth for defect removal [10.15.17, 10.15.18].

J.10.2 SL-A

The following requirements are to be satisfied:

- a) Control of straightening process [6.3.2].
- b) Traceability of heat and lot for test results [6.4.1].
- c) Report chemical composition on the certificate [7.1, 13.3].
- d) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

- e) Mandatory Charpy V-notch impact testing and requirements [7.4, 7.5, K.9 (SR 16), Table C.60 or Table E.60].
- f) Hardness testing [7.7.1 and 10.6].
- g) Minimum martensite content [7.10.4].
- h) Grain size requirements [7.11].
- i) SSC testing [Table 20, Table 21, 7.14.2].
- j) Control of stress-relief temperature [10.4.1].
- k) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- l) Grinding or machining depth for defect removal [10.15.17, 10.15.18].

J.11 SL-A Grades C110 and M125 and Associated Variant Grades E and UC

The following requirements are to be satisfied:

- a) These grades are supplied at SL-A only [Table 18].
- b) These grades are supplied seamless [Table C.3 or Table E.3].
- c) Charpy impact value (if tested) [7.4, 7.5, Table C.60 or Table E.60].
- d) SSC testing [Table 20, Table 21, 7.14.2].
- e) Hardness testing of upset pipe [10.6.6.1].
- f) Wall thickness measurement coverage and NDE [Tables C.42, C.43 and C.44 or Tables E.42, E.43, and E.44].
- g) Grinding or machining depth for defect removal [10.15.17, 10.15.18].
- h) For UC variant grades, collapse testing [P.2].

In Annex K heading, replace "normative" with "informative"

Annex K (informative)

Supplementary Requirements

K.2 SR 1—Supplementary Non-destructive Examination for Grades H40, J55, and K55

Replace first sentence with

The specified casing and tubing shall be inspected for imperfections that are greater than 12.5 % of the specified wall thickness or that reduce the net effective wall thickness below 87.5 % of the specified wall thickness or below the alternative specified minimum wall thickness, as per 8.11.2.

K.3 SR 2—Supplementary Non-destructive Examination for Grades H40, J55, K55, N80 (All Types), L80, R95, and P110 to K.9 (SR 16)

In first sentence of first paragraph, replace "87.5 % of the specified wall thickness" with

87.5 % of the specified wall thickness or below the alternative specified minimum wall thickness, as per 8.11.2

Replace section K.4 title with

K.4 SR 9—Coupling Blanks—Grades C110, M125, and Q125

K.6 SR 11—Electric-welded Grades P110 and Q125 Pipe

K.6.5 SR 11.5—Inspection and Rejection

K.6.5.6 SR 11.5.6—Disposition

In first sentence of first paragraph, replace "12.5 % of the specified wall thickness" with

12.5 % of the specified wall thickness or alternative specified wall tolerance, as per 8.11.2

K.8 SR 13—Seal-ring Couplings

K.8.1 SR 13.1—Seal-ring Groove

Add after second sentence of first paragraph

For all SL-A grades and for SL-B Grades L80 13Cr, C90, T95 and Q125, the seal-ring grooves shall be machined using the same set-up used to machine the box threads. The seal-ring groove eccentricity shall be no greater than 0.13 mm (0.005 in.) and verified for each machine set-up.

NOTE Seal-ring groove eccentricity is the maximum difference between the values of the distance from the root of the seal-ring groove to the minor cone of the coupling threads in a plane at any location around the circumference.

K.8.2 SR 13.2—Non-metallic Ring

Delete second paragraph (PSL)

Add to section

For SL-A, seal-rings for field-end box threads shall be shipped separately in a sealed package labelled with the quantity, connection description, connection manufacturer, date inspected and date packaged.

K.9 SR 16—Impact Testing (Charpy V-notch)**K.9.6 SR 16.6—Impact Test Procedures****K.9.6.3 SR 16.6.3—Test Temperature**Replace first paragraph (including list items) with

The test temperature shall be specified from the temperature choices provided in Table 19.

Replace second paragraph with

The tolerance on the test temperature shall be in accordance with Table 19.

Delete fourth paragraph (PSL)**K.13 SR 40—Electric-welded Casing, Tubing, and Pup Joints, Grades H40, J55, K55, N80 (All Types), L80 Type 1, and R95****K.13.2 SR 40.2—Non-destructive Examination of Weld Seam**Add to first paragraph

The inspection shall be performed after heat treatment and subsequent rotary straightening operation.

Replace section K.14 title with**K.14 SR 41—Supplemental Inspection when Hydrostatic Test Pressure is Limited to 69.0 MPa (10,000 psi) and Supplemental Testing and NDE Inspection(s)****K.14.2 SR 41.2—Non-destructive Examination of Pipe**Replace section K.14.2 with**K.14.2.1 Oblique Inspection Requirements**

When specified, the supplementary requirements for oblique inspection shall apply.

NOTE This inspection is applicable only to seamless products.

The technical justification for identification of the typical orientation of imperfections and the proposed oblique notch orientation shall be documented and submitted. Notches shall be based on SL-A sized reference indicators as per Table C.44 or Table E.44. The degree (orientation angle) of the notches in the reference standard shall be agreed. The inspection unit should be qualified in accordance with Annex M for these inspections.

All pipe, coupling stock (if applicable) and accessory material (if applicable) shall be inspected for the detection of oblique imperfections that are typically generated by the manufacturing process, on the outside and inside surfaces by one or more of the following methods:

- a) ultrasonic testing to acceptance level L2 in accordance with ISO 10893-10 or ASTM E213;

- b) flux leakage testing to acceptance level L2 in accordance with ISO 10893-3 or ASTM E570;
- c) eddy current testing to acceptance level L2 in accordance with ISO 10893-2 or ASTM E309.

K.14.2.2 Reporting

In the case of material shipped directly to a processor from the seamless pipe mill, the pipe mill shall provide the processor documentation regarding the oblique angle to be inspected.

The oblique angle inspected shall be stated on the certificate in accordance with 13.3 q).

Add new section

K.14.3 SR 41.3—Hardness Testing

K.14.3.1 Surface Hardness Testing

A process control plan shall be applied which has demonstrated that it ensures each pipe body, each upset and each coupling has mechanical properties conforming to the requirements of this specification. When this condition is not fulfilled, each pipe body, each upset and each coupling shall be surface hardness tested. When not included in this specification, hardness minimum and maximum values shall be in accordance with the manufacturer's specifications or set through the provisions of L.3.1.

K.14.3.2 Sampling and Test Specimen Location—Non-upset Pipe

A test ring shall be cut from both ends of each pipe. See 10.6.5.

Add new section

K.15 SR 42—Categorization of Tubulars Based on Wall Thickness

K.15.1 Categorization of Tubulars

Wall thickness categorization shall be the identification of the pipes as a percentage of the minimum wall thickness into three classes:

- 95 % and above the nominal wall thickness (three green rings);
- between 92.5 % and 94.9 % of the nominal wall thickness (two green rings);
- below 92.4 % of the nominal wall thickness (no additional marking).

K.15.2 Marking

Color rings, close to but separated from the grade markings of Table C.46 or Table E.46, shall be placed on the segregated pipe in order to identify its class of wall thickness. The color banding shall be as given in K.15.1.

Add new Annex L

Annex L

(normative)

Product Performance and Manufacturing Procedure Qualification

L.1 General

L.1.1 Applicability

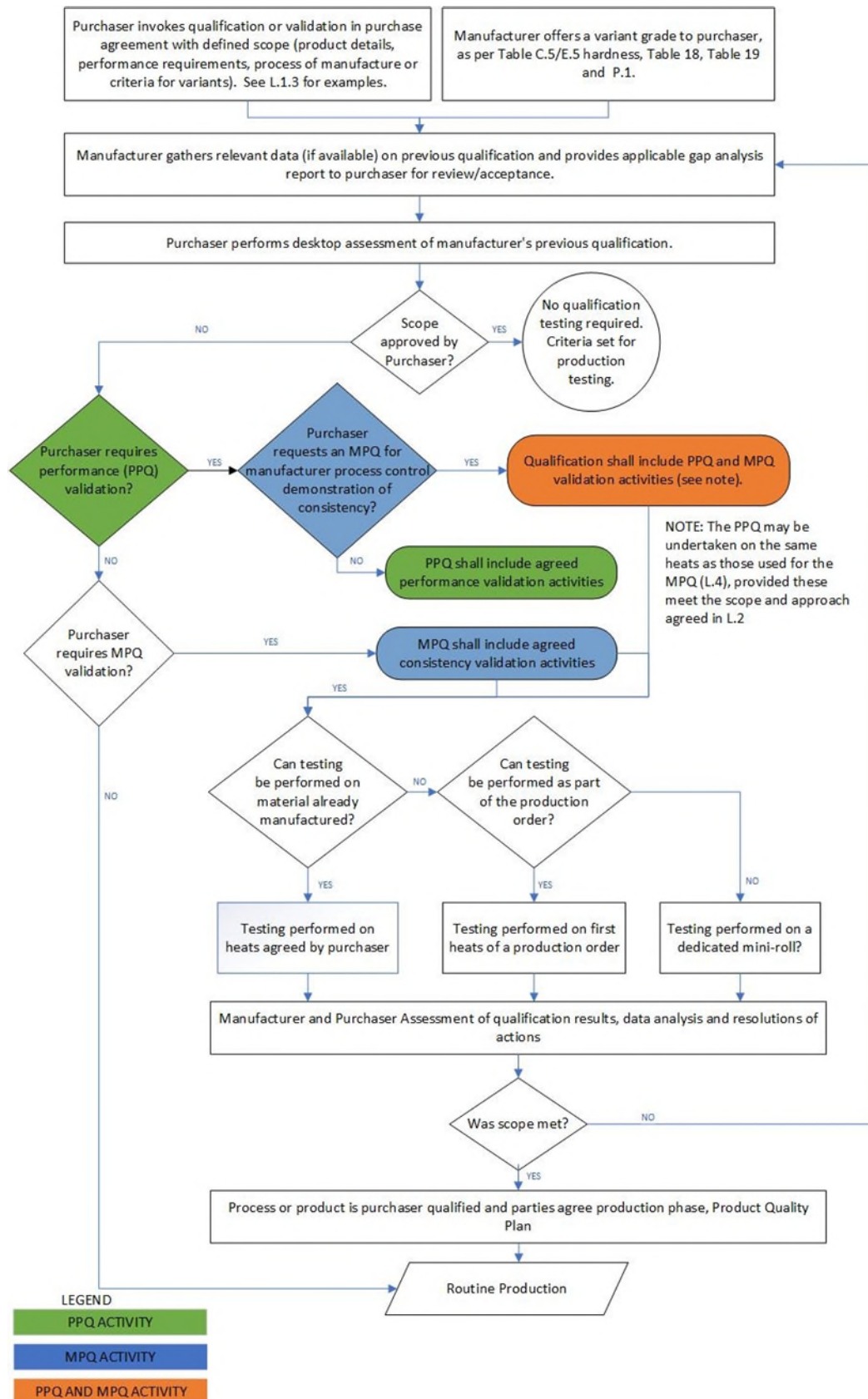
This annex is normative when a validation or qualification activity has been specified (from purchase inquiry or order, or IOGP S-735D):

- a) If PPQ and/or MPQ are specified, refer to L.1, L.2, L.3 and L.5 for PPQ, and L.1, L.2, L.4 and L.5 for MPQ.
- b) If the product requires end sizing or is a UC variant grade having a collapse rating higher than that described in API 5C3, the following sections shall be applicable:
 - L.1, L.2 and L.5 for relevant framework;
 - N.1 and P.1 for validation;
 - N.2 and P.2 for production.
- c) If validation for NDE or thread gauging is specified, as described in Annex M, the reporting requirements in L.5 shall be required above the requirements in Annex M.
- d) If the criteria or parameters need to be set for a variant grade (e.g. agreement of criteria for SSC testing as set out in Table 20 or Table 21, agreement of hardness values for LS grades as set out in Table C.5 or Table E.5), L.1, L.2, L.3 and L.5 are applicable.
- e) If the parameters need to be agreed for an upset product, L.3.2 is applicable.
- f) If qualification is to be achieved by providing relevant data from previous production or qualification activities, L.2 shall be applicable.

L.1.2 Qualification

Based on prior PPQ data, the purchaser may agree that new PPQ is not required or new PQP is required.

A typical decision tree and flow path for qualification is shown in Figure L.1.

Add new Figure L.1**Figure L.1—Flowchart for PPQ/MPQ Decisions by the Purchaser**

L.1.3 Definitions and General Requirements

L.1.3.1 Product Performance Qualification (PPQ)

The purpose of PPQ is to validate a given performance attribute or attributes for a specific product.

Examples of PPQs include:

- PPQ for uprated collapse performance rating (see P.1);
- agreement of criteria for a variant grade through PPQ (see L.3.1);
- upset product qualification for Grades T95EN, C110 or M125 (see L.3.2);
- product environmental performance envelope for grades that require SSC testing (see L.3.3).

Testing typically includes methods and acceptance criteria that are different from normal production phase testing and/or criteria listed in Section 7, Section 10, N.2 and P.2.

L.1.3.2 Manufacturing Procedure Qualification (MPQ)

The purpose of MPQ is to validate the consistency of the product meeting the specification requirements when manufactured by a particular manufacturing route with the associated manufacturing procedures or sub-procedures.

Examples of MPQs include:

- new manufacturing equipment or significant change in manufacturing procedure that affects the process of manufacture;
- product, size, weight or grade not previously made at facility;
- upset product not previously made such as Grades T95EN, C110 or M125;
- end sizing and thermal recovery process (see Annex N).

MPQ can be specified or the manufacturer can conduct MPQ to demonstrate process control as listed below. In either case, the scope and testing sections are based on two categories, grades that do not require SSC testing or grades that do require SSC testing. When the manufacturer demonstrates process control, verification requirements can be modified where allowed in API 5CT and in this specification.

Examples of modified verification requirements include:

- modify test frequency for SSC testing (see 7.14.2.1 f), Table 20 or Table 21);
- select SSC samples randomly rather than selecting samples from lots identified with maximum hardness (see 7.14.3);
- contribute to UC performance (see Annex P).

MPQ of the manufacturing route may be performed on agreed product dimensions (i.e. a single size and wall thickness) that is representative of a range of product sizes. Testing typically involves methods and acceptance criteria listed in Sections 7, Section 10, N.2 and P.2, but with enhanced test frequency and location. New testing also provides opportunities to test and validate properties in the middle of the length, for limited sacrificial lengths, which is rarely done in normal production orders.

L.1.3.3 Validation of Equipment, Product, or Process

The purpose of a validation is to confirm through the provision of objective evidence that the requirements for a specific intended use or application have been fulfilled.

Examples of validation include:

- validation of UT or EMI equipment repeatability (see M.1);
- validation for NDE on a specific product (see M.2);
- validation of thread inspection process (see M.3);
- validation of end sizing with or without thermal recovery process (see N.1).

L.1.4 PPQ Documentation Review and/or Agreement of Testing Scope

L.1.4.1 PPQ Scope

The terms of this section are normative when qualification for a tubular product with an envelope of sour environmental performance is specified.

NOTE This section is targeted at Grade M125 and the LS or E series of variant grades.

The purchaser shall define the following items to allow confirmation of the performance envelope:

- product information (size, weight, grade and process of manufacture);
- SSC test method(s) (based on Table 20 and/or Table 21, the minimum SSC test conditions);
- environmental conditions (combinations of sour environment pH, partial pressure of H₂S and temperature);
- inclusion of secondary validation needs (such as for UC products as per Annex P or chemical composition variants);
- purchaser's representative witnessing MPQ (if applicable).

When an E series variant grade, with both Method A and Method D testing requirements, has been specified for qualification, in accordance with Table 20 or Table 21, criteria shall be set higher than the base grade test condition.

The purchaser's qualification can be achieved by either acceptance of the manufacturer's prior testing or by testing meeting the scope of the agreed qualification requirements.

L.1.4.2 Sour Service Performance Envelope

The performance of the variant grade shall be declared, noting combinations of sour environment pH and partial pressure of H₂S, based on sour service qualification data that is in conformance with the requirements of ISO 15156-2:2020, Annex B and NACE TM0177:2016 for qualification of a manufacturing process.

The manufacturing chemistry and heat treatment limits, acceptance limits for hardness, yield strength, tensile strength hardenability and grain size shall be defined based on sour service qualification data.

NOTE Data from analogous grades or fundamental knowledge is acceptable.

L.1.4.3 Evaluation of Existing Data (Desktop Gap Analysis Exercise)

The purchaser evaluates the manufacturer's presented data and determines if the qualification objectives have been achieved or defines scope (see L.2.2) of additional qualification testing.

L.1.5 MPQ Documentation Review and/or Agreement of Testing Scope

The terms of this section shall apply when MPQ for any of the examples listed in L.1.3.2 is specified.

L.1.5.1 MPQ Scope

To permit relevant data for acceptance to be provided, the purchaser shall define the following items:

- product information (size, weight, grade and expected process of manufacture);
- SSC test method(s) (based on Table 20 or Table 21, the minimum SSC test conditions);
- desired SL;
- facility of interest, process and/or mill route as applicable;
- purchaser's representative witnessing MPQ (if applicable).

L.1.5.2 Previous Qualification

Qualification may be achieved by providing relevant data from previous productions or qualification activities in accordance with L.2, and acceptance by the purchaser that no further qualification activities are necessary.

If the product has been produced in the past in an industrial basis with the same manufacturing route, MPQ may be replaced by a qualification report of already tested and certified properties.

Conditions for replacing an MPQ with a previous qualification shall include:

- documentation of test results from previous qualifications of the product;
- documentation of product that is equivalent to the product to be qualified supplied and a technical justification for the applicability of the proposed extrapolation provided;
- product manufactured using industrial manufacturing scale production facilities and processes (not through pilot or laboratory scale facilities).

NOTE These prior qualification(s) do not include requirements for an audit of the manufacturer's quality management system or quality control systems but conformance with API Specification Q1 is expected.

L.1.5.3 Evaluation of Existing Data (Desktop Gap Analysis Exercise)

The purchaser evaluates the manufacturer's presented data and determines if qualification objectives have been achieved or defines scope (see L.2.2) of additional qualification testing.

L.2 Assessment of Data from Manufacturer and Agreement of Scope for Testing

L.2.1 Purchaser's Request of PPQ or MPQ Testing

Upon review of the manufacturer's manufacturing and product qualification data, the purchaser may require that a PPQ and/or MPQ testing is undertaken. Where a PPQ and MPQ are both required, these may be performed simultaneously provided that the requirements of L.3 and L.4 are met.

Qualification testing shall be completed as follows:

- prior to the start of production; or
- by testing samples from the first part of the production run.

L.2.2 Scope of Testing to Achieve Purchaser's Qualification

L.2.2.1 Products Covered and Scope

The approach and scope of the qualification shall include the following:

- a) The range of product dimensions deemed sufficiently similar in manufacture to include within the scope of qualification.

The product shall be made by the same manufacturing process route, unless justification is provided that is agreed with the purchaser that an alternate process route is acceptable.

Justification shall be provided, based on the manufacturing process, for the applicable dimensions, noting any manufacturing differences between the product dimensions that could influence performance and/or consistency.

- b) The qualification activities that will be undertaken and to which SL.
- c) Material specification detailing the target attribute and the acceptable range for:
- 1) chemical composition;
 - 2) heat treatment type;
 - 3) mechanical properties, as applicable, for hardness, tensile and impact;
 - 4) metallurgical parameters as applicable (hardenability, grain size).
- d) Any specific geometry controls required for the product performance.

L.2.2.2 Source of Material

Based on the grade specified, the documentation shall be based on the minimum quantities and heats as shown in Table L.1.

L.2.2.3 Activities During Testing

The activities to be conducted during the testing program shall be documented in the qualification inspection and test plan. The documentation in the qualification inspection and test plan shall include, as a minimum:

- a) description of the testing or inspection to be done in excess of normal production phase frequencies;
- b) number and distribution of samples, types and amounts of testing for specific products or processes in accordance with either L.3 for PPQ or L.4 for MPQ;
- c) specific target property ranges for the material manufactured.

The agreed scope, approach and activities shall be documented and added to the manufacturer's qualification reporting package.

Add new Table L.1**Table L.1—Source of Material**

Description		PPQ ^c Test Source of Material	MPQ Test Source of Material	
			For Grades not Requiring SSC Testing	For Grades Requiring SSC Testing in Accordance with Table 20 or Table 21, or if Specified
		In Accordance with L.3	In Accordance with L.4.3	In Accordance with L.4.3 and L.4.4
Numbers of product to be tested ^a	Minimum number of sacrificial lengths (joints or other products)	3	3	
	Total number of lengths (joints or other products)	3 ^b	At least 21 joints or 6 pieces of coupling stock, coupling material or accessory material for mini- roll, which includes the 3 sacrificial lengths	
Selection criteria	Primary criteria for selection of sacrificial lengths	Each sacrificial length is to be from a different heat	Lengths evenly as possible taken from the MPQ grouping at the leading, middle and trailing end as processed through heat treatment run (continuous). Should include 3 heats where possible	
	Secondary criteria for selection of sacrificial lengths	Select from material at higher end of the hardness and yield strength range permitted for the product	None ^d	Select from material at higher end of the hardness and yield strength range permitted for the product
	Wall thickness considerations	Select material that is close to the maximum thickness given in the scope of the qualification should be selected for testing	Purchaser shall specify which product, grade and SL is targeted as part of the scope in L.1.5.1	
	Traceability	Required as per 6.1	If required based on grade specified for MPQ	Required as per 6.1
^a The manufacturer shall state if the testing proposal includes heats of material manufactured previously, if the first heats of the production order or if a dedicated mini-roll are proposed to be included in the MPQ (see Figure L.1). Heats that have already been manufactured may be used for the PPQ. ^b Different products of the same grade (coupling material, coupling stock, pipe, and/or accessory material) may be selected for the three heats required for qualification, which includes the 3 sacrificial lengths. ^c The PPQ may be undertaken on the same heats as those used for the MPQ (L.4), provided these meet the scope and approach agreed in L.2. ^d Except for when the intention is to validate restricted yield products.				

L.2.3 Description of Manufacturing Process and Product

For MPQ, the manufacturing process shall be detailed in accordance with L.2.3.2.

For PPQ, the product description shall be detailed in accordance with L.2.3.1.

The purchaser can specify from IOGP S-735L which qualification activities are specified to be delivered with the scope.

L.2.3.1 Product Description

The manufacturer shall provide the following:

- a) product description (e.g. grade, delivery condition, nominal outside diameter, and specified wall thickness);
- b) for variant grades, material data sheet for the grade and product(s) of interest, including production (QC) test methods and acceptance criteria;
- c) details of the manufacturing procedure, including data from past production to demonstrate process consistency and product performance.

L.2.3.2 Manufacturing Process Information

The manufacturer shall, based on the scope specified, provide a description of the manufacturing process. The description shall include the following:

- a) Defined production route that identifies manufacturing and testing location(s), all manufacturing operations and manufacturing controls required to maintain the qualification (as applicable):
 - 1) description of the manufacturing process;
 - 2) description of the product manufacturing process.
- b) Details of additional manufacturing processes, restrictions in the manufacturing processes, specific process control requirements applicable to the product and support the claimed performance:
 - 1) manufacturer's validation of the applicable processes;
 - 2) manufacturer's proposal to demonstrate statistical process control.

L.2.3.3 Documentation

The documentation shall be included within the qualification inspection and test plan and/or provided as a standalone document, at the manufacturer's discretion.

L.3 Testing for Product Performance Qualification

L.3.1 Agreement of Criteria for Variant Grade through PPQ

The minimum requirements are to be as follows:

- a) The manufacturer shall propose their PQP for the specific product specified.
- b) In accordance with API Specification Q1, 5.4, the methods used to establish the claimed performance (if applicable) shall be documented.
- c) The proposal shall include the technical justification based on prior manufacturing performance of sufficient size for statistical analysis, demonstrating the grade meets the rating of performance envelope or the PPQ proposal as per L.1.4 or P.1.

L.3.2 Qualification of Upset Product for Grades T95EN, C110, and M125

The terms of this section are normative when purchaser has specified that the upsetting process must be qualified for an upset tubular product of Grades T95EN, C110 or M125.

L.3.2.1 Declaration of Minimum Requirements for Upset Product

The manufacturer shall provide a product qualification document which covers the following:

- a) Dimensional specification for the pipe and upset area (including tolerances if outside Table C.25 and C.26 or Table E.25 and E.26) and validation information if end sizing is conducted. The location of test specimens should be shown or given.
- b) Mechanical properties of the product and any adjustments for tensile or yield strength for the upset product that are outside the requirements of Table C.5 and Table E.5.
- c) Hot work ratio and heat treatment including grain size targets.
- d) Conformance with SSC testing in accordance with Table 20 for Method A or Table 21 for Method D.
- e) Destructive and non-destructive testing program, including frequency of hardness testing and the test specimen location in accordance with 10.6.6.2, which shall be at least those given on Table C.40 or Table E.40.

L.3.2.2 Agreement of Scope of Qualification for Product

The manufacturer shall propose the additional elements of PPQ testing related to the upset portion of the tubular (e.g. location and frequency of specimens for tensile and hardness testing above those given in Table L.2).

L.3.3 PPQ Testing for Establishing SSC Tested Product Environmental Envelope

L.3.3.1 Test Sampling and Frequency

Test sampling and frequency shall be in accordance with Table L.2.

L.3.3.2 Test Method and Inspection Criteria

Test methods and acceptance criteria shall be in accordance with ISO 15156-2:2020 and NACE TM0177:2016 with the additions and modifications in this section.

The manufacturer shall supply SSC test procedures. The purchaser shall specify if SSC tests to be conducted by a laboratory independent from the manufacturer.

The SSC test environments for variant grades shall include one or more environmental conditions that sample the manufacturer's claimed environmental envelope for a given grade (e.g. combinations of pH and partial pressure H₂S or temperature).

Method A and Method D tests shall be performed following the application specific section of ISO 15156-2:2020, Table B.1, with the modifications in a) through c).

- a) For intended pH values below 4.0, acidification shall be agreed.
- b) SSC tests shall be performed at the temperatures given in Table L.3.
- c) K_{LIMT} shall be determined as per NACE TM0177:2016, Appendix E.

The acceptance criteria for NACE TM0177:2016 Method A testing shall be that no cracking is identified visually and/or following metallographic sectioning in accordance with NACE TM0177:2016.

Add new Table L.2**Table L.2—PPQ Minimum Testing or Inspection Requirements**

Type of Test	Stage of Sampling or Product	PPQ Test Frequency
Tensile	Three sacrificial pipe lengths	3 specimen set locations — both ends and mid length At each set location, triplicate specimens with each specimen taken from a different quadrant of the length NOTE - Same frequency and specimen locations as MPQ Table L.3 for the sacrificial joints
Hardness	Adjacent to each tensile set location	Perform four-quadrant test adjacent to each tensile location
Chemical analysis ^a Ladle analysis	Heat (ladle)	One analysis for each heat (ladle)
SSC NACE TM0177:2016 Method A	Tests set(s) shall be taken from the circumferential position of the location that has the highest hardness (by quadrant hardness testing)	From each sacrificial pipe, test sets from both ends and the middle of each selected length Each test set shall consist of at least 3 test specimens (with valid results)
SSC NACE TM0177:2016 Method D ^b	Tests set(s) shall be taken from the circumferential position of the location that has the highest hardness (by quadrant hardness testing)	From each sacrificial pipe, test sets from both ends and the middle of each selected length Each test set shall consist of at least 3 test specimens (with valid results)
	Additional test sets from the length and position with the lowest K _{ISSC} performance	3 test sets of 3 specimens for K _{LIMIT} testing ^c Each shall be with different arm displacements ^d per set
^a Reporting all intentionally added or controlled elements for the ladle analysis is required. ^b For grades with suffix A requiring only Method A, the Method D tests are for information only and the number of Method D test sets can be reduced to no less than one set per sacrificial length. ^c K _{LIMIT} items are relevant to PPQ only and not to MPQ. If the scope is agreed to be a combined PPQ and MPQ, the K _{LIMIT} item from Table L.2 shall be included. ^d Arm displacements shall be agreed following the guidance from NACE TM0177:2016.		

Add new Table L.3**Table L.3—SSC Testing Temperatures and Durations**

Type of Test Temperature		SSC Test Temperature ^a	Minimum Duration of SSC Test ^a	
		Method A or Method D	Method A	Method D
Default (ambient) test temperature		+24 °C (+75 °F)	As per NACE TM0177:2016 for ambient temperature tests	
Alternative test temperatures, if specified ^b	Option 1	+4 °C (+39 °F)	60 days	21 days
	Option 2	other	other	
^a The temperature tolerance shall be ±3 °C (± 5 °F) for Method A and ±1.7 °C (±3.0 °F) for Method D.				
^b Alternative test temperatures and durations may be specified in the purchase agreement.				

L.3.3.3 Reporting of Environmental Envelope

The PPQ report shall include the following:

- a) traceability of specimens from each heat and lot with associated test data in accordance with 6.4;
- b) sour service test in accordance with NACE TM0177:2016;
- c) reporting of K_{LIMIT} in accordance with NACE TM0177:2016 from the lowest K_{ISSC} set;
- d) plot of the SSC test results (pass/fails) on a reproduction of ISO 15156-2:2020, Figure 1;
- e) chemical and mechanical tests in accordance with Table L.2;
- f) summary of the results of the testing and proposed actions following any valid test failures.

L.3.3.4 Invalidation of Tests

SSC test results shall be invalidated if an assignable cause occurred in testing.

In addition to NACE TM0177:2016 invalidation requirements, the items listed in 7.14.6 shall be utilized for decision making related to test validity.

L.3.3.5 Provisions when SSC Test Failure Occurs

If test failure(s) occur(s), an assessment to determine root cause(s) shall be performed.

Corrective action(s) to mitigate the root cause(s) shall be documented and available to the purchaser upon request.

The corrective actions shall be applied prior to retest

If failure occurs, retesting is permitted in a more benign test condition (higher pH, lower pH₂S and/or temperature) to define a reduced pH-pH₂S performance window for the grade.

The material shall be retested as per one of the following options:

- retested under the original scope of the PPQ;
- reprocessed and tested again under the original scope; or
- retested under a revised PPQ scope that has been submitted for approval to the purchaser prior to retest.

L.4 Testing for Manufacturing Procedure Qualification

L.4.1 General

The number of tested items, sacrificial joints and requirements for heats to be included in the MPQ shall be in accordance with Table L.1.

L.4.2 Analysis and Reporting of MPQ Results

Statistical analyses shall be performed to demonstrate consistency in-manufacturing processes. The manufacturer shall declare the statistical criteria applied for controlling the process.

The statistical analysis shall include the range, distribution and uncertainty of measured results to demonstrate that the process is in control. The distribution shall lie within minimum and maximum bounds with lower occurrence for values closer to the minimum and maximum limits. The manufacturer shall report the analysis, state the statistical criteria for being in-control and state conclusions.

L.4.3 Requirements for General Manufacturing Procedure Qualification

L.4.3.1 Test Sampling, Tests and Frequency

Testing methods, sampling locations and test frequencies shall be in accordance with Table L.4.

L.4.3.2 Acceptance Criteria

Testing and acceptance criteria shall be in accordance with this specification for the grade and SL assessed.

L.4.3.3 Invalidation of Tests

The criteria for invalidating test results obtained as part of the MPQ shall be in accordance with this specification.

L.4.3.4 Retests

If test failure(s) occur(s) on MPQ samples, an assessment to determine root cause(s) shall be performed.

Corrective action(s) to mitigate the root cause(s) shall be documented and available to the purchaser upon request.

The corrective actions shall be applied prior to retest.

The material shall be retested as per one of the following options:

- retested under the original scope of the MPQ;
- reprocessed and tested again under the original scope; or
- retested under a revised MPQ scope that has been submitted for approval to the purchaser prior to retest.

If a test/set (as applicable) fails to meet the acceptance criteria the following applies for retesting:

- Retests may be performed on two further retest specimens/sets (as applicable).
- Retests shall be taken from the same location as the initial failed specimens/sets (as applicable).
- If both specimens/sets satisfy the acceptance criteria, the product has passed the test.
- Retesting of retests is not permitted.

Add new Table L.4**Table L.4—MPQ Minimum Testing or Inspection Requirements**

Type of Test	Stage of Sampling or Product	MPQ Test Frequency for Grades not Requiring SSC Testing	MPQ Test Frequency for Grades Requiring SSC Testing
NDE (10.15)	All lengths included within the MPQ grouping in accordance with the scope	All lengths inspected per 10.15 Based on the SL specified for the MPQ, pipe, pup joints, coupling stock and accessory material are to be inspected for detection of imperfections in accordance with Table C.43 or Table E.43, utilizing one or more methods in accordance with Table C.42 or Table E.42. Additionally at SL-A for Grades L80 13Cr, C90, T95, P110, C110, M125 and Q125 coupling stock and accessory material are to be inspected for longitudinal and transverse imperfections on the inside surface using ultrasonic shear-wave techniques in accordance with ISO 10893-10 or ASTM E213 to acceptance level L3 as listed in Table C.44 or Table E.44.	
Dimensional measurement		For diameter and wall thickness measurements, measurements are to be taken at least on both ends and mid-length.	
Tensile ^a	Three sacrificial lengths	3 specimen set locations - both ends and mid length At each set location, triplicate specimens with each specimen taken from a different quadrant of the pipe	
	For pipe, 18 lengths separate from the 3 sacrificial. For non-pipe products, 3 lengths separate from the 3 sacrificial	1 test per length from a random quadrant of the pipe, approximately 50 % alternating ends (unless API 5CT requires both ends of each length to be tested)	
Charpy Impact	On the sacrificial pipe lengths	1 set (3 specimens) per location with locations at both ends and mid-length per pipe	
Hardness ^a	Adjacent to each tensile set location	Only if there is a through wall hardness variation listed in Table C.5 or Table E.5 Perform one-quadrant test adjacent to each tensile location	Perform four-quadrant test adjacent to each tensile location
Hardenability	According to 7.10	None Not required for non SSC tested grades	1 test per heat per heat treatment run
Chemical analysis ^b	Heat (ladle) analysis	One analysis for each heat (ladle)	
	Product analysis	None ^c Not required for non SSC tested grades	2 tests from different lengths per heat (representing the start and end of the heat)
Microstructure evaluation – grain size	On each as quenched lot	None Not required for non SSC tested grades	1 test per hardenability test (i.e. 1 test per heat per heat treatment run)
^a When the MPQ is being conducted specifically for the qualification of an upset product of Grade T95EN, C110 or M125, additional tensile, impact and hardness testing shall be agreed as part of the scope. ^b Reporting all intentionally added or controlled elements for the product and ladle analysis is required. ^c Chemical composition variants may require this test as part of the MPQ. The scope shall be agreed.			

L.4.4 Additional Requirements for Products Requiring SSC Testing

L.4.4.1 Test Sampling, Tests and Frequency

The 21 lengths (pipe) or six pieces of coupling stock that were selected in Table L.1 shall be subjected to additional testing using the methods, sampling locations and test frequencies given in Table L.5.

L.4.4.2 Acceptance Criteria

Testing and acceptance criteria shall be in accordance with this specification for the grade and SL assessed.

Testing conditions and acceptance criteria for SSC quality control testing shall be in accordance with Table 20 or Table 21 or as per the agreed PQP based on PPQ for the variant grades LS or E.

For grades that do not include SSC Method D production tests in the PQP, Method D shall be tested with the results reported for information only.

L.4.4.3 Invalidation of Tests

The criteria for invalidating test results obtained as part of the MPQ shall be in accordance with API 5CT and the items listed in 7.14.6.

SSC retest provisions for MPQ shall be in accordance with 7.14.2.2 and/or 7.14.2.3, dependent on the testing method.

L.4.4.4 Retests

If test failure(s) occur(s) on MPQ samples, an assessment to determine root cause(s) shall be performed.

Corrective action(s) to mitigate the root cause(s) shall be documented and available to purchaser upon request.

The corrective actions shall be applied prior to retest

The material shall be retested as per one of the following options:

- retested under the original scope of MPQ;
- reprocessed and tested again under the original scope; or
- retested under a revised MPQ scope that has been submitted for approval to the purchaser prior to retest.

L.5 Reporting

The reporting information shall include the requirements stated in Section 13.

The report shall also include deviations and root cause analysis of findings and non-conformance issues based on the original declared PQP and the scope agreed for the validation or qualification activity.

The report shall include the required actions to conform with the specification, original declared PQP and declared mechanical and sour service performance. Adjustment to the PQP is permitted.

Final agreed actions shall be documented and appended to the report package.

Add new Table L.5

Table L.5—Test Methods, Sampling Locations, and Frequencies for Manufacturing Procedure Qualification of Product Requiring SSC Testing

Qualification Testing Strategy ^a	Specific Requirements for Method specified	Stage of Sampling or Product	Test Frequency
Combined with MPQ for mechanical and SSC	Complete set of mechanicals and dimensional tests as per Table L.4, based on number of components for the test from Table L.1	Utilize the testing frequencies and requirements of Table L.4 for structuring the testing program based on the grade specified.	
	SSC NACE TM0177:2016 Method A	Tests set(s) shall be taken from the circumferential position of the length that has the highest hardness (by quadrant hardness testing).	3 test sets from each sacrificial length, from both ends and the middle of each selected length A test set shall consist of at least three test specimens (with valid results).
	SSC NACE TM0177:2016 Method D	a) From each sacrificial length, the location that has the greatest hardness Tests set(s) shall be taken from the circumferential position of the location that has the highest hardness (by quadrant hardness testing).	One test set from each sacrificial length (3 test sets) A test set shall consist of at least three test specimens (with valid results).
		b) From each sacrificial length, the location that has the greatest yield strength Tests set(s) shall be taken from the circumferential position of the location that has the highest yield strength.	One test set from each sacrificial length (3 test sets) A test set shall consist of at least three test specimens (with valid results).
Upsets (only applicable to qualification of Grade T95EN, C110 or M125 upset products)	One additional test set from the area with the highest wall thickness, tested in accordance with the method specified		

Add new Annex M

Annex M **(normative)**

Validation of NDE and Thread Inspections

M.1 Validation of UT and EMI Equipment Repeatability

M.1.1 Introduction

M.1.1.1 General

The capability of the NDE process to satisfy the requirements of this specification and standards referenced herein shall be validated and demonstrated.

M.1.1.2 Frequency of Validation

The equipment shall be validated every four years. The equipment validation shall remain current unless there is a change to structural components, software, or hardware, excluding like-for-like replacement that are part of typical maintenance.

M.1.1.3 Purchaser's Request

Any requests for repeating the validation of a specific criteria, i.e. acceptance (inspection) level, reference indicator angle, notch length, size, grade or wall thickness, shall be specified.

M.1.2 Prior to Validation Activity

M.1.2.1 Documentation Submission

The following information shall be supplied prior to the validation activity:

- a) scope of the validation (see M.1.2.2);
- b) NDE procedures including applicable methods in compliance with 10.15, SR 41.2 and applicable to the scope of the validation activity including scan plan information;
- c) design of UT and/or EMI reference standards in compliance with 10.15.3, M.1.3.1 and if applicable, SR 41.2;
- d) report of visual and dimensional inspection for UT and EMI reference standards and artificial reference indicators, demonstrating conformance with 10.15.3 and Table C.44 or Table E.44;
- e) detailed description of the equipment design and any capability studies that the mill may have performed on the equipment.

M.1.2.2 Scope of Validation

The scope of the validation shall consist of:

- a) renewal of existing scope of validation;
- b) extension to scope or new validation;

- c) the most stringent acceptance criteria (inspection level) in accordance with the mill's capability, based on the SL or SR specified;
- d) pipe types (manufacturing methods e.g. EW, SMLS) materials, grades;
- e) for each pipe type, ranges of pipe diameter and thickness for which validation is sought;
- f) NDE methods, techniques and documented threshold settings.

M.1.3 NDE Method-Specific Requirements During Validation

M.1.3.1 Practical Demonstrations

Transducer arrays shall be validated individually and documented in a scan plan and standard operating procedures.

Practical demonstrations of UT and EMI shall be carried out on one or more full length reference standards that cover the manufacturer's thickness and diameter ranges:

- a) if the minimum diameter is less than 75 % of the maximum diameter, and the minimum and maximum wall thickness are both less than or equal to 12 mm (0.47 in.), one reference standard having the lowest wall thickness and smallest diameter shall be used;
- b) if the minimum diameter is less than 75 % of the maximum diameter, and the minimum and maximum wall thickness are both greater than 12 mm (0.47 in.), one reference standard having the highest wall thickness and largest diameter shall be used;
- c) if the minimum diameter is greater than 75 % of the maximum diameter, one reference standard having the lowest wall thickness and smallest diameter and one reference standard having highest wall thickness and largest diameter shall be used.

M.1.3.2 UT of EW and SMLS Pipe

M.1.3.2.1 General Requirements

Practical demonstration of ultrasonic testing (UT) shall consist of:

- a) equipment set-up;
- b) static (if practicable) and dynamic standardization;
- c) gate positions for defects and coupling;
- d) signal to noise ratio;
- e) detection of reference reflectors (in accordance with 10.15.1 and if applicable SR 41.2);
- f) repeatability trial;
- g) extent of coverage;
- h) accuracy and consistency of seam tracking system and centering;
- i) documented threshold settings.

M.1.3.2.2 Repeatability Trial

The repeatability trial shall be carried out dynamically, using the maximum production conditions whether travel and/or cross-head, used during production.

Indications from reference indicators shall be set at an amplitude to enable recording and subsequent height measurement.

For automated ultrasonic systems that measure amplitudes up to 100 % full scale height, indications greater than or equal to 100 % shall be invalid.

Based on the design of the equipment, the repeatability trial runs are to be conducted as per M.1.3.2.2 a) or b).

- a) For equipment with rotating pipe assemblies, 12 uninterrupted forward test runs and 12 uninterrupted reverse test runs shall be completed.

NOTE Test runs with alternative direction of pipe or equipment travel are acceptable.

- b) For equipment with rotating head assemblies, test runs shall be completed as per M.1.3.2.2 b) 1) through 3).
 - 1) Repeatability trial test runs shall consist of 12 uninterrupted test runs in forward and 12 uninterrupted test runs in reverse.
 - 2) Each set of 12 uninterrupted test runs shall consist of a series of 3 test runs with the joint at the four different angular positions of 0°, 90°, 180° and 270°.
 - 3) During the test runs the pipe angular position shall be rotated either between runs or after a series of test runs.

NOTE Test runs with alternative direction of pipe or equipment travel are acceptable.

Reference standard shall be turned end-to-end and required test runs repeated. Any interruption or adjustment between test runs shall invalidate the results.

Response amplitudes from the same side (i.e. right/left, front/back) of each reference indicator shall be used to determine acceptance.

The results of a repeatability trial shall be acceptable when no reference indicator response amplitude deviates from the average value by more than ± 25 %.

M.1.3.2.3 Recording of Data

The following data shall be recorded:

- a) written procedure;
- b) reference standard details and dimensions;
- c) identifier of unique equipment used, including probe types, frequencies and dimensions;
- d) chart record, either paper or digital, as applicable;
- e) for each scan number, the channel, probes used, scanning direction, reference reflector identities and locations, indication amplitudes (digitally recorded);

- f) indication amplitudes for all reference reflectors recorded as percentage of screen height or as percentage of chart height (as applicable), or decibels, using an automated digital method such as a digital export feature, to at least one decimal point; and
- g) indication amplitudes for all channels and all reference reflectors entered into a spreadsheet with calculated average values and the minimum and maximum deviations from the average values.

M.1.3.3 EMI of EW or SMLS Pipe

M.1.3.3.1 General Requirements

The practical demonstration of electromagnetic inspection (EMI) shall consist of:

- a) equipment set-up;
- b) static (if practicable) and dynamic standardization;
- c) signal to noise ratio;
- d) detection of all reference reflectors;
- e) extent of coverage;
- f) repeatability trial;
- g) application to one or more production pipes, or suitable substitute, to be specified;
- h) documented threshold settings;
- i) accuracy and consistency of seam centering tracking system.

M.1.3.3.2 Repeatability Trial

The repeatability trial shall be carried out dynamically, using the maximum production conditions whether travel and/or cross-head, used during production.

Indications from reference reflectors shall be set at an amplitude to enable recording and subsequent height measurement.

For EMI systems that report amplitudes as a percentage, any amplitude reported as greater than or equal to 100 % shall be invalid.

Repeatability trial test runs shall be conducted as per M.1.3.3.2 a) through c).

- a) Repeatability trial test runs shall consist of 12 uninterrupted test runs in forward and 12 uninterrupted test runs in reverse.
- b) Each set of 12 uninterrupted test runs shall consist of a series of 3 test runs with the joint at the four different angular positions of 0°, 90°, 180° and 270°.
- c) During the test runs the pipe angular position shall be rotated either between runs or after a series of test runs.

NOTE Test runs with alternative direction of pipe or equipment travel are acceptable.

Any interruption or adjustment between test runs shall invalidate the results.

The results of a repeatability trial shall be acceptable when no reference indicator response amplitude deviates from the average value by more than $\pm 25\%$.

M.1.3.3.3 Reporting of Data

The following data shall be reported:

- a) written procedure;
- b) reference standard details and dimensions;
- c) identifier of unique equipment used, including probe types, frequencies and dimensions;
- d) chart record, either paper or digital as applicable;
- e) for each scan number, the channel, probes used, scanning direction, reference reflector identities and locations, and indication amplitudes (digitally recorded);
- f) indication amplitudes for all reference reflectors recorded as percentage of screen height or as percentage of chart height (as applicable), using a consistent method, to at least one decimal point;
- g) indication amplitudes for all channels and all reference reflectors entered into a spreadsheet with calculated average values and the minimum and maximum deviations from the average values; and
- h) additional reporting in accordance with Annex L.5.

M.1.3.4 Evaluation of Trial

If a validation activity on a specific NDE method fails, an assessment to determine root cause(s) shall be performed.

Corrective action(s) to mitigate the root cause(s) shall be documented and available to the purchaser upon request.

The corrective actions shall be applied prior to performing another repeatability trial.

Results of the trial(s) shall be used to re-evaluate the production inspection procedure and NDE settings.

M.2 Validation for NDE on Specific Product

M.2.1 Scope

The terms of this section shall apply when a validation of NDE system capability for a specific product is specified.

The demonstration shall validate that the natural defects from the process of manufacture are being detected at production examination conditions.

NOTE The demonstration may be performed on a series of products that test the boundaries of capability of the NDE. When this approach has been applied, the technical justification for the range of products covered by the testing program may be accepted in lieu of additional testing.

The validation shall be conducted on the product on part or the complete purchase order.

Validation of the repeatability of NDE on reference standards in accordance with Annex M.1 should be completed prior to conducting this activity.

The manufacturer shall perform validation in the following instances:

- when the process of product manufacture changes (rolling, chemical composition, heat treatment or other process) which alters or affects the defects typical of the manufacturing process in the product;
- when the NDE equipment has been modified;
- to validate the oblique angles to be utilized when SR 41.2 is specified.

Validation shall be to the acceptance criteria based on the most stringent of product, grade, SL, wall thickness tolerance and/or SR(s) specified.

M.2.2 Test Sampling and Acceptance Criteria

The number of joints or items selected for the validation shall be at least 125. The manufacturer may elect to conduct the trial with a larger number of production tubulars.

Add new Table M.1

Table M.1—Acceptance Criteria—Validation for NDE on Specific Products

Specification Level or Wall Thickness Tolerance	Maximum Number of Rejectable Defects	Minimum Measured Wall Thickness
SL-A	0 ^a	t_{min}
Wall thickness tolerance < 12.5 %		
SL-B	0 ^b or 2 ^a	t_{min} – 0.05 mm (-0.002 in)
Key t_{min} = minimum acceptable net effective wall thickness based on specified wall thickness (t) and wall thickness tolerance. Example for an alternative tolerance of -10 %, t_{min} $= t(1-0.10)$		
^a Defects found during second inspection that are 0.05 mm (0.002 in) larger than the criteria given in Table C.43 or Table E.43 are rejectable.		
^b Defects found during second inspection that are 1.5 times larger than the criteria given in Table C.43 or Table E.43 are rejectable.		

Previous validation data on similar product(s) may be proposed for review and acceptance in lieu of a new validation.

M.2.3 Procedure

NDE at production conditions on the total order shall be conducted in accordance with the manufacturer's internal procedures and the inspection criteria based on SL from Table C.43 or Table E.43.

At least 125 joints that have met the inspection criteria, are judged to be free from defects and have wall thickness greater than specified shall be re-inspected to the same inspection criteria at increased sensitivity with the following parameters adjusted:

- a) Reduction of equipment feed and/or speed to double volumetric coverage of initial inspection.
- b) For flaw detection:
 - 1) reference amplitude increased by +2 dB;
 - 2) alarm threshold lowered by -1 dB.

- c) For wall thickness: the alarm threshold lowered by the greater of 1 % nominal wall thickness or 0.05 mm (0.002 in.).

Defects, imperfections and the difference in the measured wall thickness from the inspections shall be tabulated.

M.2.4 Retests

If a validation for inspection procedure fails, an assessment to determine root cause(s) shall be performed.

Corrective action(s) to mitigate the root cause(s) shall be documented and available to purchaser upon request.

The corrective actions shall be applied prior to performing another inspection.

Reporting shall be in accordance with L.5.

If a validation for inspection procedure fails, a new validation shall be performed with at least double the number of joints classified as acceptable and re-inspected. For the new validation, joints shall be inspected that were not previously part of the inspected dataset.

M.3 Validation of Thread Inspection Process

M.3.1 Scope

The terms of this section shall apply when validation for a process consistency in thread inspection is specified.

This validation procedure shall be performed on a production run of the threading line for repeatability determination.

The validation shall be conducted on the agreed product on part or the complete purchase order.

NOTE 1 The validation can be done on a series of products that test the boundaries of capability of the threading operation. When this approach has been applied the technical justification for the range of products covered by the testing program can be used in lieu of testing, if the specified product is technically less difficult in terms of machinability.

Products with higher chromium percentages shall be validated separately.

NOTE 2 Validation should be performed on each size, weight, grade and thread form to judge that the cutting and gauging practice conforms to the criteria of M.3.3.

M.3.2 Test Sampling

The number of joints or couplings for the validation shall be at least 125.

M.3.3 Thread Gauging and Acceptance Criteria

Threads shall be gauged, at production conditions, in accordance with the manufacturer's internal procedures.

10 % for SL-B or 30 % for SL-A from the first inspection shall be randomly selected.

NOTE Random sample can be selected before threading and re-gauge performed inline.

The thread elements on those connections shall be re-gauged to the same inspection criteria with either of the following:

- a different set of gauges where available (i.e. gauges used on the mill end threads could be used on field end threads, and the reverse); or
- a different inspector (i.e. inspector who gauged the mill end threads could gauge the field end threads, and the reverse).

Measurements of all inspections shall be recorded.

The threading validation pass criteria shall be zero out-of-specification thread elements and zero defects are found.

M.3.4 Retests

If a validation for inspection procedure fails, an assessment to determine root cause(s) shall be performed.

The corrective actions shall be applied prior to performing another inspection.

If the validation fails, a new validation shall be performed using the same requirements but with at least double the number of joints or couplings randomly selected.

For the new validation, joints shall be inspected that were not previously part of the inspected dataset.

Corrective action(s) to mitigate the root cause(s) shall be documented and available to purchaser upon request.

M.3.5 Reporting

Reporting shall be in accordance with L.5.

Add new Annex N

Annex N **(normative)**

End Sizing and Thermal Recovery Process Requirements

N.1 Validation of End Sizing and Thermal Recovery Process

The terms of N.2 shall be used to validate the process of end sizing, with or without a subsequent thermal recovery process (ESTR process), and the terms of N.3 shall be used to demonstrate control of an ESTR process during production.

Grades with yield strengths lower than 552 MPa (80 ksi) shall be excluded from the provisions of this annex unless specified.

Throughout this annex, the ESTR manufacturer is stated as "manufacturer". The ESTR manufacturer may be the same entity that was responsible for manufacturing the plain end pipe or may be a different processing entity.

The requirements of this annex may be waived based on acceptance of the evidence provided.

If thermal recovery is applied at pipe ends only, the process shall not be considered heat treatment.

If thermal recovery is applied full-length after end sizing and the thermal recovery temperature is above the limits specified in 10.4.1 for stress-relief, a new heat treatment shall be qualified by testing as new lots.

N.2 Validation of End Sizing and Thermal Recovery Process

N.2.1 General

The terms of this section shall be used to validate the ESTR process.

The ESTR process shall be demonstrated for the manufacturing process route and location.

The ESTR process shall be demonstrated for the product size, wall thickness, grade, chemical composition, connection geometry, yield strength and maximum strain combination.

The validation process, parameters and procedures together with associated data and analysis shall be documented to demonstrate conformance with this annex.

Evidence may be presented that the ESTR process for a particular combination is covered by other validation results based on equivalent metallurgical, deformation considerations or equivalent equipment and manufacturing process route.

N.2.2 Validation Testing

N.2.2.1 Test Specimens

Test specimens for ESTR process validation shall be taken from the following locations on each end of one joint after the length is processed:

- a) A set of tensile, hardness (if applicable for the grade specified), SSC (if applicable for the grade specified) and impact test specimens sampling the zone of maximum strain (within the constraints of the sized end and specimen geometries).
- b) When thermal recovery is applied and the temperature exceeds the tempering temperature for the product, an additional set of tensile specimens that sample material immediately adjacent to the sized end (i.e. specifically, material that has experienced the thermal relief, but has not been deformed plastically by the end sizing process).
- c) A set of tensile, hardness (if applicable for the grade specified), SSC (if applicable for the grade specified) and impact test specimens, sampling a zone (mother) adjacent to the sized end, but that has experienced no plastic deformation or thermal recovery from of the ESTR process.

If the deformed area is too small to allow machining the minimum sub-size test specimen indicated in ASTM A370 for tensile test, Table C.8 or Table E.8 for impact test or NACE TM0177:2016 for SSC test, alternative validation method(s) or extrapolation from larger section product of the same grade and composition shall be agreed.

The alternative validation method or proposal shall have at a minimum the same percentage deformation as the product being validated.

N.2.2.2 General Requirements

N.2.2.2.1

The following requirements are to be met:

- a) Tests shall be performed in accordance with N.2.2.3 through N.2.2.6, as applicable for the grade.
- b) Retesting of one or more test specimens that fail the applicable acceptance criteria is permitted provided at least one of the following causes applies and both the failure and the cause shall be documented:
 - 1) The test specimen shows defective preparation or material imperfections unrelated to the intent of the test, whether observed before or after testing.
 - 2) An alternative cause that is not listed in this specification, but justified by the manufacturer and accepted by the purchaser. Such a specimen may be replaced by:
 - the retest of another specimen from the same length; or
 - if re-testing using another length, then specimens from all three zones listed in N.1.2.1 a) to c).
- c) All test results including invalid and defective specimens shall be recorded.

N.2.2.2.2

The report of end sizing validation (with or without thermal recovery) shall identify the following:

- a) product diameter, wall thickness, grade, maximum deformation and strain applied and connection geometry;
- b) process control plan including the tempering temperature and thermal recovery configuration, the temperature measurement locations, type of temperature measurement instruments, the maximum temperature of thermally treated ends, the thermal recovery temperature setup (thermal cycle ramp rate and hold time), and the total exposure time (as applicable);
- c) equipment, manufacturing process route and location;

- d) when using a previous qualification, documentation of the product that is equivalent to the product to be qualified shall be supplied. If extrapolation from existing validation is proposed, a technical justification for the applicability shall be provided.

N.2.2.3 Tensile Testing

N.2.2.3.1

The following requirements are to be met:

- a) Tensile testing shall be in accordance with ASTM A370.
- b) Tensile testing shall be performed in accordance with 10.4.7 and 10.4.8.
- c) Tensile specimens shall be the largest applicable round bar. Specimens with diameter below 8.9 mm (0.350 in.) are acceptable provided they conform to ASTM A370. The same size and type of specimen shall be used when comparing the results from each tested section.
- d) The yield strength shall be determined using the 0.2 % offset method as listed in ASTM A370 or other equivalent method agreed.

N.2.2.3.2

For the purpose of validating the ESTR process, yield strength shall comply with the following requirements:

- a) The minimum yield strength shall be the minimum yield strength of the grade in accordance with Table C.5 or Table E.5.

NOTE A lower minimum criterion, including acceptance of values up to 20.7 MPa (3 ksi) lower than the grade minimum may be agreed to account for the difference in uncertainties of yield strength measured using different specimens.

- b) Dependent on the grade, the difference of yield strength between the deformed area or the transition area (when applicable) and the unaffected pipe body (mother) shall be:
 - less than or equal to the greater of 10 % or 68.9 MPa (10 ksi) for Grades N80 (all types), L80, R95, or P110;
 - less than or equal to 7.5 % for Grades P125 or Q125;
 - less than or equal to the greater of 5 % or 34.5 MPa (5 ksi) for Grades C90, R95LS, T95, P110LS, C110, or M125.

N.2.2.4 Hardness Testing

When a maximum hardness criterion is specified for the product (grade, SL, or variant, excluding maximum hardness variation), the following requirements are to be met:

- a) Hardness testing shall be performed in accordance with 10.6.9 through 10.6.13.
- b) Hardness test specimens shall be prepared in accordance with Figure D.10 using four-quadrant testing.

For the purpose of validating the ESTR process, hardness results shall meet the maximum hardness requirements specified in 7.7, Table C.5 or Table E.5 for the grades, excluding the maximum hardness variation.

N.2.2.5 Impact Testing

N.2.2.5.1

The following requirements are to be met:

- a) Impact testing shall be performed in accordance with 7.3.7, 10.7.5 and 10.7.6.
- b) The impact test shall consist of a set of three test specimens. The specimens shall be the largest possible from Table C.8 or Table E.8 and selected based on the hierarchy of test specimen size and orientation in Table C.9 or Table E.9.

N.2.2.5.2

For the purpose of validating the ESTR process, impact results are to meet the requirements of the grade as follows:

- a) Results shall meet the requirements for the pipe nominal wall thickness, SL and grade in accordance with 7.3.1, 7.5, and Table C.5 or Table E.5.
- b) The average absorbed energy of the deformed zone shall exceed 75 % of the average absorbed energy of the zone that has not been affected by the ESTR process.

N.2.2.6 SSC Testing

For grades requiring SSC testing, SSC testing in accordance with the criteria and parameters defined in Table 20 or Table 21 shall be performed on a specimen from the ESTR section. However, if a previous successful validation, including SSC testing, has been conducted for equivalent metallurgy and manufacturing process (as per N.1.1), the following shall apply:

- a) Equivalent metallurgy shall be of the same grade, chemical composition and manufacturer with a wall thickness no less than 80 % of that of the ESTR process being validated.
- b) Equivalent manufacturing process shall have the same thermal recovery process and a maximum plastic strain that is no lower than that of the ESTR process being validated.
- c) The nominal wall thickness for the current validation is no more than 120 % of the wall thickness from the previous validation.

The purchaser shall specify if the SSC tests from a prior validation are acceptable or if new SSC tests are needed.

To validate the ESTR process, SSC test results shall be in accordance with Table 20 or Table 21.

N.3 Control of End Sizing and Thermal Recovery Process during Production

N.3.1 General

The terms of this section shall be used to demonstrate control of the ESTR process during production.

In accordance with N.3.2, the ESTR process shall be demonstrated to be appropriate for the current production run by control testing the first article of the campaign. During production of the first article, the control parameters and test results shall be recorded and verified against the documentation from ESTR process validation from N.2.

The temperature of pipe ends shall be controlled and recorded as defined within the process control plan. The process control plan temperature and time parameters shall be in accordance with the envelope defined during

ESTR process validation. For temperature recording, the temperature shall be measured with a calibrated optical pyrometer, handheld thermometer, contact pyrometer or thermocouple. Other devices may be proposed. A record of the temperature control measurements shall be open to inspection. Temperature sticks and paints may be used for periodic temperature verification but shall not be for acceptance of the product or for recorded values.

N.3.2 Control Testing

N.3.2.1 Test Specimens

The test specimens for ESTR process control shall be taken from each of the following zones on each treated end of the control test length after the length is processed:

- a) A set of tensile and hardness (if applicable based on grade specified) test specimens sampling the zone of maximum strain whilst remaining within the constraints of the sized end and specimen geometries.
- b) When thermal recovery is applied and the temperature exceeds the tempering temperature for the product, an additional set of tensile specimens that sample material immediately adjacent to the sized end (i.e. specifically, material that has experienced the thermal relief, but has not been deformed plastically by the end sizing process).
- c) A set of tensile, hardness (if applicable based on grade specified), sampling a zone adjacent to the sized end, but which has experienced no plastic deformation or thermal recovery as a consequence of the ESTR process.
- d) If specified, a set of SSC specimens sampling the zone of maximum strain while remaining within the constraints of the sized end and specimen geometries, from a section as close as possible to the to the area of maximum strain and adjacent to the (mother) pipe body.

If the deformed area is too small to allow machining test specimens, the parameters of N.1.2.1 may apply.

N.3.2.2 General Requirements

- a) Tests shall be performed in accordance with N.3.2.3 through N.3.2.5, as applicable for the grade.
- b) The process set point may be changed within the validated range without additional test specimens unless the tempering temperature is exceeded during thermal recovery.
- c) If tempering temperature is exceeded, additional test specimens shall be taken.
- d) If either tensile or hardness valid test(s) fail, retesting shall be performed with two tests for every failed test/test set from the same end that initially failed with no change in the process parameters.
 - 1) If all retests pass, the first article passes.
 - 2) If re-test results fail to meet requirements, all lengths produced since the last successful test shall be rejected.
 - 3) If re-test results fail to meet requirements, the ESTR process parameters shall be modified, unless one of the following conditions is recorded:
 - the test is invalid and a cause is assigned; or
 - the test specimen shows defective preparation or material imperfections unrelated to the intent of the test, whether observed before or after testing.

Such a defective prepared specimen shall be replaced by another specimen from the same length or if re-testing using another length, the three zones given in N.3.2 a) to c) are required to be re-tested.

N.3.2.3 Tensile Testing for Production Control

Tensile testing shall be performed in accordance with N.2.2.3 on each treated end of the first article.

N.3.2.4 Hardness Testing for Production Control

When a maximum hardness is specified for the product (grade, SL, or variant, except maximum hardness variation), one-quadrant hardness testing in accordance with N.2.2.4 shall be performed on each treated length of the first article.

N.3.2.5 SSC Testing for Production Control

If specified, SSC testing shall be performed on the first article - pin and box, in accordance with N.2.2.6.

Add new Annex P

Annex P **(normative)**

Up-rated Collapse Variant Grades—PPQ for Performance Rating and Production Testing

The terms of P.1 shall apply when PPQ is invoked in the purchase agreement for an up-rated collapse product.

The terms of P.2 shall apply when a UC variant product that has a greater collapse rating than the historical values of API 5C3 has been specified.

P.1 PPQ for Up-rated Collapse Performance Rating

P.1.1 Claimed Performance

A collapse rating for a nominal size, nominal wall thickness, grade, drift diameter and manufacturing process combination shall be declared.

NOTE The term “manufacturing process” includes forming (before and after heat treatment), heat treatment and straightening processes.

The basis for determining the rating with reference to the design equation or approach (e.g. from API 5C3) shall be documented.

The collapse rating basis shall be available to the purchaser.

The process control parameters defined in P.1.2 shall be part of the product collapse rating basis document or the PQP.

P.1.2 Product Quality Plan

Based on the requirements of P.2, a PQP for production shall be developed.

The PQP shall include process control parameters that are specific to the UC product.

The PQP shall define the properties measured during the production order including:

- frequency of full-scale collapse to failure tests;
- frequency of geometric and mechanical property parameter measurements.

Full-scale collapse to failure tests, tensile test results, wall thickness and ovality shall be included in the PQP.

P.1.3 Demonstration of Performance

The manufacturer shall have data demonstrating the capability to consistently produce pipes that exceed the declared collapse rating.

The data shall include validation methods and procedures.

When using a previous qualification, documentation of product that is equivalent to the product to be qualified shall be supplied.

A technical justification for the applicability of any proposed extrapolation shall be provided.

If the manufacturer does not have an adequate amount of relevant data to support the rating declared in P.1.1, a trial production run of at least 40 lengths from at least two heats shall be produced.

The controlled variables shall be measured and recorded at the frequency in P.1.2.

Ten lengths from each heat shall be randomly selected and collapse to failure tested in accordance with API 5C3, Annex I.

If a selection method other than random is specified, parameters shall be agreed for selecting joints to be tested to collapse to failure in accordance with API 5C3, Annex I, i.e. based on selecting tubular with the greatest susceptibility to collapse based on OD, wall thickness, ovality or eccentricity.

P.1.4 Rating Documentation

The collapse to failure test results and measurements per API 5C3, Table I.1 shall be recorded.

P.2 Up-rated Collapse (UC) Product Production Inspection and Testing

P.2.1 General

When a UC grade from Table 18 is supplied, the inspection and testing provisions in P.2.2 and P.2.3 shall apply.

The UC pipe shall be marked in accordance with 11.1.10.

The certificates shall include the requirements of 13.3 v).

The purchase agreement or IOGP S-735D shall be used by the purchaser to request, for the manufacturer's acceptance, the minimum required collapse rating for the tubular.

If unable to deliver the requested rating based on the design and testing history of the product specified, an alternative rating shall be proposed.

The collapse rating shall be validated in accordance with P.1 or an alternative methodology proposed and accepted.

During production, parameters relevant for the UC rating that were identified during product qualification in accordance with P.1 shall be measured and recorded.

P.2.2 Product Dimensional Inspections

Wall thickness shall be measured in accordance with P.2.2.1 and with the agreed PQP or documented procedure.

Wall thickness measurement shall be in accordance with the agreed PQP or documented procedure.

Where the PQP requires measurement of ovality or the documented procedure lists that parameter as critical for the UC rating, ovality shall be calculated using P.2.2.2.

Where the PQP requires measurement of eccentricity or the documented procedure lists that parameter as critical for the UC rating, eccentricity shall be calculated P.2.2.3.

Measurements and statistics recorded during production shall be kept and provided in accordance with IOGP S-735L.

P.2.2.1 Wall Thickness Measurement

Wall thickness shall be measured using the surface area coverage of the applicable grade and SL in accordance with Table C.42 or Table E.42.

NOTE When full length coverage is required by the purchaser and it is not included in the PQP, SR 41.1 can be specified.

P.2.2.2 Ovality Measurement

When ovality control contributes to the claimed rating in accordance with the documented procedure or PQP, ovality shall be measured and statistics recorded. Full-length automated ovality measurements should be performed.

If measured manually, ovality measurements shall be taken at least on both ends of 20 % of the lengths per test lot.

If measured manually, ovality shall be measured with an API ovality gauge or calculated from measurements of the outside diameter.

If ovality is determined using manual measurements, outside diameter measurements shall be taken over at least eight equally spaced circumferential positions, with one of the positions (e.g. 0 to 180° plane) defined at the maximum diameter.

Ovality shall be calculated in accordance with Equation (P.1):

$$\text{Ovality} = \frac{100 (D_{\max} - D_{\min})}{D_{\text{ave}}} \quad (\text{P.1})$$

where

D_{\max} is largest of the outside diameter measurements within a unique circumferential ring or plane of measurements;

D_{\min} is smallest of the outside diameter measurements within a unique circumferential ring or plane of measurements;

D_{ave} is average of the measurements within a unique circumferential ring or plane of measurements.

P.2.2.3 Eccentricity Measurement

Eccentricity shall be measured along the length of the pipe and statistics recorded when:

- SL-A has been specified;
- eccentricity control contributes to the claimed rating in accordance with the documented procedure or PQP.

Eccentricity shall be calculated in accordance with Equation (P.2):

$$\text{Eccentricity} = \frac{100 (t_{c \max} - t_{c \min})}{T_{c \text{ ave}}} \quad (\text{P.2})$$

where

$t_{c \max}$ is maximum wall thicknesses within a unique ring or plane of wall thickness measurements;

$t_{c \min}$ is minimum wall thicknesses within a unique ring or plane of wall thickness measurements;

$t_{c \text{ ave}}$ is average wall thickness within a unique ring or plane of wall thickness measurements.

P.2.3 Collapse to Failure Testing

A full scale collapse to failure test shall be performed on one pipe from every lot when fewer than 30 collapse to failure test results from production runs are available.

NOTE If the product has been validated using the requirements given in P.1.3, the 10 lengths that were full scale collapse to failure tested for each heat can count towards the 30 required tests.

The collapse to failure testing frequency shall be at least one test for every 10 lots from a continuous operation or heat treat cycle for SL-B products or at least one per 100 pipes for SL-A products, after collapse tests are completed on at least 30 sample lengths from production runs.

P.2.3.1 Test Specimen Dimensional Measurements

When the collapse rating basis states that a probabilistic approach for determining minimum collapse rating (for example, using API 5C3, Annex F) has been utilized, measurements or test results shall be recorded on each specimen as follows:

- tensile and residual stress test in accordance with the API 5C3, Annex I requirements; and
- dimensional measurements in accordance with P.2.2.

When the collapse rating basis states that a direct (deterministic) approach for determining minimum collapse rating has been utilized, only those dimensional measurements or test results that were identified in the documented procedure or PQP as essential to delivering the collapse rating shall be taken.

P.2.3.2 Test Records

Historical collapse to failure test results used to establish the reduced frequency of production phase testing shall be available on request.

Collapse to failure test results for the order shall be reported on the certificate as per Section 13.

Bibliography

Add to section

- [14] ISO 9001, *Quality management systems — Requirements*

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