International Association of Oil & Gas Producers

SPECIFICATION
S-735

December
2020

Supplementary Specification to API Specification 5CT Casing and Tubing

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
0.1	December 2020	Issued for Public Review

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 2014).

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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, December 2020, 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 data sheet, quality requirements specification (QRS) and information requirements specification (IRS) 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: Data Sheet for Casing and Tubing

The data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of tubulars to the technical specification. The 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 data sheet to define scope and technical requirements for enquiry and purchase of the equipment. The data sheet is compatible with the ISO 11960:2020 standard.

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

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.

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

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.

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

The 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 (data sheet, QRS, IRS);

d) this specification;

e) API Specification 5CT, 10th edition, Addendum 1.

1 Scope

1.1 Coverage

Replace first sentence of first paragraph with

This standard specifies 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).

Replace third sentence of first paragraph with

The requirements that define different levels of standard technical requirements for SL-A and SL-B are provided in Annex H (summary in Annex J) and cover the grades listed below:

— SL-A - Base grades available are J55, K55, L80 Type 1, L80 13Cr, C90 (A or D), R95, T95 (A-90%), T95 (D), C110 (A or D), P110, C125 (A, D or AD) and Q125. Variant grades available are L80 Type 1Cr, L80 Type 3Cr, R95LS (A or D), T95EC, T95E (A,D or AD), P110CY, P110EC, P110ECCY, P110LS (A or D), C110EC (A,D or AD), C110E (A,D or AD), C125EC (A,D or AD), C125E (A,D or AD), Q125ECRY, Q130RY.

— SL-B - Base grades available are H40, J55, K55, N80 Type 1, N80Q, L80 Type 1, L80 13Cr, C90(A or D), R95, T95(A-80%), P110 and Q125. Variant grades available are P110CY, P110EC, P110ECCY, Q125EC, Q130, Q135EC and Q140.

Add to start of third paragraph

Table C.59 or Table E.59 lists a set of commonly ordered non-standard size or wall tubulars which may be ordered by the purchaser.

1.3 Applicability—Grades

Replace section with

1.3.1 API or ISO Base Grades

The products to which this standard is applicable include the following base grades: H40, J55, K55, N80 Type 1, N80Q, L80 Type 1, L80 13Cr, C90 (A), C90 (D), R95, T95 (A-80%), T95 (A-90%), T95 (D), C110 (A or D), P110 and Q125. Products may be ordered to SL-A or SL-B with the following exceptions:

— Grades H40 and N80 (all types) are only available in SL-B.

— Grade C110 is only available in SL-A.

1.3.2 S-735 Grade—Base Grade

The product to which this standard is applicable is Grade C125 which is only available in SL-A.

1.3.3 S-735 Grades—Variant Grades

The variant grades to which this standard is applicable are included in Table C.60 or Table E.60.

NOTE With the exception of Grade C125, variant grades that are based on base grades are expected to be an API monogrammable product if specified by the purchaser.

a) Grades that do not require sulfide stress cracking tests:

1) Chemical composition variations of L80 Type 1 base grade: L80 Type1Cr, L80 Type3Cr.

2) Controlled yield (CY) or restricted yield (RY) variations of base grades:

   i) Variant(s) of P110: P110CY;

   ii) Variant(s) of Q125: Q130, Q130RY, and Q140.

3) Enhanced collapse (EC) variations of the base grades :

   i) Variant(s) of P110: P110EC and P110ECCY;

   ii) Variant(s) of Q125: Q125EC, Q125ECRY, Q135EC.

b) Grades requiring sulfide stress cracking tests according to Table 18 or Table 19:

1) EC variations of the base grades:

   i) Variant(s) of T95: T95EC (A, D or AD);

   ii) Variant(s) of C110: C110EC (A, D or AD);

   iii) ariant(s) of C125: C125EC (A, D or AD).

2) Variations of the base grades with modified SSC acceptance criteria:

   i) Variant(s) of R95 : R95LS (A or D);

   ii) Variant(s) of T95: T95E (A, D or AD);

   iii) Variant(s) of P110 : P110LS (A or D);

   iv) Variant(s) of C110: C110E (A, D, or AD);

   v) Variant(s) of C125: C125 (A, D or AD), C125 E (A, D or AD).

3) Base grades with specified test method:

   i) Variant(s) of T95: T95(A-80%), T95(A-90%), T95(D);

   ii) Variant(s) of C110: C110 (A or D).

where

A is tested with SSC test method A only;

D is tested with SSC test method D only;

A or D is tested with SSC test method A or D;

AD is tested with SSC test method A and D.

1.3.4 Grade Names and Variants

Within this specification, variations of grade names identify the specific requirements that are invoked and the specific marking on the product and on the certificate.

Where the grade name is used in the specification without identifying a variant (e.g. T95), the requirement described in that section applies to all of that grade's variants.

1.4 Supplementary Requirements

Add to section

An additional supplementary requirement that may be specified by the purchaser is also included in K.15.

2 Normative References

Replace ASTM E709 with

ASTM E3024/E3024M:2019, *Standard Practice for Magnetic Particle Testing for General Industry*

Add to section

API RP 5C5:2017, *Procedures for testing casing and tubing connections*

ASTM A941:2018, Sta*ndard Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys*

ISO 11960:2020, *Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells*

ISO 15156-2:2015, *Petroleum and natural gas industries — Materials for use in H_2S-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

Add new term

3.1.48
API monogrammable product
Term and definition as per API Specification Q1:2019, Annex A.3.1, API monogrammable product

Add new term

3.1.49
end sizing
Operation that plastically deforms pipe ends below recrystallization temperature by swaging, expansion or rounding, to adjust dimensions, reducing or increasing OD and potentially changing wall thickness in the deformed area to allow threading of SF or API 5B connections.

Add new term

3.1.50
enhanced collapse tubular
Tubular with collapse properties above the base grade tubular rating (when calculated using ISO/TR 10400 or API TR 5C3) that have been qualified through product performance testing.

Note to entry These tubulars may be termed either "high collapse" or "improved collapse" by the manufacturers.

Add new term

3.1.51
K_{LIMIT}
Theoretical crack growth resistance value for a crack with vanishing driving force that is determined by extrapolating from K_{Issc} tests performed with different wedge sizes.

Add new term

3.1.52
specification level
Package of testing and inspection requirements applied to a grade to deliver a product.

Add new term

3.1.53
thermal recovery (stress relieving)
Heat treatment process on pipe ends previously or subsequently end sized, intended to relieve or limit residual stresses and recover or maintain mechanical properties.

Note to entry Common industrial terminology may refer to thermal recovery as stress relieving.

Add new term

3.1.54
validation
Term and definition as per ISO 9000:2015, 3.8.13, validation.

Add new term

3.1.55
verification
Term and definition as per ISO 9000:2015, 3.8.12, verification.

3.2 Symbols

Replace definition of symbol, Ar_3

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

Delete symbol S_c

3.3 Abbreviations

Add to section

CY controlled yield
EC enhanced collapse
ESTR end-sized with or without thermal recovery
MPQ manufacturing procedure qualification
PPQ product performance qualification
PQP product quality plan
RY restricted yield
SL specification level

4 Conformance

4.1 References to Annexes

Replace seventh list item with

— SLs, see Annex H (normative);

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);

Add new list item

— manufacturing process qualification, see Annex L (normative);

Add new list item

— qualification of NDE equipment, see Annex M (normative).

4.2 Extended Scope

Replace first list item with

— The requirements that define different levels of standard technical requirements for SL-A and SL-B are given in table form in Annex H and summarized in Annex J.

5 Information to be Supplied by the Purchaser

Replace section 5.1 title with

5.1 Grades C90, T95, C110 and C125

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

Grades C90, T95, C110, C125 and all the variant grades listed in Table C.60 or Table E.60 as requiring SSC testing

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

Grades C110 and C125 and their associated variant grades

Add to NOTE

The purchaser may choose to request the manufacturer to perform either a performance envelope PPQ or an MPQ or review their documentation packages for results of previous testing as detailed in Annex L.

5.2 Casing

Replace section (including Tables 1, 2 and 3) with IOGP S-735D

5.3 Tubing

Replace section (including Tables 4, 5 and 6) with IOGP S-735D

5.4 Coupling Stock, Coupling Material, and Accessory Material

Replace section (including Tables 7, Table 8, and Table 9) with IOGP S-735D

6 Process of Manufacture

6.1 General

Replace second sentence of second paragraph with

Pup joints shall be made from the materials listed in Table C.3 or Table E.3 or in Table C.60 or Table E.60.

Delete "unless otherwise specified in the purchase agreement" from third paragraph

Replace fourth paragraph with

Electric-welded Grade P110 (SL-B) pipe and Grade Q125 (SL-B) casing shall be provided only when the supplementary requirement in K.6 (SR 11) is specified in the purchase agreement.

The following grades at SL-A shall be ordered seamless R95LS, P110LS, P110 and Q125.

Replace fifth paragraph with

Grade C110 and C125 products shall not be upset.

6.2 Heat Treatment

6.2.1 General

Add to section

For SL-B products and grades not requiring SSC testing, stress-relief of tempered products shall not be considered "heat treatment" provided the stress-relief temperature is at least 55 °C (100 °F) below the final tempering temperature.

For SL-A products and grades requiring SSC testing, the stress relief of tempered products shall not be considered "heat treatment" provided the stress relief temperature is at least 30 °C (50 °F) below the final tempering temperature.

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

Replace first paragraph with

For grades J55 and K55 products, heat treatment is not mandatory for SL-B products. A heat treatment, consistent with Table C.3, footnote b or Table E.3, footnote b shall be applied when the purchaser specifies SL-A or may be applied at the manufacturer's option. Upset product shall be full-body, full-length heat-treated after upsetting.

Delete fourth paragraph (PSLs)

Replace section 6.2.3 title with

6.2.3 Grades L80 (All Types), C90, T95, and C110 and C125

Replace second sentence of second paragraph with

If Grade L80 13Cr is tempered below 620 °C (1150 °F), it shall meet the requirements of 7.3, 7.4.4, 7.5.2 and 10.7

Replace NOTE with

NOTE In this specification, when used alone, the symbol L80 covers Grades L80 Type 1, L80 1Cr, L80 3Cr, L80 9Cr and L80 13Cr

6.3 Straightening

Add to section before 6.3.1

Straightening shall be performed using a validated (as per 6.5) and documented procedure.

Gag straightening for all applicable grades shall be in accordance with 6.3.7.

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 first paragraph

Delete second paragraph (PSLs)

Add to section

When necessary, product shall be gag press straightened, hot rotary straightenedor cold rotary straightened. Product shall be 400 °C (750 °F) minimum at the end of hot rotary straightening unless a higher minimum temperature is specified in the purchase agreement. Product that is cold-rotary straightened shall be stress-relieved at 510 °C (950 °F) or higher.

6.3.4 Grade C90 and T95

Replace first sentence of first paragraph with

When straightening is necessary, the product shall either be 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 final specified tempering temperature.

Delete second paragraph (PSLs)

Replace section 6.3.5 title with

6.3.5 Grades C110 and C125

6.3.6 Grade Q125

Delete third sentence

Add new section

6.3.7 Gag Straightening

When gag straightening is used, stress relieving post straightening shall be required if the maximum fiber strain is greater than the value established by the manufacturer during process validation (see 6.5).

6.4 Traceability

6.4.1 General

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

For C110, C125, and Q125 Grades and SL-A products,

Replace section 6.4.2 title with

6.4.2 Serialization of Grades C90, T95, C110, C125 and Q125

6.5 Processes Requiring Validation

Add new list item e)

e) end-sizing with or without subsequent thermal recovery;

Add new list item f)

f) cold straightening, unless subsequently heat treated or stress relieved (see 6.6).

Add new section

6.6 Cold Straightening Requiring Validation

a) Stress-relief of tempered products shall not be considered “heat treatment” per 6.2.1.

b) Validation of cold straightening shall address the range of product manufactured and the method used.

c) Validation shall include tensile testing on all grades and hardness testing on grades requiring SCC testing.

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

e) Gag straightening shall be validated by mechanical properties (tensile, and hardness if applicable) in the tension region of the extrados with the highest possible induced fiber strain.

7 Material Requirements

7.1 Chemical Composition

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

For grades requiring SSC testing as per Table 18 or Table 19,

Delete third paragraph (PSLs)

7.2 Tensile Properties

7.2.2 Elongation

In first sentence, replace "The minimum elongation" with

The minimum gauge length elongation

Replace definition of "U" in Equation (1) with

U is minimum specified tensile strength, in megapascals (pounds per square inch) given in Table C.5 or Table E.5 and in Table C.60 or Table E.60 for variant grades.

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 C125

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

Grades C90, T95, C110 and C125

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 Grade C110, C125 and Q125 and when specifying SL-A for Grades L80-1, R95, C90, T95, P110 either:

Delete fourth paragraph (PSLs)

7.3.2 Critical Thickness

Replace last sentence of first paragraph with

For other applications and proprietary special end-finish connections, the critical thickness shall be determined in accordance with 7.6.6.

7.3.5 Alternative Size Impact Test Specimens

Delete "Tables C.10 to C.15" and "Tables E.10 to E.15" from section

7.3.7 Test Temperature

Replace second sentence of first paragraph with

Grades J55 and K55 shall be tested at 21 °C (70 °F) unless the purchaser has specified SL-A when the test temperature decreases to 0 °C (32 °F).

Replace fourth sentence of first paragraph with

The tolerance on the test temperature shall be ±1 °C (±2 °F).

Delete third sentence of second paragraph

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 Cv shall be equal or greater than the value in Table C.61 or Table E.61, based on the SL.

Delete third sentence of first paragraph

Replace section 7.4.4 title with

7.4.4 Grades N80 (All Types), R95, L80 (All Types), C90, T95, P110, C110, C125 and Q125

Delete first sentence of 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, C125 and Q125)

Replace Table 9 with

Unit System	Transverse Requirement C_v	Longitudinal Requirement C_v
SI units, joules	$YS_{max} \times (0.00118t + 0.01259)$ or Table C.61 whichever is greater	$YS_{max} \times (0.00236t + 0.02518)$ or Table C.61 whichever is greater
USC units, foot–pounds	$YS_{max} \times (0.152t + 0.064)$ or Table E.61 whichever is greater	$YS_{max} \times (0.304t + 0.128)$ or Table E.61 whichever is greater

Delete NOTE

7.5 Charpy V-notch-Absorbed Energy Requirements for Pipe

7.5.1 Grades H40, J55, and K55

Replace first paragraph with

Grades J55 and K55 at SL-A, Charpy impact testing per SR16 shall be mandatory with the minimum full size CVN absorbed energy requirement as per Table C.61 or Table E.61.

For SL-B, testing is not a mandatory requirement.

Delete second paragraph (PSLs)

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

Replace first paragraph with

The minimum absorbed energy requirement, C_v, for full-size test specimens is provided in Table 10.

For SL-A, SR16 shall be mandatory.

For SL-B, testing is not a mandatory requirement according to 7.5.5.

Delete second paragraph (PSLs)

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

Replace Table 10 with

Unit System	Transverse Requirement C_v	Longitudinal Requirement C_v
SI units, joules Grades N80 (all types), R95, L80, C90, T95	$YS_{max} \times (0.00118t + 0.01259)$ or Table C.61, whichever is greater	$YS_{max} \times (0.00236t + 0.02518)$ or Table C.61, whichever is greater
SI units, joules Grade P110	$YS_{max} \times (0.00118t + 0.01259)$ or Table C.61, whichever is greater	$YS_{max} \times (0.00236t + 0.02518)$ or Table C.61, whichever is greater
USC units, foot–pounds Grades N80 (all types), R95, L80, C90, T95	$YS_{max} \times (0.152t + 0.064)$ or Table E.61, whichever is greater	$YS_{max} \times (0.304t + 0.128)$ or Table E.61, whichever is greater
USC units, foot–pounds Grade P110	$YS_{max} \times (0.152t + 0.064)$ or Table E.61, whichever is greater	$YS_{max} \times (0.304t + 0.128)$ or Table E.61, whichever is greater

Replace section 7.5.3 title with

7.5.3 Grades C110, C125, Q125 and Variant Grades P110CY and P110ECCY

Replace first paragraph with

The minimum absorbed energy requirement for full-size test specimens is provided in Table 11.

For variant grades P110CY and P110ECCY at SL-A, SR16 shall be mandatory.

For variant grades P110CY and P110ECCY at SL-B, testing is not required.

Delete second paragraph (PSLs)

Replace Table 11 title with

Table 11—Full Size Test Specimen Minimum Absorbed Energy Requirements (Pipe for Grades C110, C125, Q125 and Variant Grades P110CY, P110EC, and P110ECCY)

Replace Table 11 with

Unit System	Transverse Requirement C_v	Longitudinal Requirement C_v
SI units, joules Grades C110, C125, Q125 and Variant Grades P110CY, P110EC, P110ECCY	$YS_{max} \times (0.00118t + 0.01259)$ or Table C.61, whichever is greater	$YS_{max} \times (0.00236t + 0.02518)$ or Table C.61, whichever is greater
USC units, foot–pounds Grades C110, C125, Q125 and Variant Grades P110CY, P110EC, P110ECCY	$YS_{max} \times (0.152t + 0.064)$ or Table E.61, whichever is greater	$YS_{max} \times (0.304t + 0.128)$ or Table E.61, whichever is greater

7.5.5 Testing Conditions

Replace first sentence of first paragraph with

For Grades C90, T95, C110, C125 and Q125 pipe, impact testing in accordance with 10.7 is mandatory. For all grades ordered to SL-A, K.9 (SR16) is invoked and testing is mandatory as specified in 10.7.

Replace second sentence of first paragraph with

For other grades at SL-B, compliance with the requirements of 7.5.3 may be qualified by a documented procedure in lieu of testing, at the manufacturer's option.

7.7 Maximum Hardness

Replace section 7.7.1 title with

7.7.1 Grades L80 (All Types), C90, R95LS, T95, P110LS, C110 and C125

a) Grades L80 (all types), C90, T95, R95, C110, P110LS and C125 Through-wall Hardness

Add new section 4) to a)

4) For Grade C125, any mean hardness number not exceeding 33.0 HRC is acceptable. If a hardness number from a single indentation exceeds 33.0 HRC, the length or piece shall be rejected. Products with mean hardness numbers between 33.0 HRC and 35.0 HRC shall be retested.

Add new section 5) to a)

5) For Grade R95LS, any mean hardness number not exceeding 25.4 HRC is acceptable. If a hardness number from a single indentation exceeds 27.4 HRC, the length or piece shall be rejected. Products with mean hardness numbers between 25.4 HRC and 27.4 HRC shall be retested.

Add new section 6) to a)

6) For Grade P110LS, any mean hardness number not exceeding 30.5 HRC is acceptable. If a hardness number from a single indentation exceeds 32.5 HRC, the length or piece shall be rejected. Products with mean hardness numbers between 30.5 HRC and 32.5 HRC shall be retested.

Delete section c)

Add new section d)

d) Grades C125—Surface hardness (if required in accordance with 10.6)

For Grade C125, if the Brinell or Rockwell C-scale hardness number does not exceed 311 HBW or 33.0 HRC respectively, the length or piece shall be acceptable. If any of the hardness numbers are over 311 HBW or 33.0 HRC two additional indentations shall be made in the immediate area. If either of the second test hardness numbers exceeds 311 HBW or 33.0 HRC, the piece shall be rejected.

Add new section

7.7.3 Hardness Control for Grades Requiring SSC Testing as per Table 18 and Table 19

When not specified in this specification, the hardness shall be in accordance with the manufacturer's specifications or by agreement between the purchaser and the manufacturer via MPQ/PPQ.

Replace section 7.9 title with

7.9 Process Control—Grades C90, T95, C110, C125 and Q125

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

For Grades C90, T95, C110 and C125,

Delete third 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 L80-1

Delete third paragraph (PSLs)

Replace section 7.10.2 title with

7.10.2 Grades C110 and C125

Replace section 7.10.3 title with

7.10.3 All Grades Not Requiring SSC Testing as per Table 18 and Table 19

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 made 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 made 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 by agreement between the purchaser and the manufacturer via MPQ/PPQ.

Replace section 7.11 title with

7.11 Grain Size—Grades Requiring SSC Testing as per Table 18 and Table 19

Add to section

Prior austenitic grain size shall be ASTM 8 or finer for Grade C125 (determined in accordance with ISO 643 or ASTM E112).

When not specified in this specification, for grades requiring SSC testing per Table 18 and Table 19, the grain size shall be in accordance with the manufacturer's specification or by agreement between the purchaser and the manufacturer via MPQ/PPQ.

7.12 Surface Condition—Grades L80 9Cr and L80 13Cr

Replace second paragraph with

For SL-A and SL-B, pipe shall have the internal surface grit blasted or pickled to meet the requirements for Sa 2½ from ISO 8501-1. Grit blasting shall be carried out using blasting medium that do not cause surface iron contamination, for example stainless steel or aluminium oxide grit.

Add NOTE to section

NOTE Sa 2 1/2 is defined within ISO 8501-1 Table 1 as: "Very thorough blast-cleaning". When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from mill scale, rust, paint coatings and foreign matter. Any remaining traces of contamination shall show only as slight stains in the form of spots or stripes. See photographs A Sa 2½, B Sa 2½, C Sa 2½ and D Sa 2½ in ISO 8501-1.

Replace section 7.14 title with

7.14 Sulfide Stress Cracking Test—for Grades Requiring SSC Testing According to Table 18 or Table 19

7.14.1 General Guidance

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

Grades C90, T95, C110, C125 and variant grades requiring SSC testing listed in Table C.60 or E.60

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

Grade C110 and C125 and their associated variant grades.

Add to section

The purchaser should review the manufacturer's documentation packages related to product testing and may request the manufacturer to perform either a PPQ or an MPQ as detailed in Annex L. PPQ and MPQ are intended for qualification of the product performance and manufacturing process in conformance with MR0175/ISO15156, Part 2, Annex B and NACE TM 0177.

If the purchaser requires an SSC requirement higher than the minimum, an agreement shall be reached between the purchaser and the manufacturer via PPQ as provided by Table 18 and Table 19.

Delete NOTE

7.14.2 Test and Retest Requirements

Add new section heading before first paragraph

7.14.2.1 Test Requirements

Replace first paragraph of section a) with

Grades C90 and T95—for each lot, as specified by 10.2, manufacturers shall demonstrate that the product meets or exceeds the minimum SSC requirement using the purchaser-specified NACE TM0177-2016 test method(s) given in 7.14.5 and with the modifications given in Table 18 and Table 19.

Delete second paragraph of section a) (PSLs)

Replace first paragraph of section b) with

Grade C110 and C125—for each lot, as defined in 10.2, manufacturers shall demonstrate that the product meets or exceeds the minimum SSC requirement using the purchaser-specified NACE TM0177-2016 test method(s) given in 7.14.5 and with the modifications given in Table 18 and Table 19.

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

as amended by this overlay

Add to section d)

Base grades and their associated variant grades (requiring SSC testing as defined in Table C.60 or Table E.60) shall be tested according to the conditions and acceptance criteria given in Table 19 for Method D.

Delete section e)

Add new section f)

f) Products made from base and variant grades listed in Table C.60 or Table E.60 as requiring SSC testing shall meet or exceed the SSC requirements of NACE TM0177-2016 including the test method(s) and criteria given in Table 18 and Table 19 on a per lot basis.

Add new section

7.14.2.2 Re-test Requirements for Method A SSC Testing

Retesting of a failed NACE TM0177 Method A test is permitted with the following restrictions and requirements:

- For all grades except R95LS (A), T95 (A 80%) and P110LS (A), retesting of a failed specimen may be performed provided only one specimen fails in a test set.
- If more than one specimen in a test set fails, the lot shall be rejected.
- Retests shall comprise two further test specimens taken from an area of the product adjacent to where the failed test specimen was taken.
- If all of the retests conform to the requirements, the lot shall be accepted.
- If either of the retest specimens fails, the lot shall be rejected (retesting of retests is not permitted).
- Retesting of a failed test specimen in a heat treat cycle may be carried out for Grades R95LS (A), T95 (A 80%) and P110LS (A), provided that no more than one test specimen fails from the heat treat cycle.
- The length from which the failed NACE TM0177 test specimen was taken shall be rejected.
- Retest shall comprise three further test specimens extracted from lengths taken from the start, middle and end of the effected heat treat cycle.
- If all the retests conform to the requirements, the lots from the heat treat cycle shall be accepted.

- If any of the retest specimens fail, all lots from the heat treat cycle shall be rejected (retesting of retests is not permitted).
- Retesting of retests is not permitted.
- Rejected lots may be reheat-treated and tested as new lots.

Add new section

7.14.2.3 Re-test Requirements for Method D SSC Testing

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

- Retesting of a set may be performed provided that no more than one of the initial specimens in a set fails the minimum single specimen K_{ISSC} requirement, and/or if the set fails the minimum mean K_{ISSC} acceptance requirement.
- Retest shall comprise a minimum of two further valid test results from specimens taken from an area of the product adjacent to the failed set.
- Each valid re-test specimen result shall meet or exceed the specified minimum mean K_{ISSC} requirement for the grade.
- If any valid retest specimen result fails the specified minimum mean K_{ISSC} requirement and/or the new test set (initial passed specimens plus the passed retest specimens) fails the specified minimum mean K_{ISSC} acceptance requirement, the lot shall be rejected.
- Retesting of retests is not permitted.
- If all the retests conform to these requirements, the lot shall be accepted.
- Rejected lots may be reheat-treated and tested as new lots.

Add new section

7.14.2.4 Investigation of Failed Test Specimens

NACE TM0177 Method A and Method D failed test specimens that are retested shall be investigated as part of the manufacturer's quality management system for continuous improvement.

Add new Table 18

Table 18—Summary of Sulfide Stress Cracking Testing Requirements—Method A (7.14.5)

Designation	R95LS (A)	T95 (A-80 %) [d]	T95 (A-90 %) [d]	T95 (D) [d]	T95E (A or AD)	P110LS (A)	C110 (A)	C110 (D)	C110E (A or AD)	C125 (A or AD)	C125E (A or AD)
Base grade	R95	T95	T95	T95	T95	P110	C110	C110	C110	C125	C125
Specification level	SL-A	SL-B	SL-A	SL-A	SL-A	SL-A	SL-A	SL-A	SL-A	SL-A	SL-A
H_2S (psia)	14.7	14.7	14.7	NA	14.7	1.45 (N_2 bal)	14.7	NA	14.7	0.44 (CO_2 bal)	1.45 (CO_2 bal)
Solution (7.14.4)	A	A	A		A	Solution D NACE-TM0177-2016	A		A	B	B
Load full size (7.14.5)	As per PPQ	80 % YS_{min}	90 % YS_{min}		T95 (A-90 %) or higher. As per PPQ	85 % YS_{min}	85 % YS_{min}		C110 (A) or higher As per PPQ	85 % YS_{min}	C125 or higher As per PPQ
Load subsize	90 % of full size	90 % of full size	90 % of full size		90 % of full size	90 % of full size	90 % of full size		90 % of full size	By agreement	By agreement
Number of sets per lot [a] (7.14.2)	One per heat treat cycle with at least one test per every two lots	1	1		1	One per heat treat cycle with at least one test per every two lots	1		1	1	2
Number of specimens per test [b] (7.14.2)	1	1	3 [c]		3 [c]	1	3 [c]		3 [c]	3 [c]	3 [c]
Test duration days	30 days										

NOTE 1 Variant EC grades requiring SSC testing per Table C.60 or Table E.60 follow the intended base grade in this table.

NOTE 2 The grade C110-EC (A, D or AD) from Table C.60 or Table E.60 could take the form of C110-EC (A) for which case SSC requirements of C110 (A) in this table applies.

[a] Applicable to pipe body and coupling stock, coupling material and accessory material. The maximum number of pieces per lot is for pipe body is as per Table C.37 or Table E.37, for coupling stock and coupling material is as per Table C.38 or Table E.38, and for accessory material as per Table C.39 or Table E.39.

[b] Test specimens shall be fatigue pre-cracked unless the manufacturer has demonstrated and documented that fatigue pre-cracking is not necessary to avoid test result invalidation.

[c] 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.

[d] C90 grades shall follow the same requirements established for T95.

Add new Table 19

Table 19—Summary of Sulfide Stress Cracking Testing Requirements—Method D (7.14.5)

Designation	R95LS (D)	T95 (A-80 %)	T95 (A-90 %)	T95 (D) [e]	T95E (D or AD) [e]	P110LS (D)	C110 (A)	C110 (D)	C110E (D or AD)	C125 (D or AD)	C125E (D or AD)
Base grade	R95	T95	T95	T95	T95	P110	C110	C110	C110	C125	C125
Specification level	SL-A	SL-B	SL-A	SL-A	SL-A	SL-A	SL-A	SL-A	SL-A	SL-A	SL-A
H_2S (psia)	14.7	NA	NA	14.7	14.7	1.45 (N_2 bal)	NA	14.7	14.7	1 (N_2 bal)	1 (N_2 bal)
Solution	A			A	A	Solution D NACE-TM0177-2016		A	A	Solution D NACE-TM0177-2016	Solution D NACE-TM0177-2016
Test duration days	14			14	14	17		14	14	17	17
Mean K_{Issc} (ksi·in.½) full size (0.375 in.) (7.14.5)	As per PPQ			30.0	T95(D) or higher as per PPQ	31.0		24.0	C110(D) or higher as per PPQ	26.0	As per PPQ
Individual K_{Issc} (ksi·in.½) full size				27.0		28.0		21.0		23.0	
Mean K_{Issc} (ksi·in.½) sub size (0.250 in.)	As per PPQ			As per PPQ/MPQ	As per PPQ	As per PPQ/MPQ		As per PPQ/MPQ	As per PPQ	As per PPQ/MPQ	As per PPQ
Individual K_{Issc} (ksi·in.½) sub size	As per PPQ			As per PPQ/MPQ	As per PPQ	As per PPQ/MPQ		As per PPQ/MPQ	As per PPQ	As per PPQ/MPQ	As per PPQ
Non pre-cracked or pre-cracked allowed (7.14.15)	Both allowed			Both allowed	Both allowed	Pre-cracked [b]		Both allowed	Both allowed	Pre-cracked [b]	Pre-cracked [b]
Max K_I applicable for pre-cracking (ksi·in.½) (7.14.15)	27.0			27.0	27.0	18.6		18.6	18.6	18.6	18.6
Arm displacement (inches) (7.14.15)	0.028 in. + 0.001 in., - 0.002 in.			0.028 in + 0.001 in, - 0.002 in	0.028 in + 0.001 in, - 0.002 in	0.029 in + 0.001 in, - 0.002 in		0.020 in + 0.001 in, - 0.002 in	0.020 in + 0.001 in, - 0.002 in	0.018 in + 0.001 in, - 0.002 in;	0.018 in + 0.001 in, - 0.002 in
Arm displacement (mm) (7.14.15)	0.71 mm + 0.03 mm, - 0.05 mm			0.71 mm + 0.03 mm, - 0.05 mm	0.71 mm + 0.03 mm, - 0.05 mm	0.74 mm + 0.03 mm, - 0.05 mm		0.51 mm + 0.03 mm, - 0.06 mm	0.51 mm + 0.03 mm, - 0.06 mm	0.46 mm + 0.03 mm, - 0.06 mm	0.46 mm + 0.03 mm, - 0.06 mm

Table 19 *(continued)*

Designation	R95LS (D)	T95 (A-80 %)	T95 (A-90 %)	T95 (D) e	T95E (D or AD) e	P110LS (D)	C110 (A)	C110 (D)	C110E (D or AD)	C125 (D or AD)	C125E (D or AD)
Number of sets [d] (3 specimens each) of tests per lot a (7.14.2)	One heat treat cycle with at least one test per every other lot			1	1	One heat treat cycle with at least one test per every other lot		1	1	1	2
Number of specimens per set (7.14.2) and (7.14.15)	3 valid [c]			3 valid	3 valid	3 valid [c]		3 valid	3 valid	3 valid	3 valid

NOTE 1 Variant EC grades requiring SSC testing per Tables C.60 or Table E.60 follow the intended base grade in this table.

NOTE 2 Grade C110-EC (A, D or AD) from Table C.60 or Table E.60 could take the form of C110-EC (A) for which case SSC requirements of C110 (A) in this table applies.

[a] Applicable to pipe body and coupling stock, coupling material and accessory material. The maximum number of pieces per lot is for pipe body is as per Table C.37 or Table E.37, for coupling stock and coupling material is as per Table C.38 or Table E.38, and for accessory material as per Table C.39 or Table E.39.

[b] Test specimens shall be fatigue pre-cracked unless the manufacturer has demonstrated and documented that fatigue pre-cracking is not necessary to avoid test result invalidation.

[c] When the product has gone through the MPQ, the manufacturer may reduce number of specimens per test to two.

[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.

[e] C90 grades shall follow the same requirements established for T95.

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 C125 a mean hardness of 32.0 HRC or higher; or

Add to section after list item d)

When the purchaser specifies SL-A, the default criteria shall be as per c) with the option to select criteria d) if an MPQ as per Annex L confirms that the manufacturing procedure results in products that consistently meet the SSC requirements as per Table 18 and Table 19.

When SL-B is specified by the purchaser, the default criteria shall be as per c) or d) as per the manufacturer's choice.

7.14.4 Test Solution

Replace first sentence with

Test solution used for quality control tests during production of the variant grades requiring SSC testing, as listed in Table C.60 or Table E.60, shall follow the requirements in Table 18 and Table 19.

Test solutions for PPQ activities shall be in accordance with Annex L.

7.14.5 Minimum SSC Requirements

Add before first paragraph

Method A loading and solutions shall follow Table 18. For Method D, the acceptance criteria (including solutions, K_{app} for pre-cracking, arm displacement) shall follow Table 19.

a) NACE TM0177-2016 Method A, Smooth Tensile

Add to section

Full-size (6.35 mm [0.250 in.] diameter) specimen	85 % of YS_{min}	733 MPa (106,250 psi) for C125
Sub-size (3.81 mm [0.150 in.] diameter) specimen	76 % of YS_{min}	655 MPa (95,000 psi) for C125

b) NACE TM0177-2016 Method B, Bent Beam

Delete section b)

c) NACE TM0177-2016 Method D, DCB

Add to section c) 1)

A mean value of 28.6 MPa $m^{1/2}$ (26.0 ksi·$in.^{1/2}$) with a minimum of at least three valid test specimens for Grade C125.

For wall thickness greater than 50.8 mm (2.0 in.) for Grade C125, the mean value of at least three valid test specimens is 28.6 MPa×m$^{1/2}$ (26.0 ksi×in.$^{1/2}$) unless otherwise agreed between the purchaser and the manufacturer.

Add to section c) 3)

iii) 25.3 MPa m$^{1/2}$ (23.0 ksi-in.$^{1/2}$) for Grade C125

For wall thickness greater than 50.8 mm (2.0 in.) for Grade C125, the minimum individual valid specimen value is 25.3 MPa×m$^{1/2}$ (23.0 ksi×in.$^{1/2}$) unless otherwise agreed between the purchaser and the manufacturer.

Replace first sentence of section c) 5) with

Test specimens shall be fatigue pre-cracked unless the manufacturer has demonstrated and documented that fatigue pre-cracking is not necessary to avoid test result invalidation.

In section c) 5) ii), replace "Grade C110" with

Grade C110 and C125

Add new section 9) to c)

9) For Grade C125, the arm displacement shall be 0.46 mm +0.03 mm, -0.05 mm (0.018 in +0.001 in, -0.002 in).

7.14.6 Invalidation of Tests

Add new list item c)

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

Add new list item d)

d) for NACE TM0177 method A tests:

1) evidence of specimen overloading (including due to misalignment or torqueing);

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) test results outside 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 19.

Delete sixth paragraph (moved to 7.14.6)

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

In first sentence of first paragraph, replace "(as shown in Tables C.23 to C.26 inclusive, or Tables E.23 to E.26 inclusive)" with

as shown in Tables C.23 to Table C.26 and Table C.59, or Tables E.23 to Table E.26 and Table E.59

8.9 Straightness

8.9.1 Pipe

Add to section

For upset ends, the measurement shall be taken using a minimum 1.8 m (6 ft) straight-edge shouldered on the pipe-body surface beyond the runout of the upset (reference L_a in Table C.25 or Table E.25 and see Figure D.34) or an equivalent method.

8.9.2 Coupling Stock, Coupling Material, and Accessory Material

Replace section with

Straightness requirements shall be as 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 shall comply with Table C.28 or Table E.28 for both API tubulars (as defined in Table C.1 and Table C.2 or Table E.1 and Table E.2) and non-standard size/wall tubulars (as defined in Table C.59 or Table E.59). API tubulars shall be drifted with the largest mandrel diameter from Table C.29 or Table E.29 or from Table C.28 or Table E.28. For non-standard size/wall tubulars, drift diameter shall comply with Table C.59 or Table E.59. For special finish (SF) products with swaged ends, if pipe has been drift-tested full-length before final machining, the swaged end shall also be drift-tested for a minimum distance equal to the drift mandrel cylindrical section length after final machining.

8.11 Tolerances on Dimensions and Masses

8.11.2 Wall Thickness

Replace section with

The permissible under tolerance for the wall thickness of the pipe shall be 12.5 %, until a tighter tolerance is agreed between the purchaser and the manufacturer.

Alternative tolerances for the pipe body wall thickness may be selected by the purchaser at -10 %, -7.5 % or -5 %.

8.11.3 Mass

Delete second sentence of first paragraph

Replace Table 16 title with

Table 16—Mass Tolerances

Replace Table 16 with

Amount	Standard Wall Thickness Tolerance (-12.5 %)	Alternative Wall Thickness Tolerance (-10.0 %)	Alternative Wall Thickness Tolerance (-7.5 %)	Alternative Wall Thickness Tolerance (-5.0 %)
1	2	3	4	5
Single lengths	$^{+6.5}_{-3.5}$ %	$^{+10.0}_{-3.5}$ %	$^{+10.0}_{-3.5}$ %	$^{+10.0}_{-3.5}$ %
Carload 18,144 kg (40,000 lb) or more	$^{+0}_{-1.75}$ %	$^{+0}_{-1.75}$ %	$^{+0}_{-1.75}$ %	$^{+0}_{-1.75}$ %
Carload less than 18,144 kg (40,000 lb)	$^{+0}_{-3.5}$ %	$^{+0}_{-3.5}$ %	$^{+0}_{-3.5}$ %	$^{+0}_{-3.5}$ %
Order items 18,144 kg (40,000 lb) or more	$^{+0}_{-1.75}$ %	$^{+0}_{-1.75}$ %	$^{+0}_{-1.75}$ %	$^{+0}_{-1.75}$ %
Order items less than 18,144 kg (40,000 lb)	$^{+0}_{-3.5}$ %	$^{+0}_{-3.5}$ %	$^{+0}_{-3.5}$ %	$^{+0}_{-3.5}$ %

8.11.6 Extended Length Upsets

Add to section

Other upset tubulars may be ordered with extended length upsets as agreed between the purchaser and the manufacturer.

8.12 Product Ends

8.12.4 Threading

Replace last sentence with

If performed, end sizing shall be within the parameters given in 10.17.

8.12.5 Workmanship of Ends

Delete second paragraph (PSLs)

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

For SL-A and SL-B Grades L80 13Cr, C90, T95, C110, C125 and Q125, and for SL-A for Grades L80-1, R95 and P110,

Add to section

Thread surface treatment may be specified in the purchase agreement or at the manufacturer's option.

8.12.6 Special End-finish

Add before first paragraph

If requested by the purchaser for a non API connection, the manufacturer shall deliver the connection data-sheet, threaded weights and dimensions, critical thicknesses, make up requirements, and relevant connection validation testing report.

Add new section

8.12.7 End-Sizing and Thermal Recovery

When pipe ends are subjected to end-sizing as part of the threading process, with or without subsequent thermal recovery, the process shall be validated according to the requirements of L.3.4.

When pipe ends are subject to end-sizing as part of the threading process, with or without subsequent thermal recovery, process control during production shall be demonstrated by conformance to the testing requirements of 10.17.

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 the specified wall thickness (*t*) minus the permissible under-tolerance

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

below the specified wall thickness (*t*) minus the permissible under-tolerance

In list item f), replace "linear imperfection" with

linear and non-linear imperfection

Add new list item j)

j) For SL-A product or reduced wall thickness tolerance, any imperfection located in the pin ends shall result in the product being rejected.

Replace section 8.13.2 title with

8.13.2 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

In first sentence of second paragraph, replace "A thread compound" with

A thread compound specified by the purchaser

Replace seventh sentence of second paragraph with

All exposed threads shall be coated with a thread compound or a storage compound specified by the purchaser.

Replace eighth sentence of second paragraph with

If a storage compound is applied, it shall have a distinct color from the thread compound.

9 Couplings

9.1 General Requirements

In first paragraph, replace "PSL" with

SL

In second, third and fourth paragraph, replace "Grades C110" with

Grades C110, C125

9.3 Mechanical Properties

Add to section

The manufacturer shall provide a certificate of the coupling tests for SL-A products.

The manufacturer shall provide a certificate of the coupling tests for SL-B products when specified by the purchaser.

9.7 Combination Couplings

Add to section

On request, the manufacturer shall deliver a dimensional drawing of the combination coupling.

9.8 Seal-ring Couplings

Delete second sentence (PSLs)

Add to section

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.

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.

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.

Replace section 9.9 title with

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

9.10 Threading

9.10.1 General Requirements

Delete second paragraph (PSLs)

9.11 Surface Inspection

9.11.2

Replace "ASTM E709" with

ASTM E3024

9.11.3

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

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

9.11.4

In first sentence, replace "To ensure adequate plating or coating," with

To assess the coating,

Add to section

To avoid galling, imperfections such as blisters or voids shall be addressed according to the manufacturer's quality control provisions.

9.11.7

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

C110, C125, P110, and Q125 material

9.11.8

Delete section 9.11.8

Replace section 9.14 title with

9.14 Thread Surface Treatment

Replace section with

Thread surface treatment may be specified in the purchase agreement or at the manufacturer's option.

Replace section 9.15 title with

9.15 Couplings and Coupling Blank Protection—Grades C90, T95, C110, C125 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, C125 and Q125

10.3 Testing of Chemical Composition

10.3.1 Heat Analyses

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

Grades C110, C125 and Q125

10.4 Tensile Tests

10.4.1 Stress-relief Temperature—All Grades

Delete section 10.4.1 (moved to 6.2.1)

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 C110 and Q125" with

C90, T95, C110, C125 and Q125

10.4.5 Test Specimens—General

Replace fourth paragraph with

When tensile testing of the upset is required, the tensile test specimen from the upset shall be the largest round specimen feasible.

For thin wall products, where the minimum size specimen of 8.9 mm (0.350 in) is not dimensionally possible, the purchaser and manufacturer shall agree upon the most representative type and size of test specimen to be used for the test.

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, C125 and Q125

10.4.7 Test Method

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

Grades C110, C125 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, C125 and Q125)

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, C125 and Q125

10.5 Flattening Test

10.5.7 Retests

In first sentence, replace "80 % of its length after the initial cropping" with

80 % of its length after the initial cropping or shorter than either the range length selected by the purchaser (from Table C.27 or E.27) or the alternative length specified

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, C90, T95, C110, C125 or Q125

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—All Grades Requiring SSC Resting as per Table 18 and Table 19

In section a), replace "Grades C90 and T95" with

Grades C90 SL-B and T95 SL-B

Add to section a)

For SL-A, test rings shall be cut from both ends of each pipe.

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

For Grades C110 and 125,

Add new section c)

c) For Grades R95LS and P110LS, one through-wall hardness test in one quadrant shall be made per lot from one end of each pipe. Approximately 50 % of these test rings shall be cut from the front ends and approximately 50 % from the back ends of the pipe. Maximum lot sizes shall be as listed in Table C.40 or Table E.40.

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 18 and Table 19

In first sentence, replace “conformance to the requirements” with

conformance to the requirements in alignment with Table C.40 or E.40

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 per Table 18 and Table 19

Add new heading before first paragraph

10.6.7.1 Grades C90, T95, C110 and C125

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, through-wall hardness tests shall be twice per lot, with two tests made on each of two test rings, one from each end.

For coupling blanks, pup joints and accessory material heat-treated in individual lengths, the piece having the highest surface hardness in the lot shall be selected for through-wall testing.

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 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 either 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 fifth paragraph (PSLs)

10.6.10 Test Method

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

Grades L80, C90, T95, C110 and C125 and the variant grades R95LS and P110LS

Replace last sentence of fifteenth paragraph with

Additional indentations shall not be permitted if any Rockwell hardness number is over 27.4 HRC for Grades C90, R95LS or T95 or over 31.0 HRC for Grade C110 or over 32.5 for Grade P110LS or over 35.0 HRC for Grade C125.

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 C125 and Variant Grades R95LS and P110 LS

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

Grades L80, C90, T95, C110 and C125 and Variant Grades R95LS and P110LS

Replace list item a) with

a) Grades L80 (all types), C90, T95 and Variant Grade R95LS: 20.0 HRC to 27.0 HRC

Replace list item b) with

b) Grade C110 and Variant Grade P110LS: 24.0 HRC to 32.0 HRC

Replace list item c) with

c) Grade C125 and Q125: 24.0 HRC to 35.0 HRC

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

for Grades C90, T95, C110, C125 and the Variant Grades R95LS and P110LS

10.6.14 Retests—Grade L80

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

For Grade L80, Variant Grades R95LS and P110LS products,

Replace section 10.6.15 title with

10.6.15 Retests—Grades C90, T95, C110 and C125 Products Except for Coupling Blanks, Pup Joints, or Accessory Material Heat-treated after Cutting to Individual Lengths

Add to section

For Grade C125, if any mean hardness number falls between 33.0 HRC and 35.0 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 33.0 HRC, the piece shall be accepted. If the new mean hardness number exceeds 33.0 HRC, the piece shall be rejected.

Replace section 10.6.16 title with

10.6.16 Retests—Grades C90, T95, C110 and C125 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, T95, C110, C125 and Q125

10.7 Impact Test

Replace section 10.7.2 title with

10.7.2 Sampling—Grades N80 (All Types), R95, L80, C90, T95, C110, P110 and C125

10.7.5 Test Method

Replace second paragraph with

The shear area shall be measured and reported in accordance with ASTM E23 for Grade C110, C125, Q125 and SL-A products.

Replace third sentence of third paragraph with

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

Replace section 10.8 title with

10.8 Grain Size Determination—Grades C90, T95, C110 and C125

Replace section 10.9 title with

10.9 Hardenability—Grades C90, T95, C110 and C125

Replace section 10.10 title with

10.10 Sulfide Stress-cracking Test-Grades Requiring SSC Testing According to Table 18 and Table 19

10.10.1

In first sentence, replace "Grades C90, T95, and C110 products." with

Grades C90, T95, C110, C125 and the variant grades listed in Table C.60 or Table E.60 that require SSC testing.

10.10.2

Replace section with

For Grades C90 and T95 and their associated variant grades (if applicable), the level of resistance to sulfide stress cracking shall be evaluated with the requirements in 7.14 using the test methods specified in Table 18 and Table 19 for the intended base grade.

10.10.3

Replace section with

For Grades C110, C125 and their associated variant grades (if applicable), the level of resistance to sulfide stress cracking shall be evaluated with the requirements in 7.14 using the test methods specified in Table 18 and Table 19 for the intended base grade.

10.10.4

Replace section with

For variant grades listed in Table C.60 or Table E.60 as requiring SSC testing, the level of resistance to sulfide stress cracking shall be evaluated with the requirements in 7.14 using the test methods specified in Table 18 and Table 19 for the intended variant grade.

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 and Q125, and Grades J55, K55, L80-1 and R95 products with SL-A, a metallographic evaluation

10.12 Hydrostatic Tests

10.12.2 Hydrostatic Test Requirements

Delete second paragraph (PSLs)

10.13 Dimensional Testing

10.13.4 Wall Thickness Measurement

Delete second paragraph (PSLs)

Add after fourth paragraph

For Grades L80 13Cr, C90, T95, P110, P110CY Q125 pipe and coupling stock to SL-B, Grades J55 and K55 pipe to SL-A, and coupling stock for all grades except H40, J55, and K55 to SL-B, wall thickness shall be measured and recorded over the full length. The minimum coverage shall be 25 % of the surface area covered by the automated inspection in accordance with Table C.42 or Table E.42.

Replace first sentence of fifth paragraph with

For Grades C110, P110EC and P110ECCY and C125 pipe and coupling stock, all grades except J55, K55, N80 (all types) pipe to SL-A, and all grades except J55 and K55 coupling stock to SL-A wall thickness shall be measured over the full length, with a minimum coverage of 100 % of the surface area covered by the automatic system in accordance with Table C.42 or Table E.42.

Replace sixth paragraph with

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

10.13.5 Drift Test

In first sentence of 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

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, the length shall be measured from end-to-end, with the measurement included on the packing list in accordance with 13.5 d).

10.13.7 Mass (Weight) Determination

Replace first sentence of second paragraph with

The pipe manufacturer applying the markings to the pipe body (see Section 11) shall weigh the pipe to determine conformance with mass tolerance in accordance with Table 16 based on the wall thickness tolerance.

10.13.8 Straightness Evaluation

In first sentence of 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 fourth 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, the manufacturer shall have demonstrated that the equipment is compliant for detection of defects in accordance with 8.13. NDE methods and procedures shall address the possibility of coincidental defects in the affected area, for example defects located on the inside and outside at the same location.

Replace third paragraph with

Seamless pipe mills shall have a documented internal procedure to identify the typical orientation of imperfections to determine the angle of oblique notch inspected. The technical justification for oblique notch orientation shall be documented and submitted to the purchaser on request. 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.

a) For all grades except C90, T95 C110 and C125, at the discretion of the manufacturer, oblique notches in addition to notches in Table C.43 or Table E.43 may be oriented at an angle such that detection of defects typical of the manufacturing process is optimized.

b) For grades C110 and C125, and Grades C90 and T95 at SL-A, in addition to longitudinal and transverse notches, internal and external oblique notches shall be utilized in accordance with 10.15.9.2. The oblique angle inspected shall be stated on the mill test report if required by the purchaser.

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

in accordance with Annex B and IOGP S-735Q

Delete fifth paragraph

10.15.3 Reference Standards

Replace second sentence of second paragraph with

When holes are used to establish the reject threshold, the manufacturer shall use a documented procedure to ensure the correct transducer alignment with the weld line and maintain weld line centering during inspection.

10.15.4 NDE System Capability Records

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;

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

10.15.6 Full-body, Full-length NDE of Casing and Tubing—Grades J55, K55, and SL-B for Grades N80 (all types), L80 (Type 1), and R95

Replace section 10.15.6 with

Add new section

10.15.6.1 Full-body, Full-length NDE of Casing and Tubing—SL-B for Grades J55, K55, N80-Q, L80-1, and R95

Pipe shall be inspected for the detection of longitudinal imperfections on the outside and inside surfaces to acceptance level L4 by one or more of the following methods:

a) ultrasonic testing in accordance with ISO 10893-10 or ASTM E213;

b) flux leakage testing in accordance with ISO 10893-3 or ASTM E570;

c) eddy current concentric coil testing in accordance with ISO 10893-2 or ASTM E309;

d) for pipe outside surface, magnetic particle inspection in accordance with ISO 10893-5 or ASTM E3024.

Add new section

10.15.6.2 Full-body, Full-length NDE of Casing and Tubing—SL-A for Grades J55 and K55

Pipe shall be inspected for the detection of longitudinal and transverse imperfections on the outside and inside surfaces to acceptance level L3 by one or more of the following methods:

a) ultrasonic testing in accordance with ISO 10893-10 or ASTM E213;

b) flux leakage testing in accordance with ISO 10893-3 or ASTM E570;

c) eddy current concentric coil testing in accordance with ISO 10893-2 or ASTM E309;

d) for pipe outside surface, magnetic particle inspection in accordance with ISO 10893-5 or ASTM E3024.

Add new section

10.15.6.3 Full-body, Full-length NDE of Casing and Tubing—SL-B for Grade N80-1

Pipe shall be inspected for the detection of longitudinal imperfections on the outside and inside surfaces to acceptance level L3 by one or more of the following methods:

a) ultrasonic testing in accordance with ISO 10893-10 or ASTM E213;

b) flux leakage testing in accordance with ISO 10893-3 or ASTM E570;

c) eddy current concentric coil testing in accordance with ISO 10893-2 or ASTM E309;

d) for pipe outside surface, magnetic particle inspection in accordance with ISO 10893-5 or ASTM E3024.

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

Delete section 10.15.7

Replace section 10.15.8 title

10.15.8 Full-body, full-length NDE of Casing and Tubing—SL-B for Grades P110 and L80 13Cr

Replace section 10.15.8 with

Add new section

10.15.8.1 Full-body, Full-length NDE of Casing and Tubing—SL-B for Grades P110 Base Grade and L80 13Cr

Pipe shall be inspected for the detection of longitudinal and transverse imperfections on the outside and inside surfaces to acceptance level L2 by one or more of the following methods:

a) ultrasonic testing in accordance with ISO 10893-10 or ASTM E213;

b) flux leakage testing in accordance with ISO 10893-3 or ASTM E570;

c) eddy current concentric coil testing in accordance with ISO 10893-2 or ASTM E309;

d) for pipe outside surface, magnetic particle inspection in accordance with ISO 10893-5 or ASTM E3024.

Add new section

10.15.8.2 Full-body, Full-length NDE of Casing and Tubing—SL-B for Variant Grades P110CY, P110EC, and P110ECCY

Pipe shall be inspected for the detection of longitudinal and transverse imperfections on the outside and inside surfaces to acceptance level L2 by the following method:

a) ultrasonic testing in accordance with ISO 10893-10 or ASTM E213;

Replace section 10.15.9 title with

10.15.9 Full-body, Full-length NDE of Casing and Tubing—SL-A and SL-B for Grades C90, T95, C110, C125 and Q125, and SL-A for Grades L80 (All Types), R95, and P110

Replace section 10.15.9 with

Add new section

10.15.9.1 Full-body, Full-length NDE of Casing and Tubing—SL-B for Grades C90, T95, and Q125, and SL-A for L80 (All Types), R95, P110, and Q125

Pipe shall be inspected for the detection of longitudinal and transverse imperfections on the outside and inside surfaces to acceptance level L2 by ultrasonic testing in accordance with ISO 10893-10 or ASTM E213.

In addition to ultrasonic testing, pipe shall be inspected for the detection of longitudinal and transverse imperfections on the outside surface to acceptance level L2 by one or more of the following methods:

a) flux leakage testing in accordance with ISO 10893-3 or ASTM E570;

b) eddy current concentric coil testing in accordance with ISO 10893-2 or ASTM E309;

c) magnetic particle inspection in accordance with ISO 10893-5 or ASTM E3024.

Add new section

10.15.9.2 Full-body, Full-length NDE of Casing and Tubing—SL-A for Grades C90, T95, C110, and C125

Pipe shall be inspected for the detection of longitudinal and transverse imperfections on the outside and inside surfaces to acceptance level L2 by ultrasonic testing in accordance with ISO 10893-10 or ASTM E213.

Pipe shall be inspected for the detection of longitudinal and transverse imperfections on the outside surface to acceptance level L2 by one or more of the following methods:

a) flux leakage testing in accordance with ISO 10893-3 or ASTM E570;

b) eddy current concentric coil testing in accordance with ISO 10893-2 or ASTM E309;

c) magnetic particle inspection in accordance with ISO 10893-5 or ASTM E3024.

Pipe shall be inspected for the detection of oblique imperfections on the outside and inside surfaces to acceptance level L2 by one or more of the following methods:

a) ultrasonic testing in accordance with ISO 10893-10 or ASTM E213;

b) flux leakage testing in accordance with ISO 10893-3 or ASTM E570;

c) eddy current concentric coil testing in accordance with ISO 10893-2 or ASTM E309;

d) for pipe outside surface, magnetic particle inspection in accordance with ISO 10893-5 or ASTM E3024.

The angle of oblique notches shall be validated and documented by the manufacturer according to the imperfection orientation of their typical manufacturing process.

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

The manufacturer shall use a documented procedure to verify weld line centering during inspection.

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

Add before fifth paragraph

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

Delete 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

In first paragraph, replace ", except Grade C110" with

for Grades N80, L80 Type 1, and R95, and for SL-B for Grades L80 13Cr, C90, T95, P110, and Q125, and for SL-A for Grades J55 and K55

In list item d), replace "ASTM E-709" with

ASTM E3024

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 purchaser selected 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, C125 and Q125

10.15.12.1 General

In list item d) of first paragraph replace "ASTM E709" with

ASTM E3024

10.15.12.4 Ultrasonic Testing—Through-wall

Replace second sentence of first paragraph 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 from casing, tubing, thick-walled pipe, mechanical pipe or hot forgings 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 the manufacturer is proposing to use an alternative NDE method, it shall be qualified in accordance with Annex L.

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

Replace second sentence of second paragraph with

Untested ends of all grade pipe to SL-B and all grade pipe to SL-A except L80 13Cr, C90, T95, Q125, C110, and C125 shall be either:

Replace third paragraph with

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

a) treated in accordance with 10.15.13 a) or c); or

b) inspected after end finishing (and before coupling installation on threaded and coupled tubulars) using the wet magnetic-particle method.

Grades C110 and C125 pipe, with the untested ends treated in accordance with 10.15.13 b), shall be inspected after end finishing 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 before first paragraph

10.15.14.1 Pipe Upsets

Add new section

10.15.14.2 Expanded Pipe Ends

Expanded ends, including the run-out interval, shall be inspected on the outside surfaces after stress relieving operations, using the wet fluorescent magnetic particle method in accordance with ISO 10893-5 or ASTM E3024 with a circumferentially oriented magnetic field for the detection of longitudinal surface imperfections, or by another non-destructive method of equal sensitivity as demonstrated to the purchaser.

At the manufacturer's discretion, inspection may be performed after final machining.

Records in accordance with 10.15.4 shall be maintained.

10.15.16 Evaluation of Indications (Prove-up)

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

the minimum allowable 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 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 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 or 5 % of the specified wall thickness for SL-A product

Add new section

10.16 Enhanced Collapse (EC) Product

10.16.1 General

When an EC grade from Table C.60 or Table E.60 is specified on the purchase agreement, the inspection and testing provisions in 10.16 shall apply. The EC tubular shall be marked in accordance with 11.1.10 and certificates provided in accordance with 13.3 u).

The manufacturer shall propose, via IOGP S-735D, for purchaser's approval, a collapse rating for the tubular that has been validated through a PPQ according to L.3.2.

During production, the manufacturer shall measure and record parameters identified during product qualification for EC performance in accordance with Annex L.

10.16.2 Dimensional Inspections

Where the product quality plan (PQP) requires measurement and control of either ovality and/or eccentricity or the MPQ lists those parameters as critical for the EC tubulars, ovality shall conform to 10.16.2.2 and eccentricity to 10.16.2.3. Wall thickness measurement (see 10.16.2.1) is required for all EC tubulars.

10.16.2.1 Wall Thickness Measurement

Wall thickness shall be measured with ultrasonic equipment with 100 % surface area coverage.

10.16.2.2 Ovality Measurement

Ovality of the lot shall be measured and statistics reported. Full-length automated ovality measurements are preferred over manual measurements. If measured manually, ovality measurements shall be taken on both ends of 20 % of the lengths per test lot.

If measured manually, ovality shall be calculated from measurements of the outside diameter or preferably measured with an API ovality gauge. Ovality measurements shall be taken over at least eight equally spaced circumferential positions. Measurements should not be taken at equally spaced intervals (e.g. 45°).

Ovality shall be calculated according to Equation (7):

$$Ovality = \frac{100\,(D_{max} - D_{min})}{D_{ave}} \tag{7}$$

where

D_{max} is largest of the outside diameter measurements within a unique circumferential ring of measurements;

D_{min} is smallest of the outside diameter measurements within a unique circumferential ring of measurements;

D_{ave} is average of the measurements within a unique circumferential ring of measurements.

10.16.2.3 Eccentricity Measurement

Eccentricity of the lot shall be measured at the frequency agreed in the PQP and statistics reported.

Eccentricity shall be calculated using the Equation (8):

$$Eccentricity = \frac{100\,(t_{c\,max} - t_{c\,min})}{T_{c\,ave}} \quad (8)$$

where

$t_{c\,max}$ is maximum wall thicknesses within a unique ring of circumferential measurements,

$t_{c\,min}$ is minimum wall thicknesses within a unique ring of circumferential measurements;

$t_{c\,ave}$ is average wall thickness within the unique ring in 10.16.2.2.

10.16.3 Testing

The manufacturer shall inform the purchaser about the PQP developed (from either product realization or from the purchaser's requested MPQ) to deliver the collapse rating as specified by the purchaser. The manufacturer's PQP shall include as a minimum the collapse test detailed in 10.16.3.1.

10.16.3.1 Collapse Test

A full scale collapse test shall be performed on a minimum of one pipe from every production run in accordance with the procedures of API TR5C3, Annex I. The minimum collapse testing frequency shall be one test for every 300 pipes after the MPQ has been completed on at least 50 sample lengths.

On each specimen used for collapse testing, mechanical tests, residual stress test and dimensional measurements shall be carried out in accordance with the API TR 5C3, Annex I requirements. Collapse test results shall be reported and available in electronic format.

Add new section

10.17 Testing for Products Subject to End-Sizing with or without Thermal Recovery

10.17.1 General

Some special end finish connections require the ends of the pipe to be cold-worked to prepare for threading, through a process called end-sizing. Some grades of pipe require reheating to restore the mechanical properties close to the pre-cold-worked condition; this process is known as thermal recovery or stress relieving. The tests described in this section evaluate the material properties of pipe ends that have been end-sized with or without thermally recovery (ESTR). The end-sizing process, with or without thermal recovery, shall be validated, using the process described in L.3.4

For each manufacturing process route and location, and each size, wall thickness, grade, and connection geometry combination, the test specimens shall be taken from pipe ends of the first lot processed during a production run. When the process set points for controlled variables change, additional sets of test specimens shall be taken. Change in control variables that trigger additional testing shall at least include end-sizing deformation (if increased), temperature and time.

If a test result does not meet acceptance criteria, all lengths produced since the last successful test shall be rejected.

The threader is responsible for achieving the acceptance criteria in 10.17.3 and 10.17.4. However, if test results at the unaffected area do not meet the requirements of the grade, the threader is only responsible to meet the required maximum difference between the ESTR end and the unaffected pipe area from the same

end and is not responsible for meeting the associated maximum yield strength specification requirements for the grade.

10.17.2 Sample Location

The test specimens for process control during production shall be taken from the following sections:

a) a set of mechanical and SSC samples (if applicable) from a section as close as possible to the to the area of maximum strain; and

b) a set of mechanical samples from a section from the adjacent pipe body area that is not affected by deformation or thermal recovery.

10.17.3 Production Test Requirements for Grades not Requiring SSC Testing

Production shall proceed within the parameters of the manufacturer's process validated according to L.3.4, unless agreed between the manufacturer and the purchaser.

Details of tensile test specimen geometry and yield stress measurement methods may be agreed between the purchaser and the manufacturer.

10.17.3.1 Tensile Tests

Tensile testing shall be performed per 10.4.7 and 10.4.8. Tensile properties (yield and tensile stress) shall comply with the requirements of the grade as follows:

a) The yield strength shall meet the minimum yield strength requirement for the grade.

b) Results shall meet the maximum yield strength requirement specified in Table C.5 or Table E.5 for the grade. For variant grades, the yield strength results shall meet the criteria given in Table C.60 or Table E.60 for maximum. If the actual yield strength of the test specimens does not meet the maximum yield strength limit, but is within 5 % of the adjacent pipe body area, the results are acceptable.

10.17.3.2 Hardness Tests for Grades with Hardness Test Requirements

Hardness testing shall be performed in accordance with 10.6.9 through 10.6.13. The hardness test specimens shall be prepared as specified in Figure D.10 utilizing 9-point one quadrant testing. Results shall meet the maximum hardness requirement specified in 7.7, 7.8, Table C.5 or Table E.5 for the grade, and in Table C.60 or Table E.60 for the variant grade.

10.17.3.3 Impact Testing

Impact testing shall be performed in accordance with 7.3.7, 10.7.5 and 10.7.6. The impact test shall consist of a set of three test specimens with the largest possible test specimen listed in Table C.8 or Table E.8 and the hierarchy of test specimen size and orientation in accordance with Table C.9 or Table E.9.

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.61 or Table E.61. The average absorbed energy of the deformed area shall exceed 75 % of the average absorbed energy of the unaffected area.

10.17.4 Production Test Requirements for Grades Requiring SSC Testing

Production shall proceed within the parameters of the manufacturer's process validated according to L.3.4, unless agreed between manufacturer and purchaser. The requirements of 10.17.3 shall apply.

When performed, the tests shall meet the requirements specified in 7.14.5 or Table 18 and Table 19. When NACE TM0177-2016 Method D sub-size or alternative specimens are used, the acceptance criteria shall be agreed between purchaser and manufacturer.

10.17.5 Retest Provisions

Retesting is not allowed for tensile or SSC testing. Retest samples for hardness and impact testing may be taken from the same pipe end or additional pipe ends representative of equipment set-up.

10.17.6 Thermal Recovery Process Control during Production

The temperature of pipe ends shall be controlled and recorded as part of the process control plan, consistent with the temperature and time parameters defined during process validation. Temperature sticks and paints shall only be used for periodic temperature checking.

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 C.60 or Table E.60 shall be marked according to Table C.48 or Table E.48. The collapse rating shall be marked on the pipe for EC tubulars. The finished individual dimension length shall be marked on the tubular in accordance with Table C.48 or Table E.48. By agreement, 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), Q125 and grades requiring SSC testing, products

Replace section 11.2.5 title with

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

In list item 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

13.1 Electronic Media

Add to section

Data required in the certification shall be formatted for importing into a spreadsheet.

13.2 Certification Requirements

Add to section

If this specification has been invoked, the declaration of conformance shall state that IOGP S-735 (revision number) has been met and to which SL.

13.3 Certification Content

Replace list item b) with

b) Applicable SL;

Replace last sentence of list item i) with

The percent shear area shall be reported for Grades C110, C125, Q125 and for SL-A Grades L80-1, R95, C90, T95, P110 (see 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;

Replace list item q) with

q) For seamless product for which NDE is specified (either in the body of the standard, in the supplementary requirement or in the purchase order, (the method of NDE employed (UT, EMI, ET or MT), the acceptance criteria, the location, orientation, and oblique angles (if inspected) of the reference indicator(s) used, the type and size of the artificial reference indicator used;

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

For SL-A products or when agreed between the manufacturer and purchaser,

Add new list item u)

u) Manufacturer mill identification and location;

Add new list item v)

v) For EC tubulars, a report of the required collapse test data in accordance with API TR 5C3, Annex I, Table I.1. The manufacturer's claimed rating shall be stated on the report;

Add new list item w)

w) If applicable, results from end-sizing with or without thermal recovery during production testing;

Add new list item x)

x) Date of certification of conformity;

Add new list item y)

y) PQP with document number and revision level, when requested by the purchaser.

13.4 Retention of Records

In second sentence, replace "three" with

five

Add to section

The purchaser's representative access to records during the production process is covered under B.5.

Add new section

13.5 Packing List Content

The packing list shall, as applicable for each item, contain the following information:

a) Manufacturer's name, location and reference to purchase order number;

b) Diameter, wall thickness, material grade and connection;

c) Total number of joints or items;

d) Length and weight of each item, bundle or complete order (as applicable) based on the shipment method;

e) Heat or lot traceability identification in accordance with 6.4.1 when specified by the purchaser;

f) Individual joint traceability in accordance with 6.4.2 when specified by the purchaser;

g) MSDS for any chemicals accompanying shipment;

h) Shipping details.

Add new section

13.6 Additional Reports and Documents

The manufacturer shall, as applicable for each item, report the following additional items:

a) When the purchaser has specified a PPQ, the report of the testing conducted according to the requirements of L.3;

b) When the purchaser has specified an MPQ, the report of the testing conducted according to the requirements of L.4;

c) When the manufacturer has qualified NDE equipment according to Annex M, the report of the demonstration conducted according to the requirements of M.3;

d) PQP specifically when mandatory testing is proposed to be removed due to process control provisions;

e) Torque-turn plots for mill-end makeup;

f) Type of thread compound applied to mill-end and/or field-end connection and/or type of storage compound applied to un-assembled threads;

g) Products that do not conform to SL-A or SL-B as selected by the purchaser may be released under concession according to API Specification Q1, 5.10.3. Such concession requests shall be agreed by the purchaser.

Annex B
(normative)
Purchaser Inspection

Add new section

B.5 Documents and Records

Documents and records associated with the production process and product ordered shall be made available to the purchaser or purchaser's representative 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, add "C125" to "C110"

Table C.3—Process of Manufacture and Heat Treatment

Add column "Specification Level"

Add Grades R95LS, L80 1Cr, L80 3 Cr, P110LS and C125, and replace Grades P110 and Q125 with

Grade	Type	Specification Level	Manufacturing Process [a]	Heat Treatment [e]	Tempering Temperature °C min
1	2		3	4	5
R95LS [i]	—	—	S	Q	649
L80	1Cr	—	S	Q	566
L80	3Cr	—	S	Q	566
P110LS	—	SL-A	S	Q	649
P110	—	SL-A	S	Q	—
P110	—	SL-B	S or EW [g, h]	Q	—
C125	—	—	S	Q	649
Q125	1	SL-A	S	Q	—
Q125	1	SL-B	S or EW [h]	Q	—

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

Add R95LS, L80 1Cr, L80 3 Cr, P110LS, C125, and footnotes f and 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 [f]	—	—	[g]	—	[g]	[g]	[g]	[g]	[g]	[g]	—	0.020	0.010	0.45
L80	1Cr	—	0.43	—	1.90	—	—	0.80	1.20	1.00	—	0.030	0.030	—
L80	3Cr	0.08	0.43 [a]	0.30	1.90	—	—	2.80	3.60	1.00	0.15	0.030	0.030	0.50
P110LS [f]	—	—	[g]	—	[g]	[g]	[g]	[g]	[g]	[g]	—	0.020	0.010	—
C125	—	—	0.45	—	1.00	0.60	1.50	0.40	1.20	0.06	0.06	0.015	0.005	0.40

[f] For variant grades that require SSC testing, when not specified in Table C.4 or TableE.4, the chemical composition shall be in accordance with the manufacturer's specifications to achieve the SSC criteria in Table 18 and Table 19 or by agreement between the purchaser and the manufacturer via MPQ/PPQ.

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

Table C.5—Tensile and Hardness Requirements

Add column "Specification Level"

Add Grades R95LS, P110LS and C125, and replace Grade Q125 and footnote c with

Grade	Type	Specification Level	Total Elongation Under Load %	Yield Strength MPa		Tensile Strength MPa	Hardness [a, c]		Specified Wall Thickness	Allowable Hardness Variation [b]
				min	max	min	HRC	HBW	mm	HRC
1	2		3	4	5	6	7	8	9	10
R95LS	—	—	—	As per Table C.60			25.4	255	≤ 12.70	3.0
									12.71 to 19.04	4.0
									19.05 to 25.39	5.0
									≥ 25.40	6.0
P110LS	—	—	—	As per Table C.60			30.5	290	≤ 12.70	3.0
									12.71 to 19.04	4.0
									19.05 to 25.39	5.0
									≥ 25.40	6.0
C125	—	—	0.8	862	931	896	33.0	311	≤ 12.70	3.0
									12.71 to 19.04	4.0
									19.05 to 25.39	5.0
									≥ 25.40	6.0
Q125	1	SL-A	0.65	862	965	931	[b]	—	≤ 12.70	3.0
									12.71 to 19.04	4.0
		SL-B			1034				19.05	5.0

[c] For through-wall hardness tests of Grades L80 (all types), C90, T95, C110 and C125, the requirements stated in HRC scale are for maximum mean hardness number.

Table C.6—Elongation Table

Add Grade C125 (column 13)

Tensile Test Specimen				Minimum Elongation in 50.8 mm %
				Grade
				C125
Specimen Area mm²	Specified Wall Thickness mm			Specified Minimum Tensile Strength MPa
	Specimen Width 19 mm	Specimen Width 25 mm	Specimen Width 38 mm	896
1	2	3	4	13
490	≥ 25.53	≥ 19.41	≥ 12.77	15
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

Table C.6 *(continued)*

Tensile Test Specimen				Minimum Elongation in 50.8 mm %
				Grade
				C125
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
1	2	3	4	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
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.10—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grades J55 and K55

Delete Table C.10

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.14—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.1—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 (as shown in strikethrough font), and replace footnote e with

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	
		D mm	kg/m	*t* mm	*d* mm	mm	w_{pe} kg/m	Short	Long	RC	SCC
1	2	3	4	5	6	7	8	9	10	11	12
~~7~~	~~23~~	~~177.8~~	~~34.67~~	~~8.05~~	~~161.7~~	~~158.52~~	~~33.7~~	~~6.26~~	~~7.94~~	~~8.28~~	~~0.58~~
~~7~~	~~32~~	~~177.8~~	~~47.62~~	~~11.51~~	~~154.78~~	~~151.6~~	~~47.2~~	~~—~~	~~6.23~~	~~6.4~~	~~-1.31~~
~~7 ¾~~	~~46.1~~	~~195.85~~	~~68.6~~	~~15.11~~	~~166.63~~	~~163.45~~	~~67.72~~	~~—~~	~~—~~	~~—~~	~~—~~
~~8 ⅝~~	~~32~~	~~219.08~~	~~47.62~~	~~8.94~~	~~201.2~~	~~198.02~~	~~46.33~~	~~9.39~~	~~12.44~~	~~12.57~~	~~2.51~~
~~8 ⅝~~	~~40~~	~~219.08~~	~~59.53~~	~~11.43~~	~~196.22~~	~~193.04~~	~~58.53~~	~~—~~	~~10.73~~	~~10.77~~	~~0.71~~
~~9 ⅝~~	~~40~~	~~244.48~~	~~59.53~~	~~10.03~~	~~222.40~~	~~220.45~~	~~57.99~~	~~9.69~~	~~13.59~~	~~12.97~~	~~1.84~~
~~9 ⅝~~	~~53.50~~	~~244.48~~	~~79.62~~	~~13.84~~	~~216.80~~	~~212.83~~	~~78.72~~	~~—~~	~~10.57~~	~~9.92~~	~~-1.22~~
~~9 ⅝~~	~~58.40~~	~~244.48~~	~~86.91~~	~~15.11~~	~~214.25~~	~~210.29~~	~~85.47~~	~~—~~	~~9.58~~	~~8.92~~	~~-2.22~~
~~10 ¾~~	~~45.5~~	~~273.05~~	~~67.71~~	~~10.16~~	~~252.7~~	~~248.77~~	~~65.87~~	~~11~~	~~—~~	~~14.21~~	~~1.86~~
~~10 ¾~~	~~55.5~~	~~273.05~~	~~82.59~~	~~12.57~~	~~247.9~~	~~243.94~~	~~80.75~~	~~9.3~~	~~—~~	~~12.25~~	~~-0.09~~
~~11 ¾~~	~~42~~	~~298.45~~	~~62.5~~	~~8.46~~	~~281.5~~	~~277.5~~	~~62.56~~	~~13.27~~	~~—~~	~~—~~	~~—~~
~~11 ¾~~	~~60~~	~~298.45~~	~~89.29~~	~~12.42~~	~~273.6~~	~~269.65~~	~~87.61~~	~~10.17~~	~~—~~	~~13.12~~	~~—~~
~~11 ¾~~	~~65~~	~~298.45~~	~~96.73~~	~~13.56~~	~~271.3~~	~~267.36~~	~~95.27~~	~~—~~	~~—~~	~~—~~	~~—~~
~~13 ⅜~~	~~72~~	~~339.72~~	~~107.15~~	~~13.06~~	~~313.6~~	~~309.63~~	~~105.21~~	~~10.98~~	~~—~~	~~14.33~~	~~—~~

[e] Alternative drift diameter shall be the larger of the mandrel diameters indicated on this table or Table C.29. See 8.10 for drift requirements.

Table C.28—Standard Drift Size

Add footnote c

Product and Label 1	Standard Drift Mandrel Size [c] min	
	Length	Diameter

[c] Where an alternative drift is available for the product, it shall be used for drift testing.

Table C.30—Maximum Permissible Depth of Linear Imperfections

Add "C125" to "C90 – T95 – C110 – P110 –Q125" and add new row

Grade	Depth as % of Specified Wall Thickness	
	External Imperfections	Internal Imperfections
C90 – T95 – C110 – P110 –C125- Q125	5 %	5 %
All Grades ordered as SL-A or specified with wall thickness tolerance < 12.5 %	5 %	5 %

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

Replace rows A.1, A.2 and B.3 with

	Surface	Depth	Measurement Notes
A Integral Joint and External Upset Tubing (see Figure D.5 and Figure D.7)			
A.1	All surfaces of upset and upset runout interval, except as stated below	5 % *t*	Percentage of specified pipe body wall thickness t; for linear imperfections; for SL-A products.
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.			
B.3 Upset underfill in the upset run-out intervals shall be considered a defect if the remaining wall thickness (at the upset underfill) is less than the specified wall thickness minus the permissible under tolerance.			

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

Add footnote b and replace column 5 heading with

Coupling for Label 1		Grades H40, J55, K55, N80 (All Types), R95, L80 (All Types), and P110		Grades [b] C90, T95, C110, C125 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, add "C125" to "C110"

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

In column 1, add "C125" to "C110 and Q125"

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

In column 1, add "C125" to "C110 and Q125" and add "C125" to footnote c

Table C.40—Frequency of Hardness Testing

In column 1, add “Grade C125” to "Grade C110"

Add Variant Grades R95LS and P110LS and footnote f

Grade	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, P110LS	Non-upset pipe Grade R95LS		1	50	Through-wall, 1 quadrant	Approximately 50 % from each end
	Non-upset pipe Grade P110LS		1	25	Through-wall, 1 quadrant	Approximately 50 % from each end
	Coupling blanks, coupling stock, coupling material, pup joints and accessory material	Tube-length heat treatment	2 [g]	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
			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

[f] When the purchaser has specified a variant grade requiring SSC testing, the hardness testing is as per the base grade given in Table C.60 or Table E.60, with the exception of the R95LS (A or D) and the P110LS (A or D) that are given above.

Table C.41—Frequency of Flattening Tests

Replace column 1 with

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,
Q125, P110

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	Requirement					
			Visual Inspection (see 10.14)	Coverage of Wall Thickness Verification [b]	Ultrasonic Inspection	Electromagnetic Inspection Methods		Magnetic Particle Inspection [a]
						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 E3024
1	2	3	4	5	6	7	8	9
Pipe body	H40	SL-B	R	P	N	N	N	N
	J55, K55	SL-B	R	P	N	N	N	N
		SL-A		25 %	A	A	A	A
	N80 Type 1 and N80Q	SL-B	R	HL	A	A	A	A
	L80 Type 1, L80 1Cr, L80 3Cr, R95	SL-B	R	HL	A	A	A	A
		SL-A		100 %				
	L80 13Cr, P110	SL-B	R	25 %	A	A	A	A
		SL-A		100 %	C	B	B	B
	P110 Variants	SL-B - CY	R	25 %	C	N	N	N
		SL-B - EC and ECCY		100 %	C	N	N	N
	C90, T95, Q125	SL-B	R	25 %	C	B	B	B
		SL-A		100 %				
	C110, C125	SL-A	R	100 %	C	B	B	B

Table C.42 *(continued)*

Product	Grade	Specification Level	Requirement					
			Visual Inspection (see 10.14)	Coverage of Wall Thickness Verification [b]	Ultrasonic Inspection	Electromagnetic Inspection Methods		Magnetic Particle Inspection [a]
						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 E3024
1	2	3	4	5	6	7	8	9
Coupling stock and accessory material	H40	SL-B	R	P	N	N	N	N
	J55, K55	SL-B	R	P	N	N	N	N
		SL-A		HL	A	A	A	A
	N80 all types, L80 Type 1, R95	SL-B	R	25 %	A	A	A	A
		SL-A		100 %	A	A	A	A
	L80 13Cr, C90, T95, P110, Q125, C110, C125	SL-B	R	25 %	A	A	A	A
		SL-A		100 %	D	A	A	A

N = Not required

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 to inspect the outside surface.

C = Ultrasonic inspection shall be used to inspect the outside and inside surface.

D = Ultrasonic inspection shall be used to inspect the inside surface.

NA = Not applicable

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)

[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] In accordance with 10.13.4, each length of pipe, coupling stock, coupling material, or accessory material shall be measured to verify conformance with wall thickness requirements.

Table C.43—Acceptance (Inspection) Levels

Replace Table C.43 with

Material	Grade	Specification Level	Method	External imperfections			Internal imperfections			Through Wall
				Longitudinal	Transverse	Oblique	Longitudinal	Transverse	Oblique	
1	2	3	4	5	6	7	8	9	10	11
Pipe body [a]	J55, K55	SL-B	A	L4	—	—	L4	—	—	—
		SL-A	A	L3	L3	—	L3	L3	—	—
	N80 Type 1	SL-B	A	L3	—	—	L3	—	—	—
	N80 Q		A	L4	—	—	L4	—	—	—
	L80 Type 1, R95	SL-B	A	L4	—	—	L4	—	—	—
		SL-A	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—
	L80 13Cr, P110	SL-B	A	L2	L2	—	L2	L2	—	—
		SL-A	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—
	P110 Variant Grades CY, EC, and ECCY	SL-B	C	L2	L2	—	L2	L2	—	—
	C90, T95	SL-B	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—
		SL-A	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—
			A	—	—	L2	—	—	L2	—
	C110, C125	SL-A	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—
			A	—	—	L2	—	—	L2	—
	Q125	SL-A or SL-B	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—

Table C.43 *(continued)*

Material	Grade	Specification Level	Method	External imperfections			Internal imperfections			Through Wall
				Longitudinal	Transverse	Oblique	Longitudinal	Transverse	Oblique	
1	2	3	4	5	6	7	8	9	10	11
Coupling stock and accessory material	J55, K55	SL-A	A	L2	L2	—	—	—	—	—
	N80 all types, L80 Type 1, R95	SL-B	A	L2	L2	—	—	—	—	—
		SL-A	A	L2	L2	—	—	—	—	—
	L80 13Cr, C90, T95, P110, Q125	SL-B	A	L2	L2	—	—	—	—	—
		SL-A	A	L2	L2	—	—	—	—	—
			C	—	—	—	L3	L3	—	L4
	C110, C125	SL-A	A	L2	L2	—	—	—	—	—
			C	—	—	—	L3	L3	—	L4
Weld seam	P110 [b], Q125 [b]		C	L2	—	—	L2	—	—	—
	L80 Type 1 and R95 to SL-A		C	L2	—	—	L2	—	—	—
	All other grades		A	L3	—	—	L3	—	—	—

— = Not applicable

Lx = 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.

[a] Pup joints shall be inspected like pipe body.

[b] Q125 and P110 welded pipes are required to have SR 11.

Table C.44—Artificial Reference Indicators

Replace Table C.44 with

Acceptance (Inspection) Level	Specification Level	Notch Depth [a] Maximum %	Notch Length Maximum at Full Depth mm	Notch Width Maximum mm	Radially Drilled Hole Diameter [b] mm	Flat Bottom Hole Diameter [c] mm
1	2	3	4	5	6	7
L2	SL-B	5	50	1.02	1.59	6.35
	SL-A		25			
L3	SL-B	10	50	1.02	3.18	6.35
	SL-A		25			
L4	SL-B	12.5	50	1.02	3.18	6.35
	SL-A		25			

NOTE See Figure D.16

[a] Depth as a percent of specified wall thickness; The depth tolerance shall be ± 15 % of the calculated notch depth with a minimum notch depth of 0.3 mm ± 0.05 mm.

[b] Radially drilled hole diameter (through the pipe wall) shall be based on the drill bit size.

[c] Flat bottom hole ensures a minimum of 90 % of specified minimum wall thickness remains below with a tolerance of ± 1.5 %.

Table C.46—Grade Color Codes

Add Grades L80 1Cr, L80 3 Cr, C125, and footnotes d and 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
L80	3Cr	One red, one brown, one orange	Red	One brown, one orange
C125		One orange, one brown	Orange	Brown

[d] EC 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 brown band shall be applied.

— E variant grades- in addition to the base grade banding, an additional yellow band shall be applied.

— CY variant grades- in addition to the base grade banding, an additional purple band shall be applied.

— RY variant grades- in addition to the base grade banding, an additional pink band shall be applied.

— If multiple variants apply, then apply all the bands stated above (e.g. ECCY, ECRY).

Table C.48—Marking Requirements and Sequence

Delete row 7 and footnote g

In heading, add "C125" to "Grades L80 (All Types), C90, T95, C110 and Q125"

In rows 4 and 5, add "or C.59" to "Table C.1, C.2"

Replace rows 6 and 11 and footnote f

Add rows 18, 19, 20 and 21

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, C125, 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, C2 or C.59)	«....»	D or P		P		
	Specified wall thickness for coupling stock and other products with no mass designation						P
6	Grade of product and sulfide cracking test [f] (if applicable):						
	— H40	H					
	— J55	J					
	— K55	K					
	— N80 Type 1	N1					
	— N80Q	NQ					
	— R95	R					
	— R95LS (A or D)	R95LS (A or D)					
	— L80 Type 1	L					
	— L80 Type 1Cr	L1CR					
	— L80 Type 3Cr	L3CR					
	— L80 Type 9Cr	L9					
	— L80 Type 13Cr	L13					
	— C90 Type 1	C90 (A)					
		C90 (D)					
	— T95 Type 1	T95-1					
	— T95EC	T95EC (A, D or AD)					
	— T95 (A-80 %)	T95 (A-80%)					
	— T95 (A-90 %)	T95 (A-90%)					
	— T95 (D)	T95 (D)					
	— T95E (A, D or AD)	T95E (A, D or AD)					

Table C.48 *(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, C125, 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
6	***(continued)*** Grade of product and sulfide cracking test [f] (if applicable):						
	— C110						
	— C110EC (A, D or AD)	C110EC (A, D or AD)					
	— C110 (A, D)	C110 (A, D)					
	— C110E (A, D or AD)	C110E (A, D or AD)					
	— P110	P					
	— P110CY	P110CY					
	— P110EC	P110EC					
	— P110ECCY	P110ECCY					
	— P110LS (A or D)	P110LS (A or D)					
	— C125						
	— C125EC (A, D or AD)	C125EC (A, D or AD)					
	— C125 (A, D or AD)	C125 (A, D or AD)					
	— C125E (A, D or AD)	C125E (A, D or AD)					
	— Q125 Type 1	Q1					
	— Q125EC	Q125EC					
	— Q125ECCY	Q125ECCY					
	— Q130	Q130					
	— Q130RY	Q130RY					
	— Q135EC	Q135EC					
	— Q140	Q140					
	All grade designations		D or P	D or P	P	P	P
11	Supplementary requirements, if applicable:						
	— 10.16 Enhanced collapse variant grade (fill in claimed rating in MPa)	EC <<---->>	P		P		
	— K.2 (SR 1)	S1	P		P		
	— K.3 (SR 2)	S2	P		P	P	
	— K.4 (SR 9) (fill in type)	S9Q«....»		D or P		P	
	— K.8 (SR 13)	S13	P				
	— K.9 (SR 16) (fill in minimum full-size energy absorption requirement, in joules, and test temperature including ± symbol and °C)	S16«....»F			P		
	— K.10 (SR 22)	S22	P	D	P	D	
	— K.14 (SR 41)	S41.1 S41.2	P		P		

Table C.48 *(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, C125, 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
18	IOGP S-735 Product designation (specification level)	S735A or S735B	P	D or P	P	P	P
19	Wall thickness permissible under tolerance	BW10, BW7.5, BW5	P		P		
20	Length of finished tubular	<<X.xx>> m	P		P		
21	Purchaser's purchase order number	PO <<xxxxxx>>	P		P		

f In alignment with Table 18 "(A)" when tested using Method A (smooth tensile). In alignment with Table 19 "D" when tested using Method D (DCB) and in alignment with Table 18 and Table 19 "(AD)" when tested using both method A and method D.

Table C.49—Retention of Records

In column 1, add "C125" to "(Grades C90, T95 and C110)"

Add "Enhanced collapse testing" to "Mechanical Properties"

Requirement	Sub-section Reference
Mechanical Properties	
Grain size (Grades C90, T95, C110, and C125)	7.11, 10.8
Enhanced collapse testing	10.16
Manufacturer Certification	
Sulfide stress-cracking test (Grades C90, T95, and C110)	7.4, 10.110

Add new Table C.59

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

OD / Label 1 in.	Nominal Linear Mass [a, b] T&C kg/m	Wall Thickness *t* mm	Drift Diameter 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 / Label 1 in.	Nominal Linear Mass [a, b] T&C kg/m	Wall Thickness *t* mm	Drift Diameter mm
1	2	3	4
18.000	139.89	12.70	427.02
18.000	156.26	14.27	423.87
18.000	174.11	15.87	420.67
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] 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.

[b] Drift lengths shall be as per Table C.28 based on casing or tubing service.

Add new Table C.60

Table C.60—Summary of Variant Grades

	Type of Variant Grade	Grade Name	Specification Level	Base Grade	Yield Strength MPa		Tensile Strength MPa
					Min	Max	Min
1	2	3	4	5	6	7	8
Grades not requiring sulfide stress cracking test(s)	Chemical composition	L80 Type 1Cr	SL-A	L80 Type 1	As per L80 Type 1		
		L80 Type 3Cr	SL-A	L80 Type 1	As per L80 Type 1		
	Yield	P110CY [b]	SL- A and SL-B	P110	861	965	931
		Q130	SL-B	Q125	896	1034	965
		Q130RY	SL-A	Q125	896	965	965
		Q140	SL-B	Q125	965	1034	1034
	Enhanced collapse [c]	T95EC	SL-A	T95	As per T95		
		P110EC [b]	SL-A and SL-B	P110	As per P110		
		P110ECCY [b]	SL-A and SL-B	P110	861	965	862
		Q125EC	SL-B	Q125	As per Q125		
		Q125ECRY	SL-A	Q125	861	965	931
		Q135EC	SL-B	Q125	931	1034	931
Grades requiring sulfide stress cracking test(s) [a]	Enhanced collapse [c]	T95EC (A, D or AD)	SL-A	T95	As per T95		
		C110EC (A,D or AD)	SL-A	C110	758	827	793
		C125EC (A,D or AD)	SL-A	C125	861	931	896
	LS	R95LS (A or D)	SL-A	R95	655	758	724
		P110LS (A or D) [d]	SL-A	P110	758	861	862
	-	T95 (A-80 %)	SL-B	T95	655	758	724
		T95 (A-90 %)	SL-A	T95	655	758	724
		T95 (D)	SL-A	T95	655	758	724
		C110 (A or D)	SL-A	C110	758	827	793
		C125 (A, D or AD)	SL-A	C125	861	931	896
	E	T95E (A,D or AD)	SL-A	T95	655	758	724
		C110E (A,D or AD)	SL-A	C110	758	827	793
		C125E (A, D or AD)	SL-A	C125	861	931	896

Key

EC = Enhanced collapse

RY = Restrictive yield (reduced max yield strength limit vs base grade)

CY = Controlled yield (increased min yield strength limit vs base grade

(A) = Tested with SSC Test Method A only

(D) = Tested with SSC Test Method D only

(A or D) = Tested with SSC Test Method A or D

(AD) = Acceptance tested with SSC Test Method A and D

[a] Reference Table 18 and Table 19 for SSC test requirements for variant grades.

[b] When performing Charpy V notch testing, use YS_{max} as per Table 11.

[c] Production EC testing as per 10.16, qualification through PPQ as per L.3.2, MPQ as per L.4.4.

[d] For P110LS, the manufacturer shall apply a process control plan which has been demonstrated to the satisfaction of the purchaser as sufficient to ensure that each pipe body and coupling has properties (e.g. chemical composition, hardenability, grain size) conforming to the requirements of the base grade as amended by this overlay standard. When not specified in this standard, the requirements shall be in accordance with the manufacturer's specifications and by agreement between the purchaser and the manufacturer via MPQ/PPQ.

Add new Table C.61

Table C.61—Charpy V-Notch Testing Minimum Absorbed Energy Values—Full Size 10 mm x 10 mm Specimen

Grade	Average Minimum [a] Transverse and Longitudinal Absorbed Energy [b] J	
	SL-B	SL-A
1	2	3
J55	27	41
K55	27	41
N80 Type 1	41	-
N80 Q	41	-
L80 Type 1	41	60
L80 13Cr	41	60
C90	41	60
T95 (R95)	41	60
P110	41	60
C110	-	60
C125	-	60
Q125	41	66

NOTE For products with wall thicknesses > 63.5 mm, minimum absorbed energy criteria shall be by agreement.

[a] Values given in this table are the average minimums. Minimum individual values shall be ⅔ of the average value as per 7.3.1.

[b] Test temperature of 0 °C with an optional temperature of -10 °C and -46 °C by agreement.

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.

Figure D.11—Impact Test Specimen Orientation

Delete "a, b" from figure heading and footnotes a and b

Figure D.16—Reference Indicators

In footnote a, replace third list item with

— For flux leakage inspection, the length of notch shall be as required by the equipment design to provide a reproducible signal when the reference standard is passed through the equipment at the inspection-line speed for the pipe being inspected.

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, add "C125" to "C110"

Table E.3—Process of Manufacture and Heat Treatment

Add column "Specification Level"

Add Grades R95LS, L80 1Cr, L80 3 Cr, P110LS and C125, and replace Grades P110 and Q125 with

Grade	Type	Specification Level	Manufacturing Process [a]	Heat Treatment [e]	Tempering Temperature °F min
1	2		3	4	5
R95LS [i]	—	—	S	Q	1200
L80	1Cr	—	S	Q	1050
L80	3Cr	—	S	Q	1050
P110LS	—	SL-A	S	Q	1200
P110	—	SL-A	S	Q	—
P110	—	SL-B	S or EW [g, h]	Q	—
C125	—	—	S	Q	1200
Q125	1	SL-A	S	Q	—
Q125	1	SL-B	S or EW [h]	Q	—

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

Add grades R95LS, L80 1Cr, L80 3 Cr, P110LS, C125 and footnotes f and 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 [f]	—	—	[g]	—	[g]	[g]	[g]	[g]	[g]	[g]	—	0.020	0.010	0.45
L80	1Cr	—	0.43	—	1.90	—	—	0.80	1.20	1.00	—	0.030	0.030	—
L80	3Cr	0.08	0.43 [a]	0.30	1.90	—	—	2.80	3.60	1.00	0.15	0.030	0.030	0.50
P110LS [f]	—	—	[g]	—	[g]	[g]	[g]	[g]	[g]	[g]	—	0.020	0.010	—
C125	—	—	0.45	—	1.00	0.60	1.50	0.40	1.20	0.06	0.06	0.015	0.005	0.40

[f] For variant grades that require SSC testing, when not 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 18 and Table 19 or by agreement between the purchaser and the manufacturer via MPQ/PPQ.

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

Table E.5—Tensile and Hardness Requirements

Add column "Specification Level"

Add Grades R95LS, P110LS and C125, and replace Grade Q125 and footnote c with

Grade	Type	Specification Level	Total Elongation Under Load %	Yield Strength ksi		Tensile Strength ksi	Hardness [a, c]		Specified Wall Thickness	Allowable Hardness Variation [b]
				min	max	min	HRC	HBW	in.	HRC
1	2	2a	3	4	5	6	7	8	9	10
R95LS	—	—	—	As per Table E.60			25.4	255	≤ 0.500	3.0
									0.501 to 0.749	4.0
									0.750 to 0.999	5.0
									≥ 1.000	6.0
P110LS	—	—	—	As per Table E.60			30.5	290	≤ 0.500	3.0
									0.501 to 0.749	4.0
									0.750 to 0.999	5.0
									≥ 1.000	6.0
C125	—	—	0.8	125	135	130	33.0	311	≤ 0.500	3.0
									0.501 to 0.749	4.0
									0.750 to 0.999	5.0
									≥ 1.000	6.0
Q125	1	SL-A	0.65	125	140	135	[b]	—	≤ 0.500	3.0
									0.501 to 0.749	4.0
		SL-B			150				≥ 0.750	5.0

[c] For through-wall hardness tests of Grades L80 (all types), C90, T95, C110 and C125, the requirements stated in HRC scale are for maximum mean hardness number.

Table E.6—Elongation Table

Add Grade C125 (column 13)

Tensile Test Specimen				Minimum Elongation in 2.0 in. %
				Grade
				C125
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.	130
1	2	3	4	13
0.750	≥ 0.994	≥ 0.746	≥ 0.497	15
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 *(continued)*

Tensile Test Specimen				Minimum Elongation in 2.0 in. %
				Grade
				C125
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.	130
1	2	3	4	13
0.460	0.607-0.620	0.455-0.465	0.304-0.310	14
0.450	0.594-0.606	0.446-0.454	0.297-0.303	14
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 *(continued)*

Tensile Test Specimen				Minimum Elongation in 2.0 in. %
				Grade
				C125
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.	130
1	2	3	4	13
0.150	0.194-0.206	0.146-0.154	0.097-0.103	11
0.140	0.180-0.193	0.135-0.145	0.090-0.096	11
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	10
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	9.5
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.10—Charpy Impact Test Specimen Requirements for Couplings, Coupling Stock, Coupling Material, Coupling Blanks, and Accessory Material for Grades J55 and K55

Delete Table E.10

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 (as shown in strikethrough font), and replace footnote e with

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] lb			
								Round Thread		Buttress Thread	
		D in.	lb/ft	*t* in.	*d* in.	in.	w_{pe} lb/ft	Short	Long	RC	SCC
1	2	3	4	5	6	7	8	9	10	11	12
~~7~~	~~23~~	~~7~~	~~23.30~~	~~0.317~~	~~6.366~~	~~6.241~~	~~22.65~~	~~13.80~~	~~17.51~~	~~18.26~~	~~1.27~~
~~7~~	~~32~~	~~7~~	~~32.20~~	~~0.453~~	~~6.094~~	~~5.969~~	~~31.70~~	~~—~~	~~13.74~~	~~14.11~~	~~-2.88~~
~~7 ¾~~	~~46.1~~	~~7.75~~	~~46.10~~	~~0.595~~	~~6.560~~	~~6.435~~	~~45.51~~	~~—~~	~~—~~	~~—~~	~~—~~
~~8 ⅝~~	~~32~~	~~8.625~~	~~32.00~~	~~0.352~~	~~7.921~~	~~7.796~~	~~31.31~~	~~20.7~~	~~25.57~~	~~25.76~~	~~3.57~~
~~8 ⅝~~	~~40~~	~~8.625~~	~~40.00~~	~~0.450~~	~~7.725~~	~~7.600~~	~~39.33~~	~~—~~	~~23.66~~	~~23.74~~	~~1.56~~
~~9 ⅝~~	~~40~~	~~9.625~~	~~40.00~~	~~0.395~~	~~8.835~~	~~8.679~~	~~38.97~~	~~21.37~~	~~29.97~~	~~28.60~~	~~4.05~~
~~9 ⅝~~	~~53.50~~	~~9.625~~	~~53.50~~	~~0.545~~	~~>8.535~~	~~8.379~~	~~52.90~~	~~—~~	~~23.30~~	~~21.86~~	~~-2.70~~
~~9 ⅝~~	~~58.40~~	~~9.625~~	~~58.40~~	~~0.595~~	~~8.435~~	~~8.279~~	~~57.44~~	~~—~~	~~21.13~~	~~19.66~~	~~-4.89~~
~~10 ¾~~	~~45.5~~	~~10.75~~	~~45.50~~	~~0.400~~	~~9.950~~	~~9.794~~	~~44.26~~	~~24.26~~	~~—~~	~~31.32~~	~~4.10~~
~~10 ¾~~	~~55.5~~	~~10.75~~	~~55.50~~	~~0.495~~	~~9.760~~	~~9.604~~	~~54.26~~	~~20.51~~	~~—~~	~~26.47~~	~~-0.74~~
~~11 ¾~~	~~42~~	~~11.75~~	~~42.00~~	~~0.333~~	~~11.084~~	~~10.928~~	~~40.64~~	~~29.25~~	~~—~~	~~—~~	~~—~~
~~11 ¾~~	~~60~~	~~11.75~~	~~60.00~~	~~0.489~~	~~10.772~~	~~10.616~~	~~58.87~~	~~22.42~~	~~—~~	~~28.93~~	~~—~~
~~11 ¾~~	~~65~~	~~11.75~~	~~65.00~~	~~0.534~~	~~10.682~~	~~10.526~~	~~64.03~~	~~—~~	~~—~~	~~—~~	~~—~~
~~13 ⅜~~	~~72~~	~~13.375~~	~~72.00~~	~~0.514~~	~~12.347~~	~~12.191~~	~~70.67~~	~~23.91~~	~~—~~	~~30.83~~	~~—~~

[e] Alternative drift diameter shall be the larger of the mandrel diameters indicated in this table or Table E.29. See 8.10 for drift requirements.

Table E.28—Standard Drift Size

Add footnote c

Product and Label 1	Standard Drift Mandrel Size [c] min	
	Length	Diameter

[c] Where an alternative drift is available for the product, it shall be used for drift testing.

Table E.30—Maximum Permissible Depth of Linear Imperfections

Add "C125" to " C90 – T95 – C110 – P110 –Q125" and add new row

Grade	Depth as % of Specified Wall Thickness	
	External Imperfections	Internal Imperfections
C90 – T95 – C110 – P110 – C125 – Q125	5 %	5 %
All Grades ordered as SL-A or specified with wall thickness tolerance < 12.5 %	5 %	5 %

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

Replace rows A.1, A.2 and B.3 with

	Surface	Depth	Measurement Notes
A Integral Joint and External Upset Tubing (see Figure D.5 and Figure D.7)			
A.1	All surfaces of upset and upset runout interval, except as stated below	5 % *t*	Percentage of specified pipe body wall thickness t; for linear imperfections; for SL-A products.
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.			
B.3 Upset underfill in the upset run-out intervals shall be considered a defect if the remaining wall thickness (at the upset underfill) is less than the specified wall thickness minus the permissible under tolerance.			

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

Add footnote b and replace column 5 heading with

Coupling for Label 1		Grades H40, J55, K55, N80 (All Types), R95, L80 (All Types), and P110		Grades [b] C90, T95, C110, C125 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 E.37—Frequency of Tensile Tests—Casing and Tubing

In column 1, add "C125" to "C110"

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

In column 1, add "C125" to "C110 and Q125"

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

In column 1, add "C125" to "C110 and Q125" and add "C125" to footnote c

Table E.40—Frequency of Hardness Testing

In column 1, add “Grade C125” to "Grade C110"

Add Variant Grades R95LS, and P110LS, and footnote f

Grade	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, P110LS	Non-upset pipe Grade R95LS		1	50	Through-wall, 1 quadrant	Approximately 50 % from each end
	Non-upset pipe Grade P110LS		1	25	Through-wall, 1 quadrant	Approximately 50 % from each end
	Coupling blanks, coupling stock, coupling material, pup joints and accessory material	Tube-length heat treatment	2 [g]	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

[f] When the purchaser has specified a variant grade requiring SSC testing, the hardness testing is as per the base grade given in Table C.60 or Table E.60, with the exception of the R95LS (A or D) and the P110LS (A or D) that are given above.

Table E.41—Frequency of Flattening Tests

Replace column 1 with

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,
Q125, P110

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	Requirement					
			Visual Inspection (see 10.14)	Coverage of Wall Thickness Verification [b]	Ultrasonic Inspection	Electromagnetic Inspection Methods		Magnetic Particle Inspection [a]
						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 E3024
1	2	3	4	5	6	7	8	9
Pipe body	H40	SL-B	R	P	N	N	N	N
	J55, K55	SL-B	R	P	N	N	N	N
		SL-A		25 %	A	A	A	A
	N80 Type 1 and N80Q	SL-B	R	HL	A	A	A	A
	L80 Type 1, L80 1Cr, L80 3Cr, R95	SL-B	R	HL	A	A	A	A
		SL-A		100 %				
	L80 13Cr, P110	SL-B	R	25 %	A	A	A	A
		SL-A		100 %	C	B	B	B
	P110 Variants	SL-B - CY	R	25 %	C	N	N	N
		SL-B - EC and ECCY		100 %	C	N	N	N
	C90, T95, Q125	SL-B	R	25 %	C	B	B	B
		SL-A		100 %				
	C110, C125	SL-A	R	100 %	C	B	B	B

Table E.42 *(continued)*

Product	Grade	Specification Level	Requirement					
			Visual Inspection (see 10.14)	Coverage of Wall Thickness Verification [b]	Ultrasonic Inspection	Electromagnetic Inspection Methods		Magnetic Particle Inspection [a]
						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 E3024
1	2	3	4	5	6	7	8	9
Coupling stock and accessory material	H40	SL-B	R	P	N	N	N	N
	J55, K55	SL-B	R	P	N	N	N	N
		SL-A		HL	A	A	A	A
	N80 all types, L80 Type 1, R95	SL-B	R	25 %	A	A	A	A
		SL-A		100 %	A	A	A	A
	L80 13Cr, C90, T95, P110, Q125, C110, C125	SL-B	R	25 %	A	A	A	A
		SL-A		100 %	D	A	A	A

N = Not required
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 to inspect the outside surface.
C = Ultrasonic inspection shall be used to inspect the outside and inside surface.
D = Ultrasonic inspection shall be used to inspect the inside surface.
NA = Not applicable
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)

[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] In accordance with 10.13.4, each length of pipe, coupling stock, coupling material, or accessory material shall be measured to verify conformance with wall thickness requirements.

Table E.43—Acceptance (Inspection) Levels

Replace Table E.43 with

Material	Grade	Specification Level	Method	External Imperfections			Internal Imperfections			Through Wall
				Longitudinal	Transverse	Oblique	Longitudinal	Transverse	Oblique	
1	2	3	4	5	6	7	8	9	10	11
Pipe body [a]	J55, K55	SL-B	A	L4	—	—	L4	—	—	—
		SL-A	A	L3	L3	—	L3	L3	—	—
	N80 Type 1	SL-B	A	L3	—	—	L3	—	—	—
	N80 Q		A	L4	—	—	L4	—	—	—
	L80 Type 1, R95	SL-B	A	L4	—	—	L4	—	—	—
		SL-A	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—
	L80 13Cr, P110	SL-B	A	L2	L2	—	L2	L2	—	—
		SL-A	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—
	P110 Variant Grades CY, EC, and ECCY	SL-B	C	L2	L2	—	L2	L2	—	—
	C90, T95	SL-B	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—
		SL-A	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—
			A	—	—	L2	—	—	L2	—
	C110, C125	SL-A	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—
			A	—	—	L2	—	—	L2	—
	Q125	SL-A or SL-B	C	L2	L2	—	L2	L2	—	—
			B	L2	L2	—	—	—	—	—

Table E.43 *(continued)*

Material	Grade	Specification Level	Method	External Imperfections			Internal Imperfections			Through Wall
				Longitudinal	Transverse	Oblique	Longitudinal	Transverse	Oblique	
1	2	3	4	5	6	7	8	9	10	11
Coupling Stock and Accessory Material	J55, K55	SL-A	A	L2	L2	—	—	—	—	—
	N80 all types, L80 Type 1, R95	SL-B	A	L2	L2	—	—	—	—	—
		SL-A	A	L2	L2	—	—	—	—	—
	L80 13Cr, C90, T95, P110, Q125	SL-B	A	L2	L2	—	—	—	—	—
		SL-A	A	L2	L2	—	—	—	—	—
			C	—	—	—	L3	L3	—	L4
	C110, C125	SL-A	A	L2	L2	—	—	—	—	—
			C	—	—	—	L3	L3	—	L4
Weld Seam	P110 [b], Q125 [b]		C	L2	—	—	L2	—	—	—
	L80 Type 1 and R95 to SL-A		C	L2	—	—	L2	—	—	—
	All other grades		A	L3	—	—	L3	—	—	—

— = Not applicable

Lx = 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.

[a] Pup joints shall be inspected like pipe body.

[b] Q125 and P110wWelded pipes are required to have SR 11.

Table E.44—Artificial Reference Indicators

Replace Table E.44 with

Acceptance (Inspection) Level	Specification Level	Notch Depth [a] Maximum %	Notch Length Maximum at Full Depth in.	Notch Width Maximum in.	Radially Drilled Hole Diameter [b] in.	Flat Bottom Hole Diameter [c] in.
1	2	3	4	5	6	7
L2	SL-B	5	2	0.040	1/16	1/4
	SL-A		1			
L3	SL-B	10	2	0.040	1/8	1/4
	SL-A		1			
L4	SL-B	12.5	2	0.040	1/8	1/4
	SL-A		1			

NOTE See Figure D.16.

[a] Depth as a percent of specified wall thickness The depth tolerance shall be ± 15 % of the calculated notch depth with a minimum notch depth of 0.012 in. ± 0.002 in.

[b] Radially drilled hole diameter (through the pipe wall) shall be based on the drill bit size.

[c] Flat bottom hole ensures a minimum of 90 % of specified minimum wall thickness remains below with a tolerance of ± 1.5 %.

Table E.46—Grade Color Codes

Add Grades L80 1Cr, L80 3 Cr, C125, and footnotes d and e

Grade	Grade Type	Number and Color of Bands for Product [a, d, e] with Length ≥ 6.0 ft.	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
L80	3Cr	One red, one brown, one orange	Red	One brown, one orange
C125		One orange, one brown	Orange	Brown

[d] EC 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 brown band shall be applied.

— E variant grades- in addition to the base grade banding, an additional yellow band shall be applied.

— CY variant grades- in addition to the base grade banding, an additional purple band shall be applied.

— RY variant grades- in addition to the base grade banding, an additional pink band shall be applied.

— If multiple variants apply, then apply all the bands stated above (e.g. ECCY, ECRY).

Table E.48—Marking Requirements and Sequence

Delete row 7 and footnote g

In heading, add "C125" to "Grades L80 (All Types), C90, T95, C110 and Q125"

In rows 4 and 5, add "or C.59" to "Table C.1, C.2"

Replace rows 6 and 11 and footnote f

Add rows 18, 19, 20 and 21

vMarking 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, C125, 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, C2 or C.59)	«....»	D or P		P		
	Specified wall thickness for coupling stock and other products with no mass designation						P
6	Grade of product and sulfide cracking test [f] (if applicable):						
	— H40	H					
	— J55	J					
	— K55	K					
	— N80 Type 1	N1					
	— N80Q	NQ					
	— R95	R					
	— R95LS (A or D)	R95LS (A or D)					
	— L80 Type 1	L					
	— L80 Type 1Cr	L1CR					
	— L80 Type 3Cr	L3CR					
	— L80 Type 9Cr	L9					
	— L80 Type 13Cr	L13					
	— C90 Type 1	C90 (A)					
		C90 (D)					
	— T95 Type 1	T95-1					
	— T95EC	T95EC (A, D or AD)					
	— T95 (A-80 %)	T95 (A-80%)					

Table E.48 *(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, C125, 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
6	Grade of product and sulfide cracking test [f] (if applicable): ***(continued)***						
	— T95 (A-90 %)	T95 (A-90%)					
	— T95 (D)	T95 (D)					
	— T95E (A, D or AD)	T95E (A, D or AD)					
	— C110						
	— C110EC (A, D or AD)	C110EC (A, D or AD)					
	— C110 (A, D)	C110 (A, D)					
	— C110E (A, D or AD)	C110E (A, D or AD)					
	— P110	P					
	— P110CY	P110CY					
	— P110EC	P110EC					
	— P110ECCY	P110ECCY					
	— P110LS (A or D)	P110LS (A or D)					
	— C125						
	— C125EC (A, D or AD)	C125EC (A, D or AD)					
	— C125 (A, D or AD)	C125 (A, D or AD)					
	— C125E (A, D or AD)	C125E (A, D or AD)					
	— Q125 Type 1	Q1					
	— Q125EC	Q125EC					
	— Q125ECCY	Q125ECCY					
	— Q130	Q130					
	— Q130RY	Q130RY					
	— Q135EC	Q135EC					
	— Q140	Q140					
	All grade designations		D or P	D or P	P	P	P
11	Supplementary requirements, if applicable:						
	— 10.16 enhanced collapse variant grade (fill in claimed rating in MPa)	EC <<---->>	P		P		
	— K.2 (SR 1)	S1	P		P		
	— K.3 (SR 2)	S2	P		P	P	
	— K.4 (SR 9) (fill in type)	S9Q«....»		D or P		P	
	— K.8 (SR 13)	S13	P				
	— K.9 (SR 16) (fill in minimum full-size energy absorption requirement, in joules, and test temperature including ± symbol and °F)	S16«....»F			P		
	— K.10 (SR 22)	S22	P	D	P	D	
	— K.14 (SR 41)	S41.1 S41.2	P		P		

Table E.48 *(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, C125, 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
18	IOGP S-735 Product designation (specification level)	S735A or S735B	P	D or P	P	P	P
19	Wall thickness permissible under tolerance	BW10, BW7.5, BW5	P		P		
20	Length of finished tubular	<<X.xx>> ft	P		P		
21	Purchaser's purchase order number	PO <<xxxxxx>>	P		P		

[f] In alignment with Table 18 "(A)" when tested using Method A (smooth tensile). In alignment with Table 19 "D" when tested using Method D (DCB) and in alignment with Table 18 and Table 19 "(AD)" when tested using both method A and method D.

Table E.49—Retention of Records

In column 1, add "C125" to "(Grades C90, T95 and C110)"

Add "Enhanced collapse testing" to "Mechanical Properties"

Requirement	Sub-section Reference
Mechanical Properties	
Grain size (Grades C90, T95, C110, and C125)	7.11, 10.8
Enhanced collapse testing	10.16
Manufacturer Certification	
Sulfide stress-cracking test (Grades C90, T95, and C110)	7.4, 10.10

Add new Table E.59

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

OD / Label 1 in.	Nominal Linear Mass [a, b] T&C lb/ft	Wall Thickness *t* in.	Drift Diameter 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
18.000	94.00	0.500	16.812

Table E.59 *(continued)*

OD / Label 1 in.	Nominal Linear Mass [a, b] T&C lb/ft	Wall Thickness *t* in.	Drift Diameter in.
1	2	3	4
18.000	105.00	0.562	16.688
18.000	117.00	0.625	16.562
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] 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.

[b] Drift lengths shall be as per Table E.28 based on casing or tubing service.

Add new Table E.60

Table E.60—Summary of Variant Grades

	Type of Variant Grade	Grade Name	Specification Level	Base Grade	Yield Strength ksi		Tensile Strength ksi
					Min	Max	Min
1	2	3	4	5	6	7	8
Grades not requiring sulfide stress cracking Test(s)	Chemical composition	L80 Type 1Cr	SL-A	L80 Type 1	As per L80 Type 1		
		L80 Type 3Cr	SL-A	L80 Type 1	As per L80 Type 1		
	Yield	P110CY [b]	SL- A and SL-B	P110	125	140	135
		Q130	SL-B	Q125	130	150	140
		Q130RY	SL-A	Q125	130	140	140
		Q140	SL-B	Q125	140	150	150
	Enhanced collapse [c]	T95EC	SL-A	T95	As per T95		
		P110EC [b]	SL-A and SL-B	P110	As per P110		
		P110ECCY [b]	SL-A and SL-B	P110	125	140	125
		Q125EC	SL-B	Q125	As per Q125		
		Q125ECRY	SL-A	Q125	125	140	135
		Q135EC	SL-B	Q125	135	150	135
Grades requiring sulfide stress cracking test(s) [a]	Enhanced collapse [c]	T95EC (A, D or AD)	SL-A	T95	As per T95		
		C110EC (A,D or AD)	SL-A	C110	110	120	115
		C125EC (A,D or AD)	SL-A	C125	125	135	130
	LS	R95LS (A or D)	SL-A	R95	95	110	105
		P110LS (A or D) [d]	SL-A	P110	110	125	125
	-	T95 (A-80 %)	SL-B	T95	95	110	105
		T95 (A-90 %)	SL-A	T95	95	110	105
		T95 (D)	SL-A	T95	95	110	105
		C110 (A or D)	SL-A	C110	110	120	115
		C125 (A, D or AD)	SL-A	C125	125	135	130
	E	T95E (A,D or AD)	SL-A	T95	95	110	105
		C110E (A,D or AD)	SL-A	C110	110	120	115
		C125E (A, D or AD)	SL-A	C125	125	135	130

Key

EC = Enhanced collapse

RY = Restrictive yield (reduced max yield strength limit vs base grade)

CY = Controlled yield (increased min yield strength limit vs base grade)

(A) = Tested with SSC test method A only

(D) = Tested with SSC test method D only

(A or D) = Tested with SSC test method A or D

(AD) = Acceptance tested with SSC test method A and D

[a] Reference Table 18 and Table 19 for variant grades SSC test requirements.

[b] When performing Charpy V notch testing, use YS_{max} as per Table 11.

[c] Production EC testing per 10.16, qualification through PPQ as per L.3.2, MPQ as per L.4.4.

[d] For P110LS, the manufacturer shall apply a process control plan which has been demonstrated to the satisfaction of the purchaser as sufficient to ensure that each pipe body and coupling has properties (e.g. chemical composition, hardenability, grain size) conforming to the requirements of the base grade as amended by this overlay standard. When not specified in this standard, the requirements shall be in accordance with the manufacturer's specifications and by agreement between the purchaser and the manufacturer via MPQ/PPQ.

Add new Table E.61

Table E.61 —Charpy V-Notch Testing Minimum Absorbed Energy Values—Full Size 10 mm * 10 mm Specimen

Grade	Average Minimum [a] Transverse and Longitudinal Absorbed Energy [b] foot-pounds	
	SL-B	SL-A
1	2	3
J55	20	30
K55	20	30
N80 Type 1	30	-
N80 Q	30	-
L80 Type 1	30	44
L80 13Cr	30	44
C90	30	44
T95 (R95)	30	44
P110	30	44
C110	-	44
C125	-	44
Q125	30	49

NOTE For products with wall thicknesses > 2.5 in., minimum absorbed energy criteria shall be by agreement.

[a] Values given in this table are the average minimums. Minimum individual values shall be ⅔ of the average value as per 7.3.1.

[b] Test temperature of 32 °F with an optional temperature of 14 °F and -51 °F by agreement.

Annex G
(informative)
Procedures Used to Convert from USC to SI Units

G.8.2 Charpy Impact Energy

Delete "(for example, as used in Table C.10 and other minimum requirements)" from first sentence

G.8.3 Minimum Absorbed Energy Requirements for Couplings, Tables C.11 to C.17

Delete NOTE 1

Delete NOTE 2

Replace Annex H title with

Annex H
(normative)
Requirements for Specification Level A and B

Replace Annex H with

Add new Table H.2

Table H.2—Reference Table for Specification Level A and B Requirements

Reference	Grade													
	H40	J55	K55	N80-1	N80-Q	L80-1	L80 13Cr	R95	C90	T95	C110	P110	C125	Q125
Table C.3 or Table E.3	S/W	S/W	S/W	S/W	S/W	S/W	S	S/W	S	S	S	S/W	S	S/W
Specification levels offered at grade	B	A/B	A/B	B	B	A/B	A/B	A/B	A/B	A/B	A	A/B	A	A/B
6.2.2		A	A											
7.1									A	A	1		1	
Table C.5 or Table E.5														A
7.10.1						A			1	1				
7.10.2									*	*	1		1	
6.3								A	A/B	A/B		A		
7.4 / K.9 (SR 16)		A	A	*	*	A	A	A	A	A	1	A	1	A
7.3.1				*	*	A		A	A	A	1	A	1	A/B
K.7 (SR 12)														*
8.12.5		*	*	*	*	A	A/B	A	A/B	A/B	1	A	1	A/B
10.11		AW	AW	*	*	AW		AW				1W		1W
10.15.10			AW											
10.13.4 and Table C.42 or Table E.42		A	A				B		B	B				B
10.13.4 and Table C.42 or Table E.42						A	AA	A	A	A	1	A	1	A
10.15.6.1 (L4) and Table C.42 or Table E.42		B	B		1	1	1	1						
10.15.6.2 (L3) and Table C.42 or Table E.42				1										
10.15.6.3 (L3) and Table C.42 or Table E.42		A	A	*	*									
10.15.8 (L2) and Table C.42 or Table E.42							B					1		

Table H.2 *(continued)*

Reference	Grade													
	H40	J55	K55	N80-1	N80-Q	L80-1	L80 13Cr	R95	C90	T95	C110	P110	C125	Q125
10.15.9.1 (L2, two methods) and Table C.42 or Table E.42						A	A	A	1	1	1	A	1	1
10.15.9.2 (L2, two methods, obliques) and Table C.42 or Table E.42									A	A	A		A	
10.15.13							A		A	A	1	A	1	A
10.15.11 or 10.15.12 and Table C.43 or Table E.43		A	A	1	1	1	1	1	1	1	1	1	1	1
9.8 (with SR13)		A	A			A	A/B	A	A/B	A/B		A/B		A/B
10.6.8					*	*		*				*		*
10.6.5									A/B	A/B	1		1	
7.12							A/B							
7.14.5 and Table 18 and Table 19								See Table 18 and Table 19						
Supplementary requirements														
SR1	-	A	A											
SR2 (addressed in 10.15.8 and 10.15.9, above)						A	A/B	A						
SR11 (EW only)												AW/BW		AW/BW
SR16 (addressed in 7.4, above)		A	A				A	A	A	A	1	A	1	A
SR40 (EW only, addressed in 10.11)		AW	AW			AW		AW						

Replace Annex J title with

Annex J
(informative)
Summary of Specification Level Requirements

Replace Annex J with

J.1 General

Replace section with

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

The NDE and SSC requirements are described in each of the sections even when these may not represent ”additional” requirements for the grade.

Detailed requirements are given in the sub-sections indicated in square brackets [ ] after each item.

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

Requirements apply to the base grade and its variants at that SL unless the variant is specifically defined.

There are no SL-A requirements for Grades H40 or N80 (all types). Grades C110 and C125 are only offered at SL-A.

J.2 Grades J55 and K55

Replace section with

J.2.1 SL-B

NDE for longitudinal internal and external imperfections in the pipe body is to satisfy acceptance level L4 [10.15.6.1 and Tables C.43 or E.43].

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) Mandatory Charpy V-notch impact testing and requirements [K.9 SR16].

c) Metallographic examination of the weld zone (EW only) [10.11].

d) Grade K55 only: ultrasonic testing of the weld seam after hydrotest [10.15.10].

e) Wall thickness measurement with 25 % coverage [10.13.4].

f) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L3 [10.15.6.2 and Table C.43 or Table E.43].

g) NDE of coupling stock and accessory material [10.15.11].

h) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

i) Certification of couplings [13.3 s)].

J.3 Grade N80, (All Types)

Replace section with

J.3.1 SL-B

The following requirements are to be satisfied:

a) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

b) Grade N80-Q: NDE for longitudinal internal and external imperfections in the pipe body to acceptance level L4 [10.15.6.1 and Table C.43 or Table E.43].

c) Grade N80-1: NDE for longitudinal internal and external imperfections in the pipe body to acceptance level L3 [10.15.6.3 and Table C.43 or Table E.43].

d) NDE of coupling stock and accessory material [10.15.11].

J.3.2 SL-A

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

J.4 Grade L80 Type 1

Replace section with

J.4.1 SL-B

The following requirements are to be satisfied:

a) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L4 [10.15.6.1].

b) NDE of coupling stock and accessory material [10.15.11].

J.4.2 SL-A

The following requirements are to be satisfied:

a) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

b) Mandatory Charpy V-notch impact testing and requirements [K.9 SR16].

c) Minimum martensite content of 90 % (based on a minimum Rockwell C-scale hardness for an as-quenched sample) [7.10.1].

d) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

e) Metallographic examination of the weld zone (EW only) [10.11].

f) Wall thickness measurement with 100 % coverage, report the minimum wall thickness [10.13.4].

g) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.1 and Table C.43 or Table E.43].

h) NDE: ultrasonic plus another method for the outside surface [10.15.9.1].

i) NDE of coupling stock and accessory material [10.15.11].

j) Seal-ring groove machining and tolerances; seal-ring to be shipped separately [9.8].

k) Certification of couplings [13.3 s)].

J.5 Grade L80 13Cr

Replace section with

J.5.1 SL-B

The following requirements are to be satisfied:

a) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

b) Inside surface preparation [7.12].

c) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.8 and Table C.43 or Table E.43].

d) NDE of coupling stock and accessory material [10.15.11].

e) Wall thickness measurement with 25 % coverage [10.13.4].

f) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

J.5.2 SL-A

The following requirements are to be satisfied:

a) Charpy V-notch impact testing and requirements [K.9 SR16].

b) Inside surface preparation [7.12].

c) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

d) Wall thickness measurement with 100 % coverage, report the minimum wall thickness [10.13.4].

e) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.1 and Table C.43 or Table E.43].

f) NDE: ultrasonic plus another method for the outside surface of the pipe body [10.15.9.1].

g) NDE of pipe ends after end finishing [10.15.3].

h) NDE of coupling stock and accessory material [10.15.12].

i) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

j) Certification of couplings [13.3 s)].

J.6 Grades C90 and T95

Replace section with

J.6.1 SL-B

The following requirements are to be satisfied:

a) Hot straightening requirement with a minimum temperature or cold straightening followed by stress relief [6.3.4].

b) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

a) Charpy V-notch impact testing and requirements [K.9 SR16].

c) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

e) Wall thickness measurement with 25 % coverage [10.13.4].

f) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.1 and Table C.43 or Table E.43].

g) NDE: ultrasonic plus one other method of the pipe body [10.15.9.1].

h) NDE of coupling stock and accessory material [10.15.11].

i) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

j) SSC testing to Method A at 80 % of YS_{min} according to Table 18 [7.14.2].

J.6.2 SL-A

The following requirements are to be satisfied:

a) Hot straightening requirement with a minimum temperature or cold straightening followed by stress relief [6.3.4].

b) Information on chemical composition [7.1].

c) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

d) Charpy V-notch impact testing and requirements [K.9 SR16].

e) Through-wall hardness test of both ends of each pipe [10.6.5].

f) Wall thickness measurement with 100 % coverage, report the minimum wall thickness [10.13.4].

g) NDE for longitudinal and transverse and oblique, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.2 and Table C.43 or Table E.43].

h) NDE: ultrasonic plus one other method of the pipe body [10.15.9.2].

i) NDE of pipe ends after end finishing [10.15.3].

j) NDE of coupling stock and accessory material [10.15.12].

k) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

l) SSC testing according to grade designation selected by purchaser, as defined in Table 18 and Table 19 [7.14.2].

m) Certification of couplings [13.3 s)].

Replace section J.7 title with

J.7 Grade R95 and Associated Variant Grades

Replace section with

J.7.1 SL-B - Grade R95

The following requirements are to be satisfied:

a) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L4 [10.15.6.1].

b) NDE of coupling stock and accessory material [10.15.11].

J.7.2 SL-A - Grade R95

The following requirements are to be satisfied:

a) Hot straightening requirement with a minimum temperature or cold straightening followed by stress relief [6.3.2].

b) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

c) Charpy V-notch impact testing and requirements [K.9 SR16].

d) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

e) Metallographic examination of the weld zone (EW only) [10.11].

f) Wall thickness measurement with 100 % coverage, report the minimum wall thickness [10.13.4].

g) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.1 and Table C.43 or Table E.43].

h) NDE: ultrasonic plus one other method of the pipe body [10.15.9.1].

i) NDE of coupling stock and accessory material [10.15.11].

j) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

k) Certification of couplings [13.3 s)].

J.7.3 SL-A - Grade R95LS

The Variant Grade R95LS is a seamless product (Table C.3 or Table E.3).

The following requirements are to be satisfied:

a) Hardness testing [7.7.3 and 10.6.2]

b) SSC testing according to Table 18 or Table 19 [7.14.2].

c) Hot straightening requirement with a minimum temperature or cold straightening followed by stress relief [6.3.2].

d) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

e) Charpy V-notch impact testing and requirements [K.9 SR16].

f) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

g) Wall thickness measurement with 100 % coverage, report the minimum wall thickness [10.13.4].

h) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.1].

i) NDE: ultrasonic plus one other method of the pipe body [10.15.9.1].

j) NDE of coupling stock and accessory material per base grade [10.15.11].

k) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

l) Certification of couplings [13.3 s].

Replace section J.8 title with

J.8 Grade P110 and Associated Variant Grades

Replace section with

J.8.1 SL-B—Grade P110

The following requirements are to be satisfied:

a) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.8.1].

b) NDE of coupling stock and accessory material [10.15.11].

J.8.2 SL-B—Variant Grade P110CY

The following requirements are to be satisfied:

a) NDE: ultrasonic for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.8.2].

b) NDE of coupling stock and accessory material per base grade [10.15.11]

c) Wall thickness measurement with 25 % coverage [10.13.4].

d) Charpy V-notch impact testing and requirements [K.9 SR16]. Impact energy requirement calculation based on YS_{max}.

J.8.3 SL-B—Variant Grades P110EC and P110ECCY

The following requirements are to be satisfied:

a) NDE: ultrasonic for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.8.2].

b) NDE of coupling stock and accessory material per base grade [10.15.11].

c) Charpy V-notch impact testing and requirements [K.9 SR16].

d) Wall thickness measurement with 100 % coverage, report the minimum wall thickness [10.13.4].

J.8.4 SL-A—Grade P110

Grade P110 is a seamless product at SL-A (Table C.3 or Table E.3).

The following requirements are to be satisfied:

a) Hot straightening requirement with a minimum temperature or cold straightening followed by stress relief [6.3.1].

b) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

c) Charpy V-notch impact testing and requirements [K.9 SR16].

d) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

e) Wall thickness measurement with 100 % coverage, report the minimum wall thickness [10.13.4].

f) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.1].

g) NDE: ultrasonic plus one other method of the pipe body [10.15.9.1].

h) NDE of coupling stock and accessory material [10.15.12].

i) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

j) Certification of couplings [13.3 s)].

J.8.5 SL-A—Variant Grade P110LS

The Variant Grade P110LS is a seamless product (Table C.3 or Table E.3).

The following requirements are to be satisfied:

a) Hardness testing [7.7.3 and 10.6.2]

b) SSC testing according to Table 18 or Table 19 [7.14.2].

c) Hot straightening requirement with a minimum temperature or cold straightening followed by stress relief [6.3.1].

d) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

e) Charpy V-notch impact testing and requirements [K.9 SR16].

f) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

g) Wall thickness measurement with 100 % coverage, report the minimum wall thickness [10.13.4].

h) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.1].

i) NDE: ultrasonic plus one other method of the pipe body [10.15.9.1].

j) NDE: ultrasonic plus one other method of the pipe body [10.15.9.1].

k) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

l) Certification of couplings [13.3 s)].

Replace section J.9 title with

J.9 Grade Q125 and Associated Variant Grades

Replace section with

J.9.1 SL-B—Grade Q125 and Variant Grades Q130 and Q140

The following requirements are to be satisfied:

a) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

b) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

c) Wall thickness measurement with 25 % coverage [10.13.4].

d) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.1].

e) NDE: ultrasonic plus one other method of the pipe body [10.15.9.1].

f) NDE of coupling stock and accessory material per base grade [10.15.11].

g) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

J.9.2 SL-B—Variant Grades Q125EC and Q135EC

The following requirements are to be satisfied:

a) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

b) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

c) Wall thickness measurement with 100 % coverage [10.13.4].

d) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.1].

e) NDE: ultrasonic plus one other method of the pipe body [10.15.9.1].

f) NDE of coupling stock and accessory material per base grade [10.15.11].

J.9.3 SL-A—Grade Q125 and Variant Grades Q130RY and Q125ECRY

Grade Q125 and the variants Q125 ECRY and Q130RY are seamless products (Table C.3 or Table E.3).

The following requirements are to be satisfied:

a) Maximum yield strength of 965 MPa (140 ksi) specified [C.5 and E.5].

b) Charpy V-notch impact shear area minimum of 75 % [7.3.1].

c) No product to be susceptible to having material detach during make-up (appropriate processing or abrasive blasting) [8.12.5].

d) Surface hardness test of each pipe body, upset and coupling (or process control plan) [10.6.8].

e) Wall thickness measurement with 100 % coverage, report the minimum wall thickness [10.13.4].

f) NDE for longitudinal and transverse, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.1].

g) NDE: ultrasonic plus one other method [10.15.9.1].

h) NDE of pipe ends after end finishing [10.15.3].

i) NDE of coupling stock and accessory material per base grade [10.15.12]

j) Seal-ring groove machining and tolerances: seal-ring to be shipped separately [9.8].

k) Certification of couplings [13.3 s)].

Add new section

J.10 Grades C110 and C125

J.10.1 SL-A

The following requirements are to be satisfied:

a) SSC testing according to grade designation selected by purchaser, as defined in Table 18 or Table 19 [7.14.2].

b) Wall thickness measurement with 100 % coverage, report the minimum wall thickness [10.13.4].

c) NDE for longitudinal, transverse and oblique, internal and external imperfections in the pipe body to acceptance level L2 [10.15.9.2 and Table C.43 or Table E.43].

d) NDE: ultrasonic plus one other method of the pipe body [10.15.9.2].

e) NDE of pipe ends after end finishing [10.15.3].

f) NDE of coupling stock and accessory material [10.15.12].

g) Certification of couplings [13.3 s].

J.10.2 SL-B

SL-B requirements are not applicable for Grade C110 and Grade C125.

Annex K
(normative)
Supplementary Requirements

Replace "informative" with "normative" in Annex K title

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

Replace first sentence with

The casing and tubing shall be inspected for imperfections that are greater than the permissible under tolerance percentage of wall thickness, for example -12.5 %, -10 %, -7.5 %, -5 %.

Add after first paragraph

The casing and tubing shall be inspected for imperfections that reduce the net effective wall thickness to below the minimum allowable wall thickness.

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

the minimum allowable wall thickness.

Replace section K.4 title with

K.4 SR 9-Coupling Blanks-Grades C110, C125 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 %" with

the selected wall thickness tolerance percentage

Replace section K.11 title with

K.11 SR 38-Statistical Tensile Testing-Grades C90, T95, C110 and C125

K.12 SR 39-Alternative NACE TM0177-2016 Method D Sulfide Stress Cracking (SSC) Tests-Grade C110

Delete section K.12

K.13 SR 40-Electric-welded Casing, Tubing, and Pup Joints, Grades H40, J55, K55, N80 (All Types), L80 Type 1, and R95

K.13.1 SR 40.1—Height and Trim of Electric-weld Flash

Replace first sentence of first paragraph with

The weld seam, with the exception of upset ends, shall be inspected non-destructively for the full length by ultrasonic methods.

Ultrasonic methods shall use reference standards containing notches and holes in accordance with Table C.43 and Table C.44, or Table E.43 and Table E.44 to verify equipment response from artificial reference indicators.

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

Pipe upsets shall be inspected in accordance with 10.15.14.

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 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.42 or Table E.42 shall be placed on the segregated pipe in order to identify its class of wall thickness.

Add new Annex L

Annex L
(normative)
Product Performance and Manufacturing Procedure Qualification

L.1 General

This annex defines additional provisions that shall apply if the purchaser specifies the PPQ and/or the manufacturing procedure qualification (MPQ) on the purchase agreement or inquiry.

L.1.1 Definitions

L.1.1.1 Product Performance Qualification

The PPQ is conducted to validate a given performance attribute or attributes. Testing typically includes methods and acceptance criteria that are more stringent than those of production quality control tests.

Examples include:

— EC rating;

— product environmental performance envelope for grades that require SSC testing;

— end sizing and thermal recovery.

L.1.1.2 Manufacturing Procedure Qualification

The MPQ is conducted to validate the consistency of the manufacturing procedure or sub-procedure(s) to meet the specification. Testing typically involves methods and acceptance criteria that are the same as those of production quality control tests, but with enhanced test frequency and location.

Examples include:

— new manufacturing equipment;

— size or weight or grade not previously made at facility;

— size or weight or grade not previously made for purchaser;

— change in manufacturing procedure;

— demonstration of control of parameters contributing to EC performance;

— production of grades requiring SSC testing;

— control of RY or CY results;

— demonstration that NDE equipment detects production flaws;

— demonstration that thread element gauging frequency is appropriate.

L.1.3 Limitations

Pipe shall be manufactured using production facilities and processes (industrial manufacturing scale).

Pipe shall not be manufactured using laboratory facilities.

NOTE These qualification(s) do not include requirements for an audit of the manufacturers quality management system or quality control systems but conformance with API Specification Q1 is expected. The qualification requirements of this annex are not part of the API monogram program but data may be used for that purpose.

L.1.4 Scope of Qualification

Qualification shall be achieved by the manufacturer for the purchaser's acceptance:

1) providing data from previous production or qualification activities;

2) testing material left over from previous production; or

3) testing future production according to the requirements of this annex.

The scope of qualification testing shall be reduced or omitted when data from previous manufacturing is accepted by the purchaser.

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.

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

Add new Figure L.1

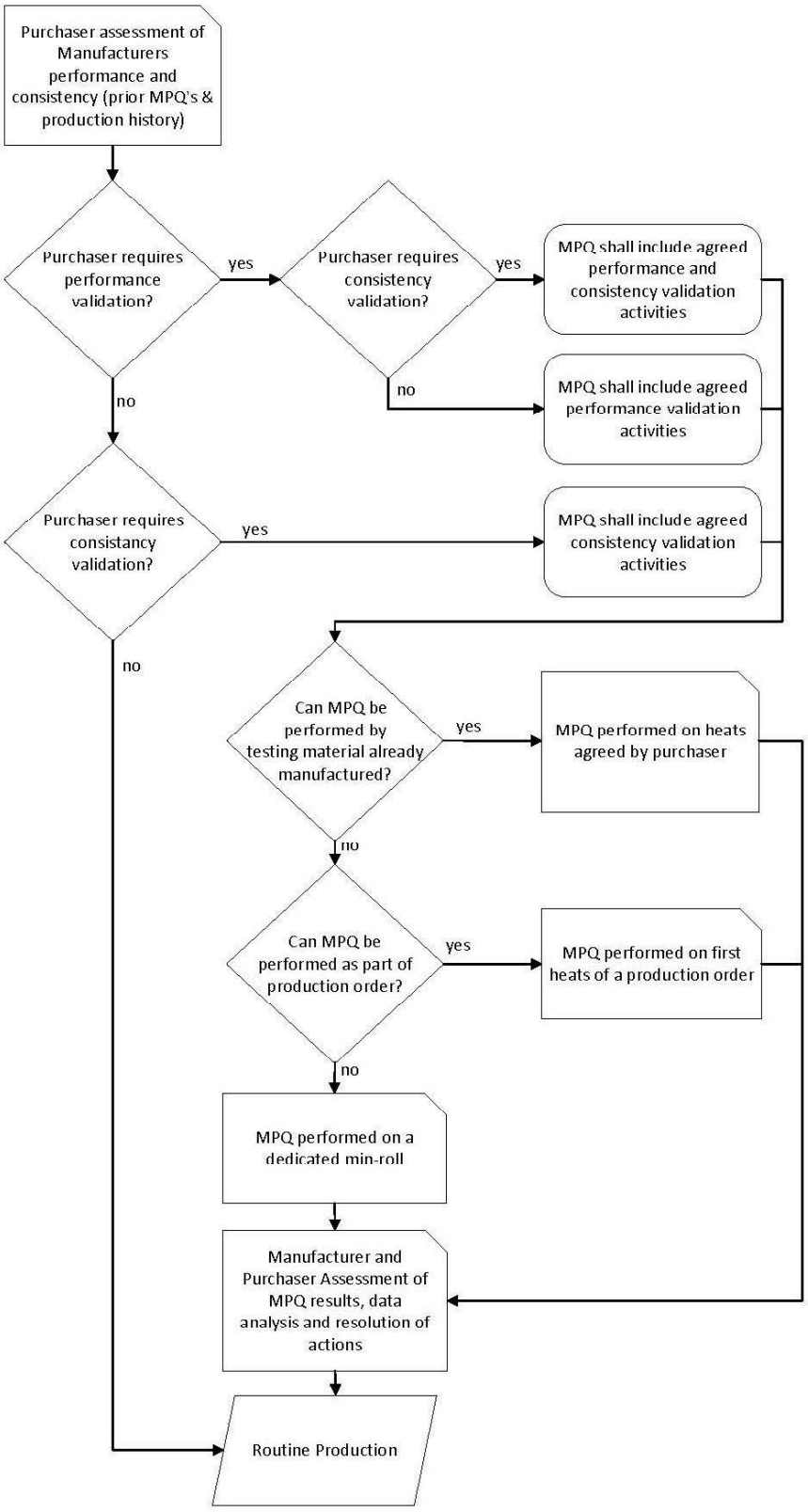

Figure L.1—Flowchart for PPQ / MPQ Decisions by the Purchaser

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

L.2.1 General

Details of the manufacturing procedure shall be provided. This includes data from past production to demonstrate process consistency and product performance.

L.2.2 Description of the Manufacturing Process

The manufacturing process shall be detailed for the PPQ or the MPQ.

The manufacturer shall provide a description of the manufacturing process and quality control plan, demonstrating:

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) Defined production route that identifies manufacturing and testing location(s), all manufacturing operations and manufacturing controls required to maintain the qualification (as applicable):

    1) material manufacturing process:

        i) melting process and general equipment description;

        ii) secondary metallurgy processes (if any) and general equipment description;

        iii) casting method (ingot or continuous cast);

        iv) further processing of starting material (rolling, forging).

    2) product manufacturing process:

        i) hot forming process and general equipment description, including minimum hot working ratio;

        ii) heat treatment, quenching and hot straightening and general equipment description;

        iii) final conditioning processes and general equipment description, including end sizing if applicable.

d) Details of additional manufacturing processes, restrictions in the manufacturing processes, specific process control requirements applicable to the product and support the claimed performance:

    1) validation of the applicable processes (if previously qualified, the reports of the previous qualification may be submitted by the manufacturer to request the purchaser to reduce the qualification test scope):

        i) non-destructive examination;

        ii) final heat treatment (excluding stress relieving);

        iii) stress relieving, if applicable;

        iv) cold straightening, if applicable.

    2) demonstration of statistical process control:

i) statistical analysis that product consistently met requirements;

ii) capability analysis, statistical criteria for ”in-control” and conclusions.

e) Enhanced inspection or testing requirements performed strictly for qualification:

1) material requirements should specify the target attribute and the acceptable range for:

i) chemical composition;

ii) heat treatment, type, cycle and temperature controls;

iii) mechanical properties, as applicable, for hardenability, hardness, tensile and impact results;

iv) SSC tests;

v) metallurgical parameters as applicable (hardenability, grain size).

2) specific geometry controls.

f) The information may be included within the MPS and/or provided as standalone document, at the manufacturer’s discretion.

L.2.3 Test Results or Previous Qualification

Documentation of test results or previous qualifications of the product shall be acceptable.

When using a previous qualification, the manufacturer shall supply documentation of product that is equivalent to the product to be qualified. A technical justification for the applicability of the proposed extrapolation shall be provided.

L.2.4 Decision to Undertake PPQ and/or MPQ through Testing

L.2.4.1 Purchaser Request of PPQ or MPQ

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

L.2.4.2 General

The number and distribution of samples, types and amounts of testing for specific products or processes shall be in accordance with either:

— L.3 for PPQ;

— L.4 for MPQ.

L.2.4.3 Scope

The agreed qualification scope, approach and activities shall address the following:

a) Including heats of material from the same grade, manufactured previously.

b) If a dedicated mini-roll is required or the first heats of a production order are used.

c) The range of product dimensions deemed sufficiently similar in manufacture to include within the scope of qualification. All product dimensions within each range must be made by the same manufacturing route and process parameters. Where such dimension ranges are defined, the manufacturer shall provide justification (based on the manufacturing process) for the applicable dimensions, noting any manufacturing differences between the product dimensions that may influence performance and/or consistency.

d) Minimum number of heats and lots, either in a single run or in multiple runs.

e) Specific target property ranges for the material manufactured. For example, the purchaser may require that the qualification be performed using material at the high end of the manufacturer's hardness and/or yield strength range for grades requiring SCC testing per Table 18 and Table 19.

f) The qualification activities that will be undertaken and the SL targeted.

g) Additional qualification activities not detailed in this Annex. For example, qualification of a specific sub-process.

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

L.3 Product Performance Qualification (PPQ)

L.3.1 General

The PPQ is conducted to validate a given performance attribute or attributes.

Testing typically includes methods and acceptance criteria that are more stringent than those of production quality control tests.

Examples include:

— EC rating (L.3.2);

— product environmental performance envelope for grades requiring SSC testing per Table 18 and Table 19 (L.3.3);

— end sizing and thermal recovery (L.3.4).

In accordance with API Specification Q1, 5.4, the manufacturer shall document and make available to the purchaser the methods used to establish the alternative claimed performance (if applicable). Appealing to industry standard principles is recommended (e.g. API TR 5C3 or similar industry documents).

L.3.2 Product Performance Qualification for Enhanced Collapse Product

The terms of this section shall apply when the purchaser requests qualification on the purchase agreement or inquiry for a tubular product with a higher collapse rating than in API TR 5C3.

L.3.2.1 Claimed Performance

The manufacturer shall declare a minimum collapse rating for a size/weight/grade combination.

The manufacturer shall document the basis for determining the rating with reference to the design equation or approach (e.g. API TR 5C3, Annex F) and the process control parameters defined in L.2.

L.3.2.2 Product Quality Plan and Process Control

The manufacturer shall present a manufacturing procedure specification combined with a PQP for production that considers the requirements of 10.16.

The manufacturer's PQP shall define control limits for geometric and mechanical property parameters and the frequency that these parameters will be measured during the production order. At a minimum, requirements about tensile test results, wall thickness, and ovality shall be included.

L.3.2.3 Demonstration of Performance

The manufacturer shall produce a trial production run of at least 100 lengths in at least two heats with lot size of no more than 50 pieces each. The controlled variables shall be measured and reported at the frequency in L.3. 10 lengths from each heat shall be randomly selected and collapse tested in accordance with API TR 5C3, Annex I (full measurements as per Annex I taken on each sample).

L.3.2.4 Documentation

The manufacturer shall document the validated rating, collapse test results and measurements per API TR 5C3, Table I.1, the manufacturing procedure specification and the PQP.

L.3.3 Product Performance Qualification Grades that Require SSC Testing

The terms of this section shall apply when the purchaser requests qualification on the purchase agreement or inquiry for a tubular product with an envelope of sour environmental performance.

L3.3.1 Claimed Performance

For variant grades requiring SSC testing (as listed in Table C.60 or Table E.60), the manufacturer shall declare the performance of the grade in terms of acceptable combinations of sour environment pH and partial pressure of H_2S, based on sour service qualification data that is in conformance with the requirements of ANSI NACE MR0175/ISO 15156, Part 2, Annex B for qualification of a manufacturing process.

The manufacturer shall justify the manufacturing chemistry and heat treatment limits, permitted hardness, yield strength and tensile strength based on sour service qualification data.

NOTE 1 Data from analogous grades or fundamental knowledge is acceptable.

The manufacturer shall quantify the manufacturing chemistry, heat treatment limits, permitted hardness, yield strength and tensile strength based on sour service qualification data.

NOTE 2 Data from analogous grades or fundamental knowledge is acceptable.

L.3.3.2 Number of Heats and Pipe Lengths

The lengths selected for sour environmental performance qualification shall be selected from material at higher end of the hardness and yield strength range permitted for the product. Three lengths (each from a different heat) shall be used for the PPQ. The qualification shall test material with the highest hardness and yield strength in accordance with this section.

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.

Material that is close to the maximum thickness given in the scope of the qualification shall be selected for testing. Different products of the same grade (coupling material, pipe, and or accessory material) may be selected for the three heats required for qualification.

Where agreed by the purchaser, heats that have already been manufactured may be used for the PPQ.

L.3.3.3 Test Sampling and Frequency

Test sampling and frequency shall be as follows:

a) tensile test: perform triplicate specimens per length at both ends and mid-length. Each specimen from a triplicate set shall be taken from a different quadrant of the pipe.

b) hardness test: perform four-quadrant test adjacent to each tensile test sample.

c) SSC test: a test set shall consist off at least three test specimens (with valid results).

d) tests set shall be taken from the circumferential position of the pipe that has the highest hardness (by quadrant hardness testing).

e) NACE TM0177 Method A: a test set shall be taken from both ends and the middle of each selected pipe (9 valid specimens per heat).

f) NACE TM0177 Method D: a test set shall be taken from both ends and the middle of each selected pipe (9 valid specimens per heat).

g) From the pipe and position with the lowest K1ssc performance, KLIMIT testing shall be a set for three different arm displacements (9 valid specimens per qualification).

L.3.3.4 Test Method and Inspection Criteria

Test methods and acceptance criteria shall be in accordance with NACE MR0175 Part 2 and NACE TM0177-2016 with the additions and modifications in this section.

The manufacturer shall supply SSC test procedures for review and acceptance by the purchaser. The purchaser may require all SSC tests to be performed by an agreed 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. For example, combinations of pH and partial pressure H_2S.

Method A and Method D tests shall be performed following the application specific section NACE MR0175, Part 2, Table B.1. For intended pH values below 4.0 the pH shall be adjusted to the required value using acetic acid rather than HCl.

SSC tests shall be performed at 24 °C (75 °F), unless testing at 4 °C (39 °F) is agreed between the purchaser and the manufacturer. SSC testing shall not be done at temperatures greater than 24 °C (75 °F). Test duration shall be as per NACE TM0177 for ambient temperature tests and 21 days for 4 °C (39 °F) if selected.

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

Acceptance criteria for NACE TM0177 Method D testing shall be detailed in the PQP for grades that include Method D production tests. For grades that do not include routine Method D production tests in the QCP, the manufacturer shall by agreement also test for Method D conditions and report the results for information only with no acceptance criteria invoked.

L.3.3.5 Reporting of the Environmental Performance Envelope

The following shall be reported:

- Traceability of specimens from each heat and lot with associated test data according to 6.4.1.
- Sour service test in accordance with NACE TM0177.
- Report K_{LIMIT} in accordance with NACE TM0177 from the lowest K_{1ssc} set.
- Plot the SSC test results (pass/fails) on a reproduction of ISO 15156/NACE MR0175, Part 2, Figure 1.
- Summary of the results of the testing and proposed actions following any valid test failures.

L.3.3.6 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.3.3.7 Variant Grades Requiring SSC Testing

For SSC tests in PPQ of variant grades, the manufacturer may retest in a more benign test fluid (higher pH and/or lower pH_2S), to define a reduced pH-pH_2S performance window for the grade.

The revised SSC test procedure shall be submitted for review and acceptance by the purchaser.

L.3.3.8 Retesting

When testing grades that are not variant grades as defined in Table C.60 or Table E.60, no retesting is allowed. If test failure(s) occur(s), the manufacturer shall perform assessment to determine root cause(s) and then apply corrective action(s) to mitigate the root cause(s). Thereafter, the material may be reprocessed/processed based on the corrective action(s) and tested as new lot(s).

L.3.4 Qualification of End Sizing and Thermal Recovery Process

The terms of this section shall be used to validate the end sizing process, with or without thermal recovery, for each manufacturing process route and location, and each size, wall thickness, grade, and connection geometry combination. The process shall be revalidated after any shutdown for repair or replacement of any equipment used in the ESTR process that may affect the material properties.

For Grades H40, J55, K55, N80, L80 and R95, the manufacturer may present evidence that the maximum compressive or tensile strain in the deformed area prior to recovery is less than that previously validated by the manufacturer for the same grade and the same base chemistry.

L.3.4.1 Claimed Performance

The manufacturer shall document the validation process and parameters, the procedures, the evaluation data and the technical analysis conducted to demonstrate compliance with the requirements of this annex. This information shall be available upon request to the purchaser.

L.3.4.2 Process Validation

L.3.4.2.1 Sample Location

Test specimens for process validation shall be taken from the following sections:

a) a section as close as possible to the area of maximum strain shall be used for tensile, hardness, impact testing and SSC testing (if applicable); and

b) a section from the adjacent area of the pipe that is not affected by deformation or heating shall be used for tensile testing.

L.3.4.2.2 Test Requirements for Grades H40, J55, K55, N80, L80, R95, P110 and Q125 during Production

The following requirements shall be met:

a) No retests shall be allowed. If these requirements are not met, the end sizing and/or thermal recovery process parameters shall be modified.

b) Tensile testing shall be performed as per 10.4.7 and 10.4.8. Tensile properties (yield and tensile stress) shall comply with the requirements for the grade. The yield strength shall meet the minimum yield strength for the grade as specified in Table C.5 or Table E.5 for the grade or for Variant grades in Table C.60 or Table E.60, except if any test exceeds the maximum yield strength limit but is within 5 % of the yield stress of the adjacent pipe body area, the result shall be acceptable.

c) Hardness testing shall be performed in accordance with 10.6.9 through 10.6.13. The hardness test specimens shall be prepared as specified in Figure D.10 utilizing 9-point one quadrant testing. Results shall meet the maximum hardness requirement specified in 7.7, 7.8, Table C.5 or Table E.5 for the grade and Table C.60 or Table E.60 for the variant grades.

d) Impact testing shall be performed in accordance with 7.3.7, 10.7.5, and 10.7.6. The impact test shall consist of a set of three test specimens with the largest possible test specimen listed in Table C.8 or Table E.8 and the hierarchy of test specimen size and orientation in accordance with Table C.9 or Table E.9. 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.61 or Table E.61.

   The average absorbed energy of the deformed area shall exceed 75 % of the average absorbed energy of the unaffected area.

L.3.4.2.3 Test Requirements for Grades C90, T95, C110, and C125 during Product Validation

The requirements of L.3.4.2.2 shall be met, in addition to the following requirements:

a) An ESTR sample shall be subjected to a SSC test to the same conditions as the pipe body. SSC test results shall meet the minimum requirement specified in 7.14.5 or Table 18 or Table 19. When NACE TM0177-2016 Method D sub-size or alternative specimens are used, the acceptance criteria shall be agreed between the purchaser and the manufacturer.

b) Prior SSC testing for a PPQ of the same grade may be submitted by the manufacturer for purchaser's consideration of agreement if:

   1) No changes have occurred to the equipment and/or stress relief process that may affect SSC performance.

   2) The wall thickness for the current PPQ is no more than 120 % of the wall thickness from the previous PPQ.

3) The percentage of deformation for the current PPQ is less than 101 % of the percentage of deformation from the previous PPQ.

4) SSC test specimens from the previous PPQ were taken from the region of greatest plastic deformation.

L.3.4.3 Qualification Requirements

L.3.4.3.1 Documentation

The manufacturer shall document all test results. The report shall identify the process route and location, and each size, wall thickness, grade, and connection geometry combination, maximum level of deformation applied, the alignment and temperature uniformity of heated ends, the location of the temperature measurement instruments used, the recovery temperature (if applicable), and the total exposure time.

L.4 Manufacturing Process Qualification

L.4.1 General

The MPQ is conducted to validate the consistency of the manufacturing procedure or sub-procedure(s) to meet the specification. Testing typically involves methods and acceptance criteria that are the same as those of production quality control tests, but with enhanced frequency and test location.

Examples include:

— new manufacturing equipment (final product, L.4.2);

— size or weight or grade not previously made at facility (final product, L.4.2);

— size or weight or grade not previously made for purchaser (final product, L.4.2);

— change in manufacturing procedure (final product, L.4.2);

— demonstration of control of parameters contributing to RY or CY products (final product, L.4.2);

— production of grades requiring SSC testing (L.4.3);

— demonstration of control of parameters contributing to EC performance (L.4.4);

— demonstration that NDE equipment detects production flaws (L.4.5);

— demonstration that thread element gauging frequency is appropriate (L.4.6).

The number of heats required for the MPQ shall be as described below or as agreed by the manufacturer and the purchaser as per L.2.4.

The MPQ and PPQ may be undertaken on new or the same heats, provided these meet the scope and approach agreed in L.2.

L.4.1.1 Analysis and Reporting of Manufacturing Procedure Qualification Results

Statistical analyses shall be performed to demonstrate that the processes are in-control.

The manufacturer shall declare the statistical criteria applied for controlling the process.

The statistical analysis shall include the range and distribution of measured results with sufficient fidelity to demonstrate that the process is in control. The distribution should lie within minimum and maximum bounds with occurrence lower for values closer to the min and max limits.

The manufacturer shall report the analyses, state the criteria for being in-control and state conclusions.

L.4.2 Requirements for General Manufacturing Process Qualification

L.4.2.1 Test Sampling, Tests and Frequency

21 lengths (pipe) or six pieces of coupling stock or accessory material shall be selected randomly at the beginning, middle and end from a production order or mini roll for testing.

Testing methods, sampling locations and test frequencies shall be in accordance with Table L.1.

Add new Table L.1

Table L.1—Test Methods, Sampling Locations and Frequencies for Manufacturing Process Qualification

Type of Test	Stage of Sampling or Product	Test Frequency
1	2	3
Chemical analysis	Heat (ladle)	1 test per heat
All intentionally added or controlled elements for both heat and products analysis shall be determined and reported	Product analysis	2 lengths per heat (representing the start and end of the cast of the heat).
Microstructure evaluation – grain size	On each as quenched lot	Sour grades: 1 test per hardenability test.
Hardenability	Casing, tubing, coupling material, coupling stock, accessory material	1 test per heat per heat treatment run.
Tensile test		Three sacrificial pipe lengths: triplicate specimens per length at both ends and mid-length from lengths from leading, middle and trailing end as processed through heat treatment run (continuous). Each specimen from a triplicate set shall be taken from a different quadrant of the pipe. Total of 27 tests for pipe.
		Remaining pipe lengths: 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). Total of 18 tests per heat for pipe.
Hardness test		Same frequency as tensile tests
		Sour grades: 4-quadrant ring test, adjacent to each tensile test sample. Total of 27 tests for pipe.
		Non-sour grades: 1-quadrant ring test adjacent to each tensile test location. Total of 27 tests for pipe.
Charpy impact test	Casing, tubing, coupling stock, accessory material	Same frequency and adjacent to the sacrificial joints tensile tests
		1 set (3 specimens along the length) per adjacent to each tensile test location on the sacrificial joints. Total of 9 sets for pipe.
Dimensional measurement	Casing and tubing	All samples on the 21 lengths.
		For diameter and wall thickness measurements, measurements shall be taken at least on both ends and mid-length.
NDE	Casing, tubing, coupling material, coupling stock, accessory material	All lengths, 100 % defect (as per 8.13) and wall thickness coverage.

L.4.2.2 Acceptance Criteria

Acceptance criteria are as per this specification for the grade and SL assessed.

L.4.2.3 Invalidation of Tests

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

L.4.2.4 Retests

MPQ samples shall not be re-tested prior to establishing the root cause and sharing the results with the purchaser.

If test failure(s) occurs, the manufacturer shall apply corrective action(s) to mitigate the root cause(s).

Thereafter, the material shall be reprocessed/processed based on the corrective action(s) and tested under a revised MPQ.

L.4.3 Requirements for Manufacturing Process Qualification for Product Requiring SSC Testing

L.4.3.1 Test Sampling, Tests and Frequency

The 21 lengths (pipe) or six pieces of coupling stock that were selected in L.4.2 shall be subjected to additional testing using the methods, sampling locations and test frequencies given in Table L.2.

Add new Table L.2

Table L.2—Test Methods, Sampling Locations and Frequencies for Manufacturing Process Qualification of Product Requiring SSC Testing

Type of Test	Stage of Sampling or Product	Test Frequency
1	2	3
SSC tests	Casing, tubing, coupling material, coupling stock, accessory material	Method A Test: 1 test from both ends and the middle of each sacrificial length (9 specimens per heat for pipe). Samples to be taken from the quadrant that was measured to have the highest average hardness. Method D Test: a) 1 set (of min 3 valid specimens) from both ends and the middle of the sacrificial pipe that had the greatest hardness (3 sets, 9 specimens per heat). Samples to be taken from the quadrant that was measured to have the greatest hardness. b) 1 set (of min 3 valid specimens) from both ends and the middle of the sacrificial pipe that had the greatest yield strength (3 sets, 9 specimens per heat). Note that if the same pipe has the highest hardness and highest yield strength, then only a) or b) is required for Method D.

L.4.3.2 Acceptance Criteria

Acceptance criteria are as per this specification for the grade and SL assessed.

Testing conditions and acceptance criteria for SSC quality control testing shall be in accordance with Table 18 or Table 19.

For grades that do not include SSC Method D production tests in the QCP, the manufacturer shall by agreement also test for Method D conditions and report the results for information only with no acceptance criteria invoked.

L.4.3.3 Invalidation of Tests

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

L.4.3.4 Retests

MPQ samples shall not be re-tested prior to establishing the root cause and sharing the results with the purchaser.

If test failure(s) occurs, then the manufacturer shall apply corrective action(s) to mitigate the root cause(s).

Thereafter, the material shall be reprocessed/processed based on the corrective action(s) and tested under a revised MPQ.

L.4.4 Requirements for Manufacturing Process Qualification for High Collapse Product

L.4.4.1 Test Sampling, Tests and Frequency

A full scale collapse test shall be performed on at least one length from every production run in accordance with the procedures of API TR5C3, Annex I.

The collapse testing frequency shall be a single test per 50 pipes until the manufacturer has performed 50 tests on that size/weight/grade combination.

On each specimen used for collapse testing, mechanical tests, residual stress test and dimensional measurements shall be carried out in accordance with the requirements of API TR5C3, Annex I.

The dataset of the 50 test results shall be recorded and be available in electronic format.

L.4.5 Manufacturing Procedure Qualification for Non-Destructive Examination on a Specific Product

L.4.5.1 Scope

This qualification procedure shall be performed on a production run of the inspection unit for inspection repeatability determination when requested by the purchaser.

The manufacturer shall conduct the MPQ on the product (which may be part or all of the purchase order).

Qualification of NDE equipment on a specifically designed reference indicators shall be in accordance with Annex M.

The manufacturer shall perform qualification on each steel source, chemistry and rolling practice to identify the natural defect pattern and how the imperfections are altered by rolling, in accordance with 10.15.1.

If steel source and rolling process changes, re-qualification shall be required.

L.4.5.2 Test Sampling, Tests and Frequency

The number of joints or items selected for the repeatability test for the MPQ shall be 125.

The manufacturer may elect to conduct the repeatability trial with a larger number of production tubulars or may present previous MPQ data on similar product(s) for acceptance by the purchaser.

L.4.5.3 Procedure

The manufacturer shall conduct NDE on the total production order (lot) in accordance with the manufacturer's internal procedures (at production conditions) and the inspection criteria based on SL from Table C.43 or Table E.43.

The manufacturer shall reinspect at increased sensitivity 125 joints that have met the inspection criteria and are judged to be free from defects with wall thickness greater than specified.

The manufacturer shall re-inspect those joints to the same inspection criteria given in Table C.43 or Table E.43 with the following parameters adjusted:

a) Scan plan coverage to be set at 200 %.

b) For flaw detection:

1) the reference amplitude increased by +2 dB;

2) the alarm threshold lowered by -1 dB.

c) For wall thickness:

The alarm threshold lowered by the greater of 1 % nominal wall thickness or 0.002 in.

The manufacturer shall tabulate defects and imperfections and the difference in the measured wall thickness from the inspections.

Add new Table L.3

Table L.3—Acceptance Criteria for Inspection Unit MPQ

Specification Level or Wall Thickness Tolerance	Maximum Number of Rejectable Defects [a, b]	Minimum Measured Wall Thickness
1	2	3
SL-A Wall thickness tolerance < 12.5 %	0 [a]	t_{net}
SL-B	0 [b] or 2 [a]	t_{net} – 0.002 in. t_{net} – 0.05 mm
Key t_{net} is minimum acceptable net effective wall thickness based on specified wall thickness (t) and wall thickness tolerance e.g. for a tolerance of -10 %, $t_{net} = t*(1-0.10)$		
[a] Defects found during second inspection 0.002 in. (0.05 mm) larger than the criteria given in Table E.43 are rejectable. [b] Defects found during second inspection 1.5 times larger than the criteria given in Table E.43 are rejectable.		

L.4.5.4 Retests

If an MPQ for inspection procedure fails, the manufacturer shall determine root cause(s) and perform corrective actions.

If an MPQ for inspection procedure fails, the manufacturer shall perform a new MPQ with double the number of items or joints classified as acceptable and re-inspected.

L.4.6 Process Consistency Validation in Thread Inspection

L.4.6.1 Scope

This qualification procedure shall be performed on a production run of the threading line for repeatability determination when specified by the purchaser.

The manufacturer shall conduct the MPQ on the agreed product, either in part or the complete purchase order.

The manufacturer should perform qualification on each size, weight, grade and thread form to validate gauging practice.

L.4.6.2 Test Sampling, Tests and Frequency

The number of joints for the MPQ shall be 125.

Documentation of test results or previous MPQ data on equivalent product(s) shall be acceptable.

L.4.6.3 Procedure

The manufacturer shall gauge all threads in accordance with the manufacturer's internal procedures (at production conditions).

The manufacturer shall randomly select 10 % for SL-B or 30 % for SL-A from the first inspection.

NOTE Random sample may be selected before threading and regauge performed inline.

The manufacturer shall re-gauge the thread elements on those connections to the same inspection criteria with:

— a different set of gauges where available (gauges used on the mill end threads may be used on field end threads, and the reverse); or

— a different inspector (inspector who gauged the mill end threads may gauge the field end threads, and the reverse).

Measurements of all inspections shall be recorded by the manufacturer.

The threading MPQ pass criteria shall be zero out-of-specification thread elements or if zero defects are found.

L.4.6.4 Retests

When an MPQ for threading procedure fails, the manufacturer shall determine root cause(s) and perform corrective actions by agreement with the purchaser.

If the MPQ for threading fails, the manufacturer shall perform a new MPQ using the same requirements but with double the number of joints or items.

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 from the initial declared QCP.

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

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

Add new Annex M

Annex M
(normative)
Qualification of NDE Equipment

M.1 Introduction

M.1.1 General

Qualification shall be subject to demonstration by the mill to satisfy the requirements of this specification and standards referenced herein.

M.1.2 Frequency

The manufacturer shall be qualified at a frequency of four years. This remains valid unless there is a change to the equipment, for example structural components, software or hardware.

M.1.3 Purchasers Request

The purchaser may request repeating the qualification for a specific project. This shall be specified in the purchase order.

M.2 Prior to the Qualification Audit

M.2.1 Process of Qualification

The process for the qualification of pipe mill NDE equipment and practices shall be as follows.

M.2.2 Documentation Submission

The following information shall be supplied to the purchaser for agreement prior to the audit:

a) scope of the qualification (see M.2.3);

b) NDT procedures: including applicable methods in compliance with 10.15 and applicable to the scope (and for UT and EMI: reference standards) of the audit;

c) design of UT and/or EMI reference standards in compliance with 10.15.4.3 d);

d) report of visual and dimensional inspection for UT and EMI reference standards, demonstrating compliance with 10.15.3.

M.2.3 Scope of Qualification

The scope of the qualification shall consist of:

a) renewal of existing scope of qualification, extension to scope or new qualification;

b) SL defined as either level A or level B, based on the most stringent requirement, based on the mill's capability;

c) pipe types (manufacturing methods e.g. EW, SMLS) materials, grades;

d) for each pipe type: ranges of pipe diameter and thickness for which qualification is sought;

e) NDE methods, techniques and documented threshold settings.

M.3 NDE Method-specific Requirements during the Qualification Audit

M.3.1 General Requirements

The qualification audit shall include:

a) practical demonstration of each applicable NDE method and technique, performed on welds or pipes (as applicable);

b) calibrations, control checks and maintenance;

c) qualification and certification of NDE personnel;

d) elements of the quality system/business management system related to NDE.

M.3.2 Practical Demonstrations

Inspection parameters shall be qualified on an individual basis.

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

M.3.3 UT of EW and SMLS Pipe

M.3.3.1 General Requirements

The practical demonstration of ultrasonic testing shall be carried out on one or more reference standards which cover the manufacturer's thickness and diameter ranges.

Ultrasonic testing shall consist of:

a) equipment set-up;

b) static (if practicable) and dynamic standardization;

c) gate positions for defects and coupling, S/N ratio;

d) detection of reference reflectors (in accordance with 10.15.1);

e) repeatability trial;

f) extent of coverage;

g) accuracy and consistency of seam tracking system;

h) documented threshold settings.

M.3.3.2 Reference Standards

For wall thickness ≤ 12 mm (0.47 in.), the reference standard shall have the lowest wall thickness and smallest diameter to be qualified.

For wall thickness > 12 mm (0.47 in.) the reference standard shall have the highest wall thickness and largest diameter to be qualified.

M.3.3.3 Repeatability Trial

The repeatability trial shall be carried out dynamically, using the conveyor assembly at the maximum scanning speeds (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 automated ultrasonic systems that measure amplitudes up to 100 % full scale height, indications greater than 100 % shall be invalid.

Ten uninterrupted test runs, in the forward direction, shall be without adjustment of equipment or settings.

When specified in IOGP S-735D, ten uninterrupted test runs, in the reverse direction (after turning the reference standard end-to-end), without any adjustment of equipment or settings. Any interruption or adjustment shall invalidate the results.

For equipment with rotating head assemblies, 20 runs shall be completed in total consisting of:

— five runs at every pipe angular position (0°, 90°, 180° and 270°);

— the pipe being rotated after a series of five runs.

The results of a repeatability trial shall be acceptable when no reference reflector indication amplitude deviates from the average value by more than ±25 % or equivalent dB tolerances.

M.3.3.4 Recording of Data

The following data shall be recorded:

a) written procedure;

b) reference standard details and dimensions;

c) 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 shall be recorded as percentage of screen height or as percentage chart height (as applicable), or decibels, using an automated digital method such as a digital export feature, to at least one decimal point (e.g. 81.6 %, not rounded up to 82 %); and

g) indication amplitudes for all channels and all reference reflectors shall be entered into a spreadsheet supplied by the auditor for the calculation of the average values and the minimum and maximum deviations from the average values.

M.3.4 EMI of EW or SMLS Pipe

M.3.4.1 General Requirements

The practical demonstration of electromagnetic inspection (EMI) shall be carried out on one or more reference standards.

EMI shall consist of:

a) equipment set-up;

b) static (if practicable) and dynamic standardization;

c) gate positions for defects, S/N 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 determined by the purchaser;

h) documented threshold settings.

M.3.4.2 Reference Standards

The reference standard shall be representative of the diameter and thickness range to be qualified.

M.3.4.3 Repeatability Trial

The repeatability trial shall be carried out dynamically, using the conveyor assembly at the maximum scanning speeds (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 measure amplitudes up to 100 % full scale height indications greater than 100 % shall be invalid.

Ten uninterrupted test runs, in the forward direction, shall be without adjustment of equipment or settings.

The results of a repeatability trial shall be acceptable when no reference reflector indication amplitude deviates from the average value by more than ±25 % or equivalent dB tolerances.

M.3.4.4 Recording of Data

The following data shall be recorded:

a) written procedure;

b) reference standard details and dimensions;

c) 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 shall be recorded as percentage of screen height or as percentage of chart height (as applicable), using a consistent method, to at least one decimal point (e.g. 81.6 %, not rounded up to 82 %); and

g) indication amplitudes for all channels and all reference reflectors shall be entered into a spreadsheet supplied by the auditor for the calculation of the average values and the minimum and maximum deviations from the average values.

M.3.5 Evaluation of Trial

The results of a repeatability trial shall be considered acceptable when no reference reflector indication amplitude deviates from the average value by more than ±25 % (or equivalent dB tolerances).

When a qualification audit on a specific NDE method fails, the manufacturer shall determine root cause(s) and perform corrective actions by agreement with the purchaser. The manufacturer should perform a repeatability trial using the same requirements with the corrective actions applied.

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