

API Ballot 6768
TG OCTG
WI 2459- Product Analysis Tolerances

Work Item Number	2459
Title of Work Item	Product Analysis Tolerances
Ballot Revision Level	1
Type of Ballot (Initial, Comment, Comment resolution (reference API ballot#), 1 st Re-ballot, 2 nd Re-ballot, etc.)	Initial
Submitter Name(s)	Carly Antonucci
API Document Modified	API 5CT 11 th ed
Impacted Documents	N/A
Revision Key	Current API document in black, Deletions in red strikethrough, Additions in red with gray highlight

Work Item Charge: Establish and incorporate product analysis tolerances into 5CT.

Ballot Rationale: Section 10.3 of API 5CT requires chemical composition of each heat to be reported along with two product analyses from that heat. It is well known that for some elements, chemical composition changes slightly between the melt and product analysis because of attributes such as segregation. In general, the heat analysis is more representative of the chemistry because its measurement is not a discreet area. However, the product analysis chemical composition limits in C.4/E.4 currently do not have any allowable measurement tolerances. Whenever something is being measured, tolerances need to exist (whether they are driven by calibration or by testing variation). Additionally, other API standards often reference the heat analysis rather than the product analysis.

Ballot Text:

Tables

C.4/E.4 Chemical Composition-Heat Analysis, Mass Fraction (%)..... 4

C.X/E.X Chemical Composition- Product Analysis, Mass Fraction (%).....

Table 1—Purchaser-supplied Information (Casing)

Requirement	Reference
Standard	API 5CT
Quantity	
Type of pipe or couplings	
Casing:	
Threaded or plain-end	7.12.1, Table C.1 or Table E.1
Type of connection: SC, LC or BC, or other connection	7.12.2, 7.12.6, Table C.1 or Table E.1
With or without couplings	7.12.2, Table C.1 or Table E.1
Special clearance couplings—BC	8.6, Tables C.1, C.28 or Tables E.1, E.28
Special clearance couplings with special bevel—BC	8.6
Label 1 or specified outside diameter	Table C.1 or Table E.1
Label 2 or specified mass or wall thickness	Table C.1 or Table E.1
Grade and type where applicable	Tables C.1, C.4, C.X or Tables E.1, E.4, E.X
Length	7.6, Table C.22 or Table E.22
Seamless or electric-welded	5.1, Table C.3 or Table E.3
Critical thickness for SF couplings, stock, or blanks	6.3.2
Delivery date and shipping instructions	
Inspection by the purchaser	Annex B
For all Grades except L80 13 Cr, impact test minimum absorbed energy requirement in wall thickness greater than 63.5 mm (2.5 in.)	Table C.14 or Table E.14

Table 2—Purchaser-supplied Information (Tubing)

Requirement	Reference
Standard	API 5CT
Quantity	
Type of pipe or couplings	
Tubing:	
Non-upset, external upset, or integral joint	Table C.2 or Table E.2
Threaded, plain-end, or other connection	7.12
With or without couplings	7.12
Regular couplings with special bevel NU, EU	8.9, Tables C.19, C.29, and C.35 or Tables E.19, E.29, and E.30

Special clearance couplings—EU	8.6, Tables C.19 and C.30 or Tables E.19 and E.30
Label 1 or specified outside diameter	Table C.2 or Table E.2
Label 2 or specified mass or wall thickness	Table C.2 or Table E.2
Grade and type, where applicable	Table C.2 or Table E.2, Table C.4 or Table E.4, Table C.X or Table E.X
Length	7.6, Table C.22 or Table E.22
Seamless or electric-welded	5.1, Table C.3 or Table E.3
Critical thickness for SF couplings	6.3.2
Delivery date and shipping instructions	
Inspection by the purchaser	Annex B
For all Grades except L80 13 Cr, impact test minimum absorbed energy requirement in wall thickness greater than 63.5 mm (2.5 in.)	Table C.14 or Table E.14
For Grade L80 13 Cr, impact test minimum absorbed energy requirement in wall thickness greater than 35.6 mm (1.4 in.)	Table C.14 or Table E.14

Table 3—Purchaser-supplied Information (Coupling Stock and Material and Accessory Material)

Requirement	Reference
Standard	API 5CT
Quantity	
Kind of product: coupling stock, coupling material, or accessory material	
Traceability for Grades other than C110 and Q125	5.4.1
Yield strength for Grade Q125	6.2.3, A.15 (SR 43)
Impact test minimum percent shear area for Grades N80, L80 Type 1, L80 3Cr, C90, R95, T95, P110, and Q125	6.3.3, A.16 (SR 44)
Minimum percentage martensite required for quenched and tempered products for Grades L80 Type 1, C90, and T95	6.10.2, A.17 (SR 45)
SSC test requirements for Grades C90 and T95	6.14.2, 9.10.2, A.18 (SR 46)
SSC test method(s) and test solution(s) for Grade C110	6.14, 9.10, A.11 (SR 39)
Outside diameter and tolerances	7.2
Wall thickness and tolerances	7.2
Straightness tolerance	7.9.2
Length	7.6
Grade and type, where applicable	Tables C.3, and C.4, and C.X or Tables E.3, and E.4, and E.X
Impact requirements or critical thickness	6.4
Inspection by the purchaser	Annex B
Critical thickness for SF accessory material	6.3.2
Wall thickness verification of SF accessory material	9.13.4

NDE of product ends (all Grades)	9.15.13, A.20 (SR 48)
Delivery date and shipping instructions	
For all Grades except L80 13 Cr, impact test minimum absorbed energy requirement in wall thickness greater than 63.5 mm (2.5 in.)	Table C.14 or Table E.14
For grade L80 13 Cr, impact test minimum absorbed energy requirement in wall thickness greater than 35.6 mm (1.4 in.)	Table C.14 or Table E.14

6.1 Chemical Composition

Product shall conform to the requirements specified in Table C.4 or Table E.4 **for heat analysis and Table C.X or Table E.X for product analysis** for the grade and type specified.

For Grades C90, T95, and C110, the manufacturer shall inform the purchaser at the time of inquiry of the minimum and maximum concentrations for all elements intentionally added to each heat, regardless of the purpose of the addition.

9.3.2 Product Analyses

Two tubular products from each heat used shall be analyzed for product analyses. Product analyses shall be made by the manufacturer on the finished tubular product before or after heat treatment. For electric-welded products, the chemical analysis may be determined on samples of skelp.

Product analyses shall include the results of quantitative determinations of all elements listed in Table **C.4 C.X** or Table **E.4 E.X**, including elements used by the manufacturer to control mechanical properties.

NOTE For couplings, pup joints, and accessory material, the product analyses requested can be furnished by the steel manufacturer or processor, and can be taken from material in tubular or bar form.

Table C.4/E.3—Process of Manufacture and Heat Treatment

Grade	Type	Manufacturing Process ^a	Heat Treatment ^e	Tempering Temperature °C min
1	2	3	4	5
H40	—	S or EW	—	—
J55 ⁱ	—	S or EW	— ^b	—
K55	—	S or EW	— ^b	—
N80	1 ⁱ	S or EW	^c	—
N80	Q	S or EW	Q ^d	—
R95 ⁱ	—	S or EW	Q	538
L80	1	S or EW	Q	566
L80	3Cr	S	Q	566
L80	9Cr ⁱ	S	Q ^f	593
L80	13Cr	S	Q ^f	593 ^j
C90	—	S	Q	621
T95	—	S	Q	649

C110	—	S	Q	649
P110	—	S or EW ^{g, h}	Q	—
Q125	—	S or EW ^h	Q	—

^a EW = electric-welded process; S = seamless process.

^b Full-body, full-length normalized, normalized and tempered or quenched and tempered at the manufacturer's option, or as specified in the purchase agreement (see 5.2.2).

^c Full-body, full-length heat treatment is mandatory; at the manufacturer's option either normalized or normalized and tempered.

^d Includes the method of interrupted quenching followed by controlled cooling.

^e Q = quenched and tempered.

^f L80 9Cr and L80 13Cr may be air-quenched.

^g Special chemical requirements for electric-welded P110 pipe are specified in Table C.4/E.4 and Table C.X/E.X.

^h Products shall be heat-treated full-body, full-length; special requirements unique to electric-welded P110 and Q125 are specified in A.6 (SR 11).

ⁱ Quenched and tempered product in large *D/t* ratio combinations and nonquenched and tempered product may exhibit ductile rupture values lower than internal yield values; see API 5C3/ISO 10400 calculated performance values in columns 15 and 18 in Table K.1 and Table L.1.

^j See 5.2.3.

Table C.5/E.4—Chemical Composition, ^{-Heat Analysis}, Mass Fraction (%)

Grade	Type	C		Mn		Mo		Cr		Nb	Ni	Cu	P	S	Si
		min	max	min	max	min	max	min	max	max	max	max	max	max	max
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H40	—	—	—	—	—	—	—	—	—	—	—	—	0.030	0.030	—
J55	—	—	—	—	—	—	—	—	—	—	—	—	0.030	0.030	—
K55	—	—	—	—	—	—	—	—	—	—	—	—	0.030	0.030	—
N80	1	—	—	—	—	—	—	—	—	—	—	—	0.030	0.030	—
N80	Q	—	—	—	—	—	—	—	—	—	—	—	0.030	0.030	—
R95	—	—	0.45 ^c	—	1.90	—	—	—	—	—	—	—	0.030	0.030	0.45
L80	1	—	0.43 ^a	—	1.90	—	—	—	1.50	—	0.25	0.35	0.030	0.030	0.45
L80	3Cr	—	0.30	—	1.20	—	—	2.50	3.90	0.30	0.25	0.35	0.020	0.010	0.45
L80	9Cr	—	0.15	0.30	0.60	0.90	1.10	8.00	10.0	—	0.50	0.25	0.020	0.010	1.00
L80	13Cr	0.15	0.22	0.25	1.00	—	—	12.0	14.0	—	0.50	0.25	0.020	0.010	1.00
C90	—	—	0.35	—	1.20	0.25 ^b	0.85	—	1.50	—	0.99	—	0.020	0.010	—
T95	—	—	0.35	—	1.20	0.25 ^d	1.00	0.40	1.50	—	0.99	—	0.020	0.010	—
C110	—	—	0.35	—	1.20	0.25	1.00	0.40	1.50	—	0.99	—	0.020	0.005	—
C125	—	—	0.45	—	1.00	0.50	1.75	0.40	1.50	—	0.99	—	0.020	0.005	—
P110	—	—	—	—	—	—	—	—	—	—	—	—	0.030 ^e	0.030 ^e	—
Q125	—	—	0.35	—	1.35	—	0.85	—	1.50	—	—	—	0.020	0.010	—

NOTE—Elements shown shall be reported in product analysis.

- ^a The carbon content for L80 may be increased up to 0.50 % maximum if the product is oil-quenched or polymer-quenched.
- ^b The molybdenum content for Grade C90 Type 1 has no minimum tolerance if the wall thickness is less than 17.78 mm.
- ^c The carbon content for R95 may be increased up to 0.55 % maximum if the product is oil-quenched.
- ^d The molybdenum content for T95 Type 1 may be decreased to 0.15 % minimum if the wall thickness is less than 17.78 mm.
- ^e For EW Grade P110, the phosphorus content shall be 0.020 % maximum and the sulfur content 0.010 % maximum.

Table C.X/E.X—Chemical Composition-Product Analysis, Mass Fraction (%)

Grade	Type	C		Mn		Mo		Cr		Nb	Ni	Cu	P	S	Si
		min	max	min	max	min	max	min	max	max	max	max	max	max	max
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H40	—	—	—	—	—	—	—	—	—	—	—	—	0.030	0.030	—
J55	—	—	—	—	—	—	—	—	—	—	—	—	0.030	0.030	—
K55	—	—	—	—	—	—	—	—	—	—	—	—	0.030	0.030	—
N80	1	—	—	—	—	—	—	—	—	—	—	—	0.030	0.030	—
N80	Q	—	—	—	—	—	—	—	—	—	—	—	0.030	0.030	—
R95	—	—	0.48 ^c	—	1.93	—	—	—	—	—	—	—	0.030	0.030	0.48
L80	1	—	0.44 ^a	—	1.93	—	—	—	1.62	—	0.26	0.36	0.030	0.030	0.47
L80	3Cr	—	0.31	—	1.23	—	—	2.50	4.02	0.30	0.26	0.36	0.020	0.010	0.47
L80	9Cr	—	0.16	0.30	0.63	0.90	1.12	8.00	10.12	—	0.51	0.26	0.020	0.010	1.02
L80	13Cr	0.15	0.23	0.25	1.03	—	—	12.0	14.12	—	0.51	0.26	0.020	0.010	1.02
C90	—	—	0.38	—	1.23	0.25 ^b	0.87	—	1.54	—	1.00	—	0.020	0.010	—
T95	—	—	0.38	—	1.23	0.25 ^d	1.02	0.40	1.54	—	1.00	—	0.020	0.010	—
C110	—	—	0.38	—	1.23	0.25	1.02	0.40	1.54	—	1.00	—	0.020	0.005	—
C125	—	—	0.48	—	1.03	0.50	1.77	0.40	1.54	—	1.00	—	0.020	0.005	—
P110	—	—	—	—	—	—	—	—	—	—	—	—	0.030 ^e	0.030 ^e	—
Q125	—	—	0.38	—	1.38	—	0.87	—	1.54	—	—	—	0.020	0.010	—

NOTE—Elements shown shall be reported in product analysis.

- ^a The carbon content for L80 may be increased up to 0.51 % maximum if the product is oil-quenched or polymer-quenched.
- ^b The molybdenum content for Grade C90 Type 1 has no minimum tolerance if the wall thickness is less than 17.78 mm.
- ^c The carbon content for R95 may be increased up to 0.58 % maximum if the product is oil-quenched.
- ^d The molybdenum content for T95 Type 1 may be decreased to 0.15 % minimum if the wall thickness is less than 17.78 mm.
- ^e For EW Grade P110, the phosphorus content shall be 0.020 % maximum and the sulfur content 0.010 % maximum.