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Re: Comparison of API Spec 5L 43rd edition and ISO 3183 (2nd ed.) /API Spec 5L 44th edition

API Subcommittee 5, Task Group on Line Pipe developed the above subject comparison in an effort to aid in the transition to the 44th edition of API Spec 5L on Line Pipe. This comparison is for information only and does not alter or interpret any of these standards. The responsibility remains with the user of the standard to review the new edition for changes.

A summary of the differences are given in attachment 1 with the details provided in attachment 2.

Sincerely,

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Attachment 1: Summary of Technical Differences between API 5L (43rd ed.) and ISO 3183 (2nd ed.) / API 5L (44th ed.)

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General:

1. Scope – ISO/44th does not cover water pipe but does cover sour & offshore pipe
2. Pipe sizes – Wider pipe range for ISO/44th
3. Delivery conditions – ISO/44th more thoroughly/explicitly covers alternate delivery conditions within grade
4. Manufacturing – ISO/44th is more restrictive with steelmaking (BOF or EAF) and pipe making (remove SAW seam lubricant, no manual SAW tacking, 0.3-1.5% cold expansion) requirements

Acceptance Criteria:

1. Chemical composition – ISO/44th updated to modern methods
2. Tension test – ISO/44th similar but values rounded up to nearest 5 MPa, & new X90-X120
3. Toughness in ISO/44th
 - PSL1 – no requirements
 - PSL2 (Base temperature is 0°C)
 - Min body CVN energy similar to 43rd
 - Min 27 or 40J weld/HAZ CVN energy (SMLS & SAW) not in 43rd
 - Min 85% CVN (vs. 60%) & DWTT (vs. 40%) shear, if agreed

Surface conditions, imperfections & defect:

1. Diameter – ISO/44th centred on nominal vs. just over nominal for 43rd
2. Out of round – ISO/44th more restrictive (esp. for smaller diameters in range), new body OOR requirement.
3. Geometric deviations – flat spots or peaks limited in ISO/44th to 3.2mm not in 43rd
4. Local end straightness (bell/crimp) – new requirement to 4mm/m max
5. End finish – ISO/44th uses square cut for $t \leq 3.2\text{mm}$ vs. bevel & limits belled ends to $t \leq 3.6\text{mm}$
6. Misaligned welds – ISO/44th much more restrictive (≤ 3 or 4mm) vs. confirm by NDI

Inspection/Test Frequency:

1. Body Tensile, CVN, DWTT – ISO/44th is 1/test unit (generally heat) vs. 1/100, 200 or 400 pipes/heat depending on diameter in 43rd.
2. Weld CVN – ISO/44th requires 1/test unit vs. not required in 43rd.
3. Macrographic test – For welded pipe, ISO/44th requires 1/shift vs. none in 43rd

Sampling & Test Pieces:

1. CVN specimens – ISO/44th allows for $\frac{3}{4}$ -sized specimens not in 43rd, but does not allow for $\frac{1}{2}$ or $\frac{2}{3}$ sized longitudinal samples in 43rd.

Test Methods:

1. Hydrostatic – ISO/44th allows end loading compensation to be applied without agreement.
2. Diameter – ISO/44th only identifies ring gauging as one of many methods
3. Sorting – 43rd does not discuss sorting

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Records Retention: ISO/44th has wider list of records to retain

Welded Joints:

1. Qualifications – ISO/44th allows purchaser approval of qualifications while 43rd required API 1104
2. Weld heights – ISO/44th allows 3.5 or 4.5mm max for SAW
3. Weld seam separation – ISO/44th addresses spiral welds better than 43rd.
4. NDE – ISO/44th allows UT in addition to RT method while 43rd only allowed RT

Manufacturing Procedure Qualification:

When called and for Sour & offshore service, ISO/44th requires manufacturer to identify characteristics manufacturing procedure and/or qualification tests prior to production. No equivalent in 43rd

Repair welding:

1. Methods – ISO/44th does not allow flux core arc welding process
2. Procedure Qualification – ISO/44th more formal than CSA
3. Essential variables – Many more for ISO/44th including HI, gas composition, etc.
4. TW tensile – ISO/44th allows torch cut edges
5. Weld/HAZ CVN – ISO/44th requires CVN tests which meet long seam requirements not required in CSA
6. Nick breaks – eliminated in ISO/44th
7. RW procedure - to be UT and/or RT in ISO/44th

Non-Destructive Inspection (non-sour and on-shore):

1. General – many differences in methods, calibration, criteria, etc. between 43rd and ISO/44th which require a thorough review/analysis.
2. SMLS end NDI – ISO/44th requires UT or MT if automatic system does not cover ends while 43rd allowed a short distance at end to not be inspected.
3. RT film class & density – limits defined in ISO/44th not in 43rd
4. RT IQI – ISO does not allow hole IQI's while CSA does.
5. UT/EMI standardization frequency – once /4 hrs in ISO/44th edition vs. 1/ 8 hrs in 43rd
6. RT of Volumetric indications – explicitly addressed in ISO/44th

Sour Service: (new service for ISO/44th)

1. Steel composition – ISO/44th is much more restrictive than standard 43rd with $\leq 0.002\%$ S, ≤ 1.5 Ca/S, inclusion shape controlled, etc. for welded, and $\leq 0.003\%$ S for seamless
2. HIC testing – mandatory with ISO/44th giving restrictive acceptance criteria
3. Hardness – ISO/44th requires macro-hardness on routine samples with ≤ 22 HRC vs. ≤ 35 HRC in 43rd
4. ID HFW weld flash – ISO/44th is ~2x more restrictive than 43rd
5. Inspection frequency – ISO/44th defines higher hardness & diameter frequency

Offshore Service: (new service for ISO/44th)

1. Steel & Pipe making – ISO/44th has casting method, HFW edge prep & intermittent tacking limitations not in 43rd

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2. Chemistry – ISO/44th is more restrictive esp. S, Nb, CE values than 43rd
3. Out of Round – ISO/44th is ~2x more restrictive than 43rd
4. Length – ISO/44th requires 11.7-12.7m lengths while 43rd requires 4.27-13.72m
5. Straightness – Body: ISO/44th requires 0.15% vs. 0.2% tolerance for 43rd
Ends (bell/crimp): ISO/44th 3mm/m vs. not specified in 43rd
6. ID HFW weld flash – ISO/44th is ~2x more restrictive than 43rd
7. Mechanical property frequency – ISO/44th is ~2x more than 43rd

Non-Destructive Inspection for Sour & Offshore Service:

(new service for ISO/44th)

1. End Lamination inspection – ISO/44th requires UT for last 50mm not required by 43rd.
2. SMLS UT for long imperfections – ISO/44th requires full body UT not in 43rd
3. SMLS UT thickness – ISO/44th requires full body thickness checks not required in 43rd
4. HFW weld UT – ISO/44th per ASTM E213 while 43rd allows E213 or E273.
5. SAW UT of weld – ISO/44th requires new, more comprehensive inspection than 43rd
6. SAW Body/Edge/End Lamination– ISO/44th mandates lamination UT not in 43rd

Coupling/Threading: ISO/44th very similar to 43rd

Fracture Arrest Criteria (welded pipe) –

1. Ductility – ISO/44th requires $\geq 85\%$ CVN & DWTT min vs. $\geq 60\%$ & $\geq 40\%$, respectively for 43rd
2. Fracture arrest CVN energy - ISO/44th defines 5 methods while 43rd only references 1.

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
1.1	Scope	1.1	Gas, oil & water	1	Petroleum & Nat. Gas systems	Yes	ISO/44 th excludes water
1.2	Scope	1.1	Seamless, & welded steel pipe	1	Seamless & welded steel pipe	No	Similar
1.3	Pipe Size	1.4	Nominal diameter PSL1: 10.3-2032mm PSL2: -114.3-2032mm Wall Thickness: 1.7≤t≤?	9.11.1 (Table 9)	Nominal diameter 10.3-2134mm Wall Thickness: 1.7≤t≤52.0	No	Similar
1.4	Grade	1.3	PSL1: A25 - X70 PSL2: B - X80	9.3	PSL1: L175-L485 PSL2: Non-sour: L245 - L830 Sour: L245 – L485	Yes	Similar (ISO/44 th includes sour)
1.5	Units	1.1	USC with soft SI	2.1	USC & SI separately	No	Similar
1.6	Rounding	-	Not specified	2.2	ISO 31-0:1992 or ASTM E29-04	Yes	Applies to all sections
2	Quality systems	-	Q1 if licensee	2.3	Recommend QAS with API Q1 for licensees	no	Similar
3	Normative references						
3.1	Rounding		ASTM E29-04	2.1	ISO 31-0:1992 (ASTM E29-04)	No	Similar
3.2	Quality system		API Q1 if licensed	2.3 note	ISO/TS 29001 (non-mandatory) API Q1 if licensee	No	Similar
3.3	Terms & definitns - steel products		API 5T1 references API 5L	4	ISO 6929 or ASTM A941 API 5T1 references API 5L	No	New requirement
3.4	Terms & definitns – heat treatment	NA	Not specifically referenced	4	ISO 4885 or ASTM A941 API 5T1 references API 5L	No	New requirement
3.5	Terms & definitns - Sampling procs, inspect'n & inspect'n documentation	2.1	ASTM A370	4	ISO 377, ISO 404, ISO 10474 or ASTM A370	No	Allows equivalent ASTM A370
3.6	General tech delivery requirements	SR15	Not specifically referenced General info in text	9.1.1	ISO 404 -	No	Requires understanding of ISO 404 & ISO 10474
3.7	Threading & inspection	7.9.2	API Std 5B	9.12.2.1 N.11.4 O.6	API Spec 5B	No	Equivalent
3.8	Evaluation & testing of thread compounds	2.1	API RP 5A3	9.12.2.4	ISO 13678 or API RP 5A3	No	Equivalent
3.9	Specific Inspection	SR15	No equivalent – some portions addressed in SR15 as well as quality system.	10.1.1.1	ISO 10474 – Identifies: what needs to be reported: official regs & tech rules and/or specified by PO) who signs the document: regulatory officer, manufacturer's representative independent of manufacturing &/or	No	Requires understanding of ISO 404 & ISO 10474

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
					purchaser's representative		
3.10	Sampling/prep for chem. analysis	NA 9.2	No specific equivalent standard but at least partially addressed in body of spec.	10.2.2	ISO 14284 or ASTM E1806	?	Need to review ISO &/or ASTM specs
3.11	Tensile sampling, prep, & testing	9.3	Addressed in body of spec & ASTM A370	10.2.3.2 10.2.4.2	ISO 6892 or ASTM A370, & Fig 5	No	ASTM identical
3.12	CVN impact sampling, prep & testing	9.3.5.1	ASTM A370	10.2.3.3 10.2.4.3	ASTM A370 unless ISO 148-1 & required striker radius are specified on PO.	No	ASTM Identical with option
3.13	DWTT	9.3.5.3 SR6.3	API 5L3	10.2.3.4	API 5L3	No	Identical
3.14	(full sect'n) Bend test sampling, prep & test	9.3.3	ASTM A370	10.2.3.5 10.2.4.5	ISO 8491 or ASTM A370	No	ASTM identical
3.15	Guided bend test sampling, prep & test	9.3.4	ASTM A370	10.2.3.6 10.2.4.6	ISO 7438 or ASTM A370 & Figure 8	No	ASTM identical
3.16	Flattening test sampling, prep & test	9.3.2	ASTM A370, except test piece length $\geq 63.5\text{mm}$	10.2.3.7 10.2.4.7	ISO 8492 or ASTM A370, except test piece length $\geq 60\text{mm}$	No	ASTM similar
3.17	Analysis methods for product checks	NA	No specific equivalent standard but at least partially addressed in body of spec	10.2.4.1	ISO/TR 9769 or ASTM A751	No	ASTM identical
3.18	Tensile elong'n conversion	9.3	Addressed in body of spec & ASTM A370	10.2.4.2	ISO 2566-1 or ASTM A370	No	ASTM identical
3.19	Portable hardness tests	NA	Not addressed	10.2.4.8	Tests per ISO 6506, ISO 6507, ISO 6508 or ASTM A370 and methods ASTM A956, ASTM A1038, ASTM E110	Yes	Not previously addressed
3.20	Visual acuity test	9.7	ASNT SNT-TC-1A	10.2.7.3	ISO 11484 or ASNT SNT-TC-1A	No	ASNT equivalent
3.21	Sorting & reprocessing, & retesting	9.12 & 9.13	Discussed in body of document	10.2.11 10.2.12 & 5L Ann. N	ISO 404 Discussed in body of API 5L regional annex N	Yes ?	ISO 404 retesting different
3.22	Repair weld qualification	C.2 C.3	<u>Procedure:</u> Addressed in body with allowance to use ASME section IX <u>Performance:</u> Addressed in body	D.2.1.2 D3.1.1	<u>Procedure:</u> ISO 15614-1, API 5L (43 rd) or ASME Section IX <u>Performance:</u> ISO 9606-1, ASME Section IX, API 5L (43 rd) App.C.3, EN287-1	No	Allows 43 rd edition
3.23	NDT personnel qualifications (excluding VT)	9.8.1	ASNT SNT-TC-1A, or equivalent	E.1.1	ISO 11484 or ASNT SNT-TC-1A, or an equivalent	No	Similar
3.24	Electromagnetic	9.8.2 a,b	<u>Flux leakage:</u> ASTM E570 <u>Eddy-current:</u> ASTM E309	E.2 a,b K.3.4 K.4.4	<u>Flux leakage:</u> ISO 9402, ISO 9598 or ASTM E570 <u>Eddy-current:</u> ISO 9304 or ASTM E309	No	ASTM equivalent
3.25	Ultrasonic	9.8.2	<u>Pipe body:</u> ASTM E213 (angle beam)	E.2 c,d	<u>Pipe body:</u> (angle beam)	Yes	Straight beam

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
		c,d	<u>Weld seam:</u> ASTM E273	K.2.1 K.3.1/2/ 4 K.4.1/2 K.5.1/2	ISO 9303, 9305, 11496, 12094, 13663 or ASTM E213, Pipe body (straight beam) ISO 10124, or ASTM A435, or A578 <u>Weld seam:</u> ISO 9764, ISO 9765, or ASTM E213		not referenced Weld seam different
3.26	Magnetic Particle	9.8.2 e	ASTM E709	E.2 e K.2, K.3.4, K.5.4	ISO 13664, 13665 or ASTM E709	No	ASTM Same
3.27	Radiographic	9.8.2 f	ASTM E94	E.2 f	ISO 12096 or ASTM E94	No	ASTM same
3.28	Liquid Penetrant	9.8.2 g	ASTM E165	E.2 f	ISO 12095 or ASTM E165	No	ASTM same
3.29	Radiographic film	NA	Not addressed	E.4.2.2	ISO 11699-1 T2 or T3 or ASTM E1815-06 class I or II	Yes	Not previously addressed
3.30	Image Quality Indicators	9.8.4.3 9.8.4.4	<u>Hole-type:</u> ASTM E1025 <u>Wire-type:</u> ISO 1027 or ASTM E747	E.4.3	<u>Hole-type:</u> not allowed <u>Wire-type:</u> ISO 19232-1: or ASTM E747	Yes	44th doesn't allow holes Wire-type identical
3.31	Coupling Tensile test piece	8.2	<u>Round-bar:</u> ASTM E8 <u>Strip:</u> ASTM A370	F.2.2	<u>Round-bar:</u> ISO 6892 or ASTM E8 <u>Strip:</u> ISO 6892 or ASTM A370	No	ASTM same
3.32	Sour environment	NA	Not addressed	H.4.3 H.7.3.1. 3	ISO 15156-2	Yes	Previously out of scope
3.33	4-point bend	NA	Not addressed	H.7.3.2. 1	ISO 7539-2 or ASTM G39	Yes	Previously out of scope
3.34	HIC/SWC tests	NA	Not addressed	H.7.2.2	NACE TM0284	Yes	Previously out of scope
3.35	SSC tests	NA	Not addressed	H.7.3.2. 1	NACE TM0177	Yes	Previously out of scope
3.36	Hardness tests	NA	Not addressed	H.7.3.3. 1 J.8.3.2. 1	<u>Vickers:</u> ISO 6507-1 or ASTM E92 <u>Rockwell:</u> ISO 6508 or ASTM E18	Yes	Previously out of scope
3.37	CTOD tests - offshore	NA	Not addressed	J.8.2.2 J.8.3.1	ISO 12135 or ASTM E1290	Yes	Previously out of scope
3.38	UT thickness test	NA	Not addressed	K.3.3	ISO 10543 or ASTM E114	Yes	Not previously addressed
3.39	MPI Surface preparation	NA	Not addressed	K.3.4.4	ISO 8501-1 (SA2.5)	Yes	Previously out of scope
4 Terms & definitions							
4.1	Arc burn	7.8.11	Localized points of surface melting caused by arcing between electrode or ground and the pipe surface.	9.10.3.1	Localized points of surface melting caused by arcing between electrode or ground and the pipe surface.	No	Similar
4.2	May Should	3.10 3.15	May: verb to indicate that a provision is optional Should: used to indicate that a provision is not mandatory but is recommended as good practice	NA	Not specifically defined	?	Not in ISO/44 th

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
	Shall	3.16	Shall: used to indicate that a provision is mandatory				
4.3	As agreed If agreed Unless otherwise agreed	NA	Not specifically defined	4.1 4.19 4.53	As agreed: Requirement to be as agreed upon with manufacturer & purchaser, & specified on PO If agreed: Requirement to be as prescribed, or more stringent than prescribed, if agreed upon by the manufacturer and the purchaser and specified in the PO. Unless otherwise agreed: Requirement that applies, unless an alternative requirement is agreed upon between the manufacturer and the purchaser and specified on the PO	No	Not in 43 rd
4.4	As rolled	NA	Not defined	4.2	Delivery condition without any special rolling &/or heat treatment	No	Implied in 43rd
4.5	Calibration	3.1	The adjustment of instruments to a known basic reference, often traceable to the NIST or an equivalent organization	NA	Not specifically defined	No	Implied in ISO/44 th
4.6	Carload	3.2	Quantity of pipe loaded on a rail car for shipment from pipemaking facilities	NA (9.14.3)	Not referenced for mass tolerance as now use ≥20 tons	Yes	ISO/44 th refs tons while 43 rd by car
4.7	Certificate of compliance	12.1.1	Document stating that the material has been manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements.	4	Addressed in ASTM A941: identical to API 5L 43 rd edition	No	Same
4.8	Cold Expanded Pipe	3.3	Pipe that, while at ambient mill temp, received a permanent increase in OD or circumference of ≥0.3% throughout its length by internal hydrostatic pressure in closed dies or by internal expanding mechanical device.	4.3	Pipe that, while at ambient mill temperature, has received a permanent increase in OD or circumference throughout length by internal hydraulic pressure in closed dies or by internally expanding mechanical device.	No	Equivalent
4.9	Cold-sized pipe	NA	Not defined	4.4	Pipe that, after forming (including EW sizing), while at ambient temp, has received a permanent increase or decrease in OD or circumference for all or part of length.	No	Implied
4.10	Cold finishing	NA	Not defined	4.5	Cold working operation (normally drawing) with permanent strain >1.5%	No	Specific to ISO/44 th
4.11	Cold Forming	NA	Not defined	4.6	Process in which a strip or plate is formed into a pipe without heat	No	Specific to ISO/44 th
4.12	Continuous welding	5.1.2.1 .1	Process of forming a seam by heating the skelp in a furnace and mechanically pressing the formed edges together wherein successive coils of skelp have been joined together to provide a continuous flow of steel for the welding mill.	4.7	Process of forming a seam by heating the skelp in a furnace and mechanically pressing the formed edges together wherein successive coils of skelp have been joined together to provide a continuous flow of steel for the welding mill.	no	same
4.13	COW pipe COWH pipe COWL pipe COW seam	5.1.3.7 5.1.3.1 0	Single or double longitudinal seam pipe produced by a combination GMAW and SAW welds with at least one SAW pass on ID and OD.	4.8 4.9 4.10 4.11	Tubular product having one or two longitudinal seams or one helical seam, produced by a combination of GMAW and SAW wherein the GMAW bead is not completely removed by the SAW process	No	Same

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
4.14	CW pipe	5.1.3.2	Pipe with one longitudinal seam produced by the continuous welding process	4.12	Tubular product having one longitudinal seam produced by the continuous welding process	No	Same
4.15	defect	3.4	An imperfection of sufficient magnitude to warrant rejection of the product based on the stipulations of the spec.	4.13	Imperfection of a size and/or population density greater than the acceptance criteria specified in the international standard	No	Similar
4.16	dent	7.8.1 (5T1 3.1.4)	Not specifically defined is in API 5T1: similar to CSA	9.10.2	Not specifically defined is in API 5T1: similar to CSA	No	Same
4.17	EW pipe EW Seam Electric Welding	5.1.3.3 5.1.2.1 .2	Pipe that has one longitudinal seam produced by the EW process. Process of forming a seam by electric resistance or induction welding, wherein the edges to be welded are mechanically pressed together and the heat for welding is generated by the resistance to flow of the electric current.	4.14 4.15 4.16	Tubular product having one longitudinal seam produced by a low or high frequency EW process Process of forming a seam by electric resistance or induction welding, wherein the edges to be welded are mechanically pressed together and the heat for welding is generated by the resistance to flow of the electric current applied by induction or conduction .	No	Similar
4.18	Gas metal arc welding	5.1.2.2 .2	Welding process that produces coalescence of metals by heating them with an arc or arcs between a continuous consumable electrode and the work. Shielding is obtained entirely from an externally supplied gas or gas mixture. Pressure is not used and the filler metal is obtained by the electrode .	4.17	Welding process that produces coalescence of metals by heating them with an arc or arcs between a continuous consumable electrode and the work, wherein the arc and the molten metal are shielded by an externally supplied gas or gas mixture.	No	Similar
4.19	Heat	3.5	The metal produced by a single cycle of a batch melting process.	4 ASTM A951	Generic term denoting a specific lot of steel based upon steelmaking and casting considerations	No	Similar
4.20	HFW pipe	5.1.3.3 .2	EW pipe with a minimum welder frequency of 100 kHz	4.18	EW pipe produced with a welding current frequency equal to or greater than 70 kHz	No	Similar but difference min welder frequency
4.21	Imperfection	3.7	A discontinuity or irregularity in the product detected by methods outlined in this specification.	4.20	Discontinuity or irregularity in the product wall or on the product surface that is detectable by inspection methods outlined in this international standard	No	Similar
4.22	Indication	NA	Not specifically addressed	4.21	Evidence obtained by non-destructive inspection	No	Implied
4.23	Inspection	NA	Not specifically addressed	4.22	Activities such as measuring examining, testing, weighing, or gauging one or more characteristics of a product, and comparing the results of such activities with the specified requirements in order to determine conformity	No	Implied
4.24	Instrument standardization / Standardization	3.18	Standardization: The adjustment of a non-destructive inspection instrument to an arbitrary reference value.	4.23	Adjustment of a non-destructive inspection instrument to an arbitrary reference value	No	Similar
4.25	Jointer	7.7	Two lengths of pipe coupled together by the manufacturer or two lengths of pipe welded together by the manufacturer in accordance with Appendix A .	4.24	Two lengths of pipe coupled or welded together by the manufacturer	Yes	Differentiation between double jointer and mill jointer required
4.26	lamination	NA	Not specifically addressed	4.25	Internal metal separation that creates layers,	No	Implied

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
		(5T1 3.1.9)	API 5T1: Internal metal separation creating layers generally parallel to the surface		generally parallel to the pipe surface.		
4.27	Laser welding LW pipe	5.1.2.1 .3	Welding process that uses a laser beam and a keyhole cutting technique to produce melting and coalescence of the edges to be welded. The edges may be preheated. Shielding is obtained entirely from an externally supplied gas or gas mixture.	4.26 4.28	Process of forming a seam by using a laser beam keyhole welding technique to produce melting and coalescence of the edges to be welded, with or without preheating the edges, wherein shielding is obtained from an externally supplied gas or gas mixture.	No	Similar
4.28	LFW pipe	5.1.3.3	EW process performed with a maximum welder frequency of 100 kHz	4.27	EW pipe produced with a welding current frequency less than 70 kHz	No	similar
4.29	Manufacturer	3.9	A firm, company or corporation responsible for marking the product to warrant that it conforms to this specification. The manufacturer may be, as applicable, a pipe mill or processor; a maker of couplings; or a threader. The manufacturer is responsible for compliance with all of the applicable provisions of the specification.	4.29	Firm, company or corporation for making and marking the product in accordance with the requirements of this international standard.	No	Similar
4.30	Non-destructive inspection	NA	Not specifically addressed	4.30	Inspection of pipe to reveal imperfections, using radiographic, ultrasonic or other methods specified in this international standard that to not involve disturbance, stressing or breaking of the materials.	No	Implied
4.31	Normalizing formed/rolling	NA	Not specifically addressed	4.31 4.32	Pipe delivery condition resulting from the forming/rolling process in which the final deformation is carried out within a certain temperature range, leading to a material condition equivalent to that obtained after normalizing, such that the specified mechanical properties would still be met in the event of subsequent normalizing	No	Implied
4.32	Pipe body	NA	Not specifically addressed	4.33	For SMLS pipe, the entire pipe; for welded pipe, the entire pipe excluding the weld(s) and HAZ	No	Implied
4.33	Pipe grade	NA	Not specifically addressed	4.34	Designation of the pipe strength level	No	Implied
4.34	Pipe mill	3.11	A firm, company or corporation that operates a pipe-making facility	4.35	A firm, company or corporation that operates a pipe-making facilities	No	Similar
4.35	Processor	3.12	A firm, company or corporation that operates facilities capable of heat treating pipe made by the pipe mill	4.36	A firm, company or corporation that operates facilities capable of heat treating pipe made by the pipe mill	No	Similar
4.36	Product analysis	3.13	A chemical analysis of the pipe, plate or skelp	4.37	Chemical analysis of the pipe, plate or skelp	No	Same
4.37	Purchaser	NA	Not specifically addressed	4.38	Party responsible for both the definition of requirements for a product order and for payment of that order	No	Implied
4.38	Quenching and tempering	NA ASTM A951	Not specifically addressed Rapid cooling followed by reheating to a temperature below Ac1 then cooling at a desired rate	4.39	Heat treatment consisting of quench hardening followed by tempering	No	Similar
4.39	SAW pipe SAWH pipe SAWL pipe	5.1.3.5 5.1.3.8 5.1.3.1	Pipe that has one or two longitudinal seams or one helical seam produced by automatic submerged arc welding process with at least one	4.40 4.41 4.42	Tubular product having one or two longitudinal seams, or one helical seam, produced by the submerged arc welding process.	No	Similar

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
	SAW seam	1	pass on the ID and one pass on the OD	4.43			
4.40	Seamless pipe SMLS pipe	5.1.3.1 5.1.1	Pipe produced by the seamless process of hot working steel to form a tubular product without a welded seam. It may be subsequently cold finished to produce the desired shape, dimensions or properties	4.44	Pipe without a welded seam, produced by hot forming process, which can be followed by cold sizing or cold finishing to produce the desired shape, dimensions and properties	No	Similar
4.41	Service condition	NA	Not specifically addressed	4.45	Condition of use that is specified by the purchaser in the PO	No	Implied – but unique to ISO
4.42	Special process Process requiring validation	3.17	Special process: Final operations performed during pipe manufacturing that affect attribute compliance required in this specification	8.2	Processes requiring validation: Final operations performed during pipe manufacturing that affect attribute compliance required in this specification	No	Similar – new terminology
4.43	Strip/plate end weld	5.1.4.5	Skelp end weld: the seam weld that joins the plate or skelp ends together in helical seam pipe.	4.46	Weld that joins strip or plate ends together	No	similar
4.44	Submerged arc-welding	5.1.2.2 .1	Welding process that produces coalescence of metals by heating them with an arc(s) between bare metal consumable electrode(s) and work. The arc and molten metal are shielded by a blanket of granular, fusible material on the work. Pressure is not used, and part or all of the filler metal is obtained from the electrodes.	4.47	Welding process that produces melting and coalescence of metals by heating them with an arc(s) between bare metal consumable electrode(s) and the work, wherein the arc and molten metal are shielded by a blanket of granular flux.	No	Similar
4.45	Tack weld	5.1.4.7	Seam weld used to align the abutting edges until the final seam welds are produced, made by: manual or semi-automatic SAW, EW, GMAW, FCAW, or SMAW using low H electrodes	4.48	Intermittent or continuous seam weld used to maintain the alignment of the abutting edges until the final seam weld is produced.	No	Similar
4.46	Inspection Lot Test unit	3.8	Inspection lot: A definite quantity of product manufactured under conditions that are considered uniform for the attribute to be inspected	4.49	Test Unit: Prescribed quantity of pipe that is made to the same specified OD & WT, by the same pipe-manufacturing process, from the same heat and under the same pipe manufacturing conditions.	Yes	New term with ISO
4.47	Thermo-mechanical forming / rolled	NA	Not specifically addressed	4.50 4.51	Hot forming process for pipe or pipe delivery condition resulting from the hot-rolling process for strip or plate, in which the final deformation is carried out in a certain temperature range leading to a material condition with certain properties that cannot be achieved or repeated by heat treatment alone, and such deformation is followed by cooling, possibly with increased cooling rates, with or without tempering, self-tempering included.	No	Implied
4.48	Undercut	3.19	A groove melted into the parent metal adjacent to the weld toe and left unfilled by the deposited weld metal	4.52	groove melted into the parent metal adjacent to the weld toe and left unfilled by the deposited weld metal	No	identical
4.49	Welded Pipe	NA	Not specifically addressed	4.54	CW, COWH, COWL, EW, HFW, LFW, LW, SAWH, or SAWL pipe	No	Implied
5.0	Manufacturing						
5.1	Product specification Levels	1.2	PSL 1 & PSL 2 – CE, max YS, Ev, limits	6	PSL 1 & PSL 2 – many differences	No	Similar
5.2	Pipe grade	1.3	PSL1 A25–X70	6.1	PSL 1: (various delivery conditions)	No	Similar for

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			PSL2: B-X80		L175 – L485 (A25-X70) PSL2: (various delivery conditions) Non-sour: L245-L830 (B-X120) Sour: L245-L485 (B-X70)		PSL2 but sour not addressed in 43 rd
5.3	Pipe size	1.4	PSL 1: 10.3–2134mm PSL 2: 114.3 -2134mm	9.11.1.2	PSL1 & PSL2: 10.3 – 2134mm	Yes	ISO/44 th does not differential PSL1 & PSL2
5.4	Delivery conditions	5.4	Documented HT procedures may be: AR, Norm, Norm & tempered, subcritical stress relieved or aged hardened X grades – may be Q&T Gr.B – only SMLS Q&T, by agreement.	6.2	Pipe feedstock and HT condition defined with Grade	No	Similar but ISO/44 th more specific
5.5	Pipe process of manufacture	5.1	Seamless, continuous, electric, laser, long & helical SAW, GMAW, COW, 2-seam	8.1	SMLS, CW, LFW, HFW, LW, 1&2 seam SAWL, SAWH, 1&2 seam COWL, COWH	No	ISO/44 th disallows GMAW pipe
5.6	Processes requiring validation	3.17	<i>SMLS + As-rolled (non-expanded):</i> Final reheating & hot sizing or stretch reduction; cold finishing, if applied, and repair welding, NDT <i>SMLS + As-rolled (expanded):</i> Cold expansion, NDT & repair welding <i>SMLS + heat treatment:</i> Heat treatment, NDT & repair welding <i>Welded without filler metal + as-rolled (non-exp):</i> Seam welding, NDT, sizing; if applicable, seam heat treatment, and repair welding <i>Welded without filler metal + as-rolled (expand):</i> Seam welding, cold expansion, NDT; if applicable, seam heat treatment, and repair welding <i>Welded without filler metal + heat treated:</i> Seam welding, full body heat treatment, NDT; if applicable, repair welding <i>Welded with filler metal + as rolled (non expand):</i> Pipe forming, seam welding, NDT, & repair welding <i>Welded with filler metal + as rolled (expanded):</i> Seam welding, expansion, NDT, & repair welding <i>Welded with filler metal + heat treated:</i> Seam welding, full body heat treatment, NDT, & repair welding	8.2	<i>SMLS + As-rolled:</i> Final reheating practice, and hot sizing or stretch-reducing; if applicable upsetting & cold finishing <i>SMLS + heat treated:</i> Heat treatment <i>EW + As-rolled:</i> Sizing and seam welding; if applicable, seam heat treatment and upsetting; <i>EW + heat treated:</i> Seam welding and full body heat treatment	Yes	NDT & repair welding excluded in ISO/44 th Also limitations for pipe welded with filler metal excluded in ISO/44 th
5.7	Steel source	NA	Not specifically addressed	8.3.1	Iron making / steelmaking: BOF or EAF	Yes	44 th more restrictive

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5.8	Deoxidation practices	NA	Not specifically addressed	8.3.2	killed with fine grain practice	Yes	ISO more restrictive
5.9	Skelp width for helical seam pipe	5.3.1	0.5-3.0 x OD	8.3.4	0.5-3.0 x OD	No	Identical
5.10	Skelp/plate weld repairs	5.3.2	None for PSL2	8.3.3	None for PSL2	No	Identical
5.11	Lubricant in SAW/ COW weld region	NA	Not specifically addressed	8.3.5	to be removed	Yes	New requirement
5.12	Tack welding methods	5.1.4.7	Manual or semi-auto SAW, ERW, GMAW, FCAW, low H SMAW	8.4.1	Semi-auto SAW, ERW, GMAW, FCAW, low H SMAW	Yes	Disallows manual SAW
5.13	Tack weld treatment	5.1.4.7	Melted & coalesced in final seam	8.4.2	Melted & coalesced in final seam or removed by machining	Yes	ISO/44 th allows machining
5.14	COW weld seams	5.1.3.7	Continuous GMAW covered OD & ID by SAW	8.5	Continuous GMAW covered OD & ID by SAW	No	Same
5.15	SAW weld seams	5.1.3.5 5.1.3.1 1	≥1 auto SAW on ID & OD	8.6	≥1 SAW on ID & OD	No	Similar
5.20	Double seam welds	5.1.3.8 5.1.3.9	~180° apart	8.7	~180° apart	No	Same
5.21	ERW weld seam treatment	5.1.3.3 .1	PSL 1 – Normalize weld & HAZ or For >X42: alternate HT by agreement with back-up For ≤X42, ensure no untempered martensite PSL 2 – min 100 kHz welder. Normalize weld & HAZ or alternate HT by agreement with back-up	8.8.1 8.8.2	PSL 1 – Normalize weld & HAZ or For >X42: alternate HT by agreement with back-up For ≤X42, ensure no untempered martensite PSL 2 – Normalize weld & HAZ or alternate HT by agreement with back-up	No	Similar
5.22	LW weld seam treatment	5.1.3.4	Normalize weld & HAZ or alternate HT by agreement with back-up	8.8.2	Normalize weld & HAZ or alternate HT by agreement with back-up	No	Same
5.22	Cold Sizing	-	Not addressed	8.9.1	1.5% max, unless Norm, Q&T or stress relieved	Yes	New req'ts from 49 CFR regs?
5.23	Cold Expansion	5.2	Except CW, may be cold expanded provided weld protected.	8.9.2	Limited to 0.3%-1.5%, unless agreed. 1.5% max, unless Norm, Q&T or stress relieved	Yes	New req'ts in ISO/44 th from 49 CFR regs?
5.24	Sizing Ratio	-	Not addressed	8.9.3	$s_r = D_a - D_b / D_b$ where: D _a = manufacturer-designated OD after sizing D _b = manufacturer-designated OD before sizing	No	Implied
5.25	Strip/plate end welds	-	Not addressed	8.10.1	Not allowed in longitudinal seam pipe	No	New
5.26	Junctions of skelp end & helical seam welds	5.5	Permitted if >300mm from pipe ends By agreement, circ separation >150mm	8.10.2	Permitted if >300mm from pipe ends By agreement, circ separation >150mm	No	Same
5.27	Skelp end welds in helical pipe	5.5	Properly prepared auto SAW &/or GMAW	8.10.4	SAW &/or GMAW and similar inspection to helical seam	No	Similar
5.28	Jointers	7.7 App. A	If specified Subjoint >1.5m.	8.11 Ann. A	If agreed Subjoint >1.5m	No	Similar
5.29	Traceability	5.6.1	PSL1 – establish & follow procedures to maintain	8.13	PSL1 – establish & follow documented procedures	Yes	ISO/44 th PSL2

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6.0 Acceptance criteria																																																																																																																			
6.1	General	NA 1.3	Not specifically addressed Pipe manufactured as $\geq X60$ shall not be substituted for pipe ordered as $\leq X52$, without purchaser approval.	9.1	General delivery requirements per ISO 404 Pipe manufactured for grades L415 or higher shall not be substituted for pipe ordered as L360 or lower, without purchaser approval	No	Similar																																																																																																												
6.2	Chemical composition	Table 2A&2B	Chemistry maxima (see Annex A: Table 4 & 5) (by agreement in brackets) <table><thead><tr><th></th><th>PSL 1</th><th>PSL2</th></tr></thead><tbody><tr><td>C</td><td>.21-.28</td><td>.22-.24</td></tr><tr><td>Mn</td><td>.60-1.65</td><td>1.20-1.85</td></tr><tr><td>P</td><td>.030-.080</td><td>0.025</td></tr><tr><td>S</td><td>0.030</td><td>0.015</td></tr><tr><td>Si</td><td>NS</td><td>NS</td></tr><tr><td>V</td><td>NS</td><td>NS</td></tr><tr><td>Nb</td><td>NS</td><td>NS</td></tr><tr><td>Ti</td><td>NS-.06</td><td>.04-.06</td></tr><tr><td>Cu</td><td>NS</td><td>NS</td></tr><tr><td>Ni</td><td>NS</td><td>NS</td></tr><tr><td>Cr</td><td>NS</td><td>NS</td></tr><tr><td>Mo</td><td>NS</td><td>NS</td></tr><tr><td>B</td><td>NS</td><td>NS</td></tr><tr><td>Nb+V</td><td>.03-NS</td><td>.06-NS</td></tr><tr><td>Nb+V+Ti</td><td>.06-.15</td><td>.06-.15</td></tr><tr><td>CE_{IW}</td><td>NS</td><td>.43</td></tr><tr><td>P_{cm}</td><td>NS</td><td>.25</td></tr></tbody></table> Use P _{cm} for C \leq 0.12 otherwise CE _{IW}		PSL 1	PSL2	C	.21-.28	.22-.24	Mn	.60-1.65	1.20-1.85	P	.030-.080	0.025	S	0.030	0.015	Si	NS	NS	V	NS	NS	Nb	NS	NS	Ti	NS-.06	.04-.06	Cu	NS	NS	Ni	NS	NS	Cr	NS	NS	Mo	NS	NS	B	NS	NS	Nb+V	.03-NS	.06-NS	Nb+V+Ti	.06-.15	.06-.15	CE _{IW}	NS	.43	P _{cm}	NS	.25	9.2 Table 4 & 5	Chemistry maxima (see Annex A – Table 4 & 5) $t\leq 25.0\text{mm}$: <table><thead><tr><th></th><th>PSL1</th><th>PSL2</th></tr></thead><tbody><tr><td>C</td><td>.21-.28</td><td>.10-.24</td></tr><tr><td>Mn</td><td>.60-1.65</td><td>1.20-1.85</td></tr><tr><td>P</td><td>.030-.080</td><td>.020-.025</td></tr><tr><td>S</td><td>.030</td><td>.010-.015</td></tr><tr><td>Si</td><td>NS</td><td>.40-.55</td></tr><tr><td>V</td><td>NS</td><td>.05-NS</td></tr><tr><td>Nb</td><td>NS</td><td>.05-NS</td></tr><tr><td>Ti</td><td>NS</td><td>.04-NS</td></tr><tr><td>Cu</td><td>.50</td><td>.50-NS</td></tr><tr><td>Ni</td><td>.50</td><td>.30-NS</td></tr><tr><td>Cr</td><td>.50</td><td>.30-NS</td></tr><tr><td>Mo</td><td>.15</td><td>.15-NS</td></tr><tr><td>B</td><td>NS</td><td>NS-.004</td></tr><tr><td>Nb+V</td><td>.03-NS</td><td>.06-NS</td></tr><tr><td>Nb+V+Ti</td><td>.06-.15</td><td>.06-.15</td></tr><tr><td>CE_{IW}</td><td>NS</td><td>.43</td></tr><tr><td>P_{cm}</td><td>NS</td><td>.25</td></tr></tbody></table> $t>25\text{mm}$: by agreement Use P _{cm} for C \leq 0.12 otherwise CE _{IW}		PSL1	PSL2	C	.21-.28	.10-.24	Mn	.60-1.65	1.20-1.85	P	.030-.080	.020-.025	S	.030	.010-.015	Si	NS	.40-.55	V	NS	.05-NS	Nb	NS	.05-NS	Ti	NS	.04-NS	Cu	.50	.50-NS	Ni	.50	.30-NS	Cr	.50	.30-NS	Mo	.15	.15-NS	B	NS	NS-.004	Nb+V	.03-NS	.06-NS	Nb+V+Ti	.06-.15	.06-.15	CE _{IW}	NS	.43	P _{cm}	NS	.25	Yes	ISO/44 th much more restrictive but most key elements are by agreement
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6.3	Tensile Properties PSL1		PSL1 Min/max (see Annex A: Table 6) <table><thead><tr><th>Grade</th><th>YS (body)</th><th>TS (body & weld)</th></tr></thead><tbody><tr><td>A25</td><td>175/-</td><td>310/-</td></tr><tr><td>A</td><td>210/-</td><td>335/-</td></tr><tr><td>B</td><td>241/-</td><td>414/-</td></tr><tr><td>X42</td><td>290/-</td><td>414/-</td></tr><tr><td>X46</td><td>317/-</td><td>434/-</td></tr><tr><td>X52</td><td>359/-</td><td>455/-</td></tr><tr><td>X56</td><td>386/-</td><td>490/-</td></tr><tr><td>X60</td><td>414/-</td><td>517/-</td></tr><tr><td>X65</td><td>448/-</td><td>531/-</td></tr><tr><td>X70</td><td>483/-</td><td>565/-</td></tr></tbody></table>	Grade	YS (body)	TS (body & weld)	A25	175/-	310/-	A	210/-	335/-	B	241/-	414/-	X42	290/-	414/-	X46	317/-	434/-	X52	359/-	455/-	X56	386/-	490/-	X60	414/-	517/-	X65	448/-	531/-	X70	483/-	565/-	9.3	PSL1 Min/max body (see Annex A: Table 6) <table><thead><tr><th>Grade</th><th>YS (body)</th><th>TS (body & weld)</th></tr></thead><tbody><tr><td>L175/A25</td><td>175/-</td><td>310/-</td></tr><tr><td>L210/A</td><td>210/-</td><td>335/-</td></tr><tr><td>L245/B</td><td>245/-</td><td>415/-</td></tr><tr><td>L290/X42</td><td>290/-</td><td>415/-</td></tr><tr><td>L320/X46</td><td>320/-</td><td>435/-</td></tr><tr><td>L360/X52</td><td>360/-</td><td>460/-</td></tr><tr><td>L390/X56</td><td>390/-</td><td>490/-</td></tr><tr><td>L415/X60</td><td>415/-</td><td>520/-</td></tr><tr><td>L450/X65</td><td>450/-</td><td>535/-</td></tr><tr><td>L485/X70</td><td>485/-</td><td>570/-</td></tr></tbody></table>	Grade	YS (body)	TS (body & weld)	L175/A25	175/-	310/-	L210/A	210/-	335/-	L245/B	245/-	415/-	L290/X42	290/-	415/-	L320/X46	320/-	435/-	L360/X52	360/-	460/-	L390/X56	390/-	490/-	L415/X60	415/-	520/-	L450/X65	450/-	535/-	L485/X70	485/-	570/-	Yes	Similar – 44 th rounded to nearest 5MPa for each and includes grades up to L830 44 th has new Y:T limits																																										
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L360/X52	360/-	460/-																																																																																																																	
L390/X56	390/-	490/-																																																																																																																	
L415/X60	415/-	520/-																																																																																																																	
L450/X65	450/-	535/-																																																																																																																	
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Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th																																																																																			
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6.4	Tensile Properties PSL2		<p>PSL2 Min/max body (<i>see Annex A: Table 7</i>)</p> <table><thead><tr><th>Grade</th><th>YS</th><th>TS</th></tr></thead><tbody><tr><td>B</td><td>241/448*</td><td>414/758</td></tr><tr><td>X42</td><td>290/496</td><td>414/758</td></tr><tr><td>X46</td><td>317/524</td><td>434/758</td></tr><tr><td>X52</td><td>359/531</td><td>455/758</td></tr><tr><td>X56</td><td>386/544</td><td>490/758</td></tr><tr><td>X60</td><td>414/565</td><td>517/758</td></tr><tr><td>X65</td><td>448/600</td><td>531/758</td></tr><tr><td>X70</td><td>483/621</td><td>565/758</td></tr><tr><td>X80</td><td>552/690**</td><td>621/827</td></tr></tbody></table> <p>Weld tensile min same as body (no max)</p> <p>* for D<8.625", YS ≤ 496 MPa ** for t>0.984 in, YS max by agreement</p>	Grade	YS	TS	B	241/448*	414/758	X42	290/496	414/758	X46	317/524	434/758	X52	359/531	455/758	X56	386/544	490/758	X60	414/565	517/758	X65	448/600	531/758	X70	483/621	565/758	X80	552/690**	621/827	9.3	<p>PSL2 Min/max body (<i>see Annex A: Table 7</i>)</p> <table><thead><tr><th>Grade</th><th>YS</th><th>TS</th><th>YS/TS*</th></tr></thead><tbody><tr><td>L245/B</td><td>245/450**</td><td>415/760</td><td>0.93</td></tr><tr><td>L290/X42</td><td>290/495</td><td>415/760</td><td>0.93</td></tr><tr><td>L320/X46</td><td>320/525</td><td>435/760</td><td>0.93</td></tr><tr><td>L360/X52</td><td>360/530</td><td>460/760</td><td>0.93</td></tr><tr><td>L390/X56</td><td>390/545</td><td>490/760</td><td>0.93</td></tr><tr><td>L415/X60</td><td>415/565</td><td>520/760</td><td>0.93</td></tr><tr><td>L450/X65</td><td>450/600</td><td>535/760</td><td>0.93</td></tr><tr><td>L485/X70</td><td>485/635</td><td>570/760</td><td>0.93</td></tr><tr><td>L555/X80</td><td>555/705</td><td>625/825</td><td>0.93</td></tr><tr><td>L625/X90</td><td>625/775</td><td>695/915</td><td>0.93</td></tr><tr><td>L690/X100</td><td>690/840</td><td>760/990</td><td>0.93</td></tr><tr><td>L830/X120</td><td>830/1050</td><td>915/1145</td><td>0.93</td></tr></tbody></table> <p>Weld tensile min same as body (no max) * for D>323.9mm only ** for D<219,1 (8.625"), YS ≤ 495 MPa</p>	Grade	YS	TS	YS/TS*	L245/B	245/450**	415/760	0.93	L290/X42	290/495	415/760	0.93	L320/X46	320/525	435/760	0.93	L360/X52	360/530	460/760	0.93	L390/X56	390/545	490/760	0.93	L415/X60	415/565	520/760	0.93	L450/X65	450/600	535/760	0.93	L485/X70	485/635	570/760	0.93	L555/X80	555/705	625/825	0.93	L625/X90	625/775	695/915	0.93	L690/X100	690/840	760/990	0.93	L830/X120	830/1050	915/1145	0.93	Yes	Similar – 44 th rounded to nearest 5MPa for each and includes grades up to L830 44 th has new Y:T limits
Grade	YS	TS																																																																																							
B	241/448*	414/758																																																																																							
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L830/X120	830/1050	915/1145	0.93																																																																																						
6.5	Hydrostatic test	9.4.1	Test without leakage	9.4	Hydrotest without leakage in body or weld Joints need not be tested, provided pipe to making joints previously passed hydro	No	Clarification for joints																																																																																		
6.6	Bend Test	6.2.3	No cracks in any portion of test piece and no openings in weld	9.5	No cracks in any portion of test piece and no openings in weld	No	Similar																																																																																		
6.7	Flattening test	6.2.2	<p>EW >A25 & LW D<323.9:</p> <p>a) >X60 & t≥12.7mm, flatten to 2/3 D w/o weld opening - All other grades/t, flatten to ½ D w/o weld opening</p> <p>b) D/t>10, continue flattening to 1/3 D w/o cracks or breaks other than in weld</p> <p>c) All pipe D/t, continue flattening until opposite walls meet; no evidence of lamination or burnt metal.</p> <p>EW GrA25:</p> <p>a) Flatten to ¾ D w/o weld fracture. b) continue flattening to 60% D w/o cracks or breaks other than in weld.</p>	9.6	<p>EW >A25 & LW D<323.9:</p> <p>a) >L415 & t≥12.7mm, flatten to 66% D w/o weld opening - All other grades/t, flatten to 50% D w/o weld opening</p> <p>b) D/t>10, continue flattening to 33% D w/o cracks or breaks other than in weld</p> <p>EW & CW GrA25:</p> <p>a) Flatten to 75% D w/o weld fracture. b) continue flattening to 60% D w/o cracks or breaks other than in weld.</p>	Yes	44 th no longer requires flattening until opposite walls meet																																																																																		
6.8	Guided bend test	6.2.4 (9.3.4 & 9.10.3)	<p>SAW & GMAW all sizes& LW D≥323.9mm:</p> <p>The test pieces shall not :</p> <p>a) fracture completely b) weld crack/rupture >3.2mm & any depth c) parent metal/HAZ/fusion line crack/rupture >3.2mm long & >12.5% t deep though edge cracks ≤6.4mm are acceptable</p>	9.7	<p>The test pieces shall not :</p> <p>a) fracture completely b) weld crack/rupture >3.2mm & any depth c) parent metal/HAZ/fusion line crack/rupture >3.2mm long & >12.5% t deep though edge cracks ≤6.4mm are acceptable</p>	No	Similar																																																																																		
6.9	CVN test	6.2.5	Body	9.8	Body (all pipes)	Yes	ISO/44 th energy																																																																																		

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
		SR5A SR5B	PSL 1: not required PSL2: required: (see Annex A: Table 8) Temp 0°C or lower All grades: trans - 27J min/heat long – 41J min/heat report shear area X80: Trans- 68J all heat avg Long – 101 all heat avg SR5A: test >60%; all heat average ≥ 80% SR5B: Test: energy specified by customer Weld & HAZ: Not addressed	Table 8	PSL 1: not required PSL2: required: (see Annex A: Table 8) Temp 0°C or lower Grades Diameters (mm) <762 to1219 to1422 ≤L485 27J 40J 40-54J to L625 40J 40J 54J to L690 40J 54-68J 81J For welded pipe D≤508mm, if agreed, >85% shear/test unit, otherwise just reported for information Weld & HAZ: (all but HFW) Temp 0°C or lower D<1422mm & Grade≤L555 - 27J D>1422 or Gr>L555 – 40J		similar except at large OD /higher grades Added weld & HAZ energy for filler metal welds.
6.10	DWTT	NA SR6	Not required for PSL1 or PSL2 SR6: 80% of heats ≥40% shear	9.9	Body (welded pipes) PSL 1: not required PSL2: required Temp 0°C or lower ≥85% shear/test unit By agreement for t>25.4mm	Yes	ISO/44 th ductility more restrictive as test min increased from 40% to 85%
7.0	Surface conditions, imperfections and defects						
7.1	General	7.8.9	Cracks, sweats and leaks are defects.	9.10.1	Pipe free from cracks, sweats and leaks.	No	Similar
7.2	Undercuts	7.8.12	Minor – no treatment required: * Depth ≤ 0.8mm & ≤ 12.5% t with max length 0.5t & no more than 2 in any 300mm; or * Depth ≥ 0.4 mm any length Not Minor: * Depth ≤ 0.8mm & ≤ 12.5% t removed by grinding * Depth ≤ 0.8mm & ≤ 12.5% t removed by cutting out, downgrading, or weld repairing	9.10.2	* Depth ≤ 0.4mm acceptable – any length * Depth > 0.4mm but < 0.8mm acceptable with indiv. length ≤ 0.5t, & indiv. depth ≤ 0.1t, & max 2 in 300mm – removed by grinding * Others remove by cutting out ring, downgrading or weld repairing	Yes	Previously minor undercuts in 43 rd now require grinding?
7.3	Arc burns	7.8.11	Remove by grinding (retain min wall) – etch to confirm removal; cut out cylinder; or reject pipe	9.10.3	Remove by grinding (retain min wall) – etch to confirm removal; cut out cylinder; or reject pipe	No	Equivalent
7.4	Laminations in bevel face	7.8.10	Exceeding 6.4mm is defect	9.10.4	Exceeding 6.4mm is defect	No	Equivalent
7.5.1	Dents	7.8.1	Dents > 6.4mm/ 1/2 D in length defects. Dents 3.2mm w/sharp bottom gouge defects.	9.10.5.2	Dents same as 5L 43 rd edition.	No	Same
7.5.2	Geometric deviations	-	Not addressed	9.10.5.1	Flat spots and peaks > 3.2mm defects.	Yes	Not addressed in 43 rd
7.6	Hard spots	7.8.8	Min. dimension > 50.8mm/ hardness ≥ 35 HRC (327 HB). Visual examination for irregularities in curvature of pipe.	9.10.6 H.5.2	Larger than 50mm/ hardness exceeds 35 HRC, 345 HV10 or 327 HBW. Sour: Hard spots ≥50mm: ≤250HV10 / 22HRC / 24 HBW – ID surface or repair to ID bead ≤275 HV10 / 22HRC / 24 HBW – OD surface or	No	Similar for non-sour

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
					repair to OD bead		
7.7	Other surface imperfections	7.8.14	Any ID or OD surface imperfection > 0.125t considered a defect.	9.10.7	Imperfection $\leq .125 t$ and does not encroach on min. wall permissible. Imperfection > .125 t and does not encroach on min. wall is a defect; can be ground out or cut out. Imperfections that encroach on min. wall are defects.	No	Similar & implied
8.0	Dimensions, mass and tolerances						
8.1	Dimensions (diameter and wall thickness)	7.1	As specified in Table 4, 5, 6A, 6B, 6C, E-6A, E-6B, or E-6C or intermediate values by agreement. Covers OD 10.3 - 2032mm WT 2.1 – 31.75mm	9.11.1	As specified in Table 9. Values are ranges, not specific diameters matched to wall thicknesses. Products referred to as “special plain-end” & “regular plain-end” based on wall thickness. Pipe delivered in random lengths or approximate length, as specified in P.O. Covers OD 10.3 - 2134mm WT 1.7 – 52.0mm	No	Similar but wider range in ISO/44 th
8.2	Mass per unit length	7.4	Imperial and metric.	9.11.2	Imperial and metric.	No	Same
8.3.1	Body Diameter	7.2 (Table 7)	All Pipe (see Annex A – Table 10) < 60.3mm: +0.41mm -0.8mm ≥ 60.3 & < 508mm: ±0.75% OD Seamless ≥ 508mm: ±1.00% OD Welded ≥ 508mm & ≤ 914mm: +0.75% -0.25% OD > 914mm: +6.4mm -3.2mm	9.11.3.1 (Table 10)	All Pipe (see Annex A – Table 10) < 60.3mm: + 0.4mm - 0.8mm ≥ 60.3mm to ≤ 168.3mm: ± 0.75% OD > 168.3mm to ≤ 610mm: Seamless - ± 0.75% OD Welded - ± 0.75% OD (± 3.2mm max) > 610mm to ≤ 1422mm: Seamless - ± 1.0% OD Welded - ± 0.5% OD (± 4.0mm max) > 1422mm: as agreed	Yes	Similar tolerance but ISO/44 th centered over nominal for larger D's ISO/44 th more restrictive
8.3.2	End Diameter	7.2 (Table 8)	Diameter tolerance Pipe (see Annex A – Table 10) ≤ 273.1mm: - 0.4mm +1.6mm > 273.1mm: -0.8mm +2.4mm End-end difference: 2.4mm	9.11.3.1 (Table 10)	Diameter tolerance Pipe (see Annex A – Table 10) < 60.3mm to ≤ 168.3mm: - 0.4mm + 1.6mm >168.3 to ≤ 610mm: ± 0.5% (1.6mm max) >610mm to ≤ 1422mm: Seamless - ± 2.0mm Welded - ± 1.6mm > 1422mm: as agreed	Yes	Similar tolerance but ISO/44 th centered over nominal for larger D's ISO/44 th more restrictive
8.3.3	Body Out of Round	NA	Not addressed	9.11.3.1 (Table 10)	≥ 60.3mm to ≤ 610mm: 2% OD > 610mm to ≤ 1422mm for $D/t \leq 75$: 1.5% OD (15mm max); for $D/t > 75$: by agreement	Yes	ISO/44 th more restrictive as no previous requirements
8.4	End Out of Round	7.2 (Table 8)	(see Annex A – Table 10) Diameter tolerance: ±1% OD Max. diff. diameters (pipe with $D/t \leq 75$): > 508mm & ≤ 1067mm: ≤ 12.7mm > 1067mm: ≤ 15.9mm	9.11.3.1 (Table 10)	(see Annex A – Table 10) Max differential diameters ≥ 60.3mm to ≤ 610mm: 1.5% OD > 610mm to ≤ 1422mm for $D/t \leq 75$: 1.0% OD (13mm max); for $D/t > 75$: by agreement	Yes	ISO/44 th more restrictive – especially for smaller diameters in range.

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
8.3.5	Wall thickness	7.3 (Table 9)	All pipe (see Annex A – Table 11 & figures) $< 508\text{mm OD}$: +15% - 12.5% WT seamless $\geq 508\text{mm OD}$: +17.5% -10.0% WT welded $\geq 508\text{mm OD}$: +19.5% -8.0% WT Note :values for grade B and lower pipe not included	9.11.3.2 (Table 11)	(see Annex A – Table 11 & figures) Seamless: $\leq 4.0\text{mm WT}$: +0.6mm - 0.5mm $> 4.0\text{mm to } < 25.0\text{ mm WT}$: +15% -12.5% WT $\geq 25.0\text{mm WT}$: +3.7mm - 3.0mm (or $\pm 10\%$ whichever greater) Welded: $\leq 5.0\text{mm WT}$: $\pm 0.5\text{mm}$ $> 5.0\text{mm to } < 15.0\text{mm WT}$: $\pm 10\%$ $> 15.0\text{mm WT}$: $\pm 1.5\text{mm}$	Yes	ISO/44 th ties tolerance to t while 43 rd ties it to OD. ISO/44 th more/less restrictive, depending on pipe size
8.5	Length	7.5 (Table 11, unless agreed)	T&C pipe (m) Nom min min max Avg 6 4.88 5.33 6.86 12 6.71 10.67 13.72 Plain-end Pipe (m) Nom min min max Avg 6 2.74 5.33 6.86 12 4.27 10.67 13.72 15 5.33 13.35 16.76 18 6.40 16.00 19.81 24 8.53 21.34 25.91 Min. and max. lengths varied and not rounded from USC units.	9.11.3.3 (Table 12, unless agreed)	T&C pipe (m) Nom min min max Avg 6 4.88 5.33 6.86 9 4.11 8.00 10.29 12 6.71 10.67 13.72 Plain-end Pipe (m) Nom min min max Avg 6 2.74 5.33 6.86 9 4.11 8.00 10.29 12 4.27 10.67 13.72 15 5.33 13.35 16.76 18 6.40 16.00 19.81 24 8.53 21.34 25.91 Min. and max. lengths varied and not rounded. Approximate lengths tolerance is $\pm 500\text{ mm}$.	No	similar
8.6	Straightness	7.6	Low grade pipe < 114.3 reasonably straight. All other pipe not to exceed 0.2% of length.	9.11.3.4	Not to exceed 0.2% length. <u>Bell/Crimp/local deviation:</u> $\leq 4\text{mm within } 1\text{m from pipe end}$	Yes	ISO/44 th has new end tolerance?
8.7	Finish of pipe ends	7.9	Threaded (PSL1 only) API 5B & 5L §8 Thread protection §11.2 Belled (PSL1 only) $\leq 3.6\text{mm WT}$ Special couplings (PSL1 only) When on PO, to Fig.1 Must be visually insp. Plain end (PSL 1&2)	9.12	Threaded (PSL 1 only) <u>SMLS & long seam welded with OD<508mm</u> Threads API 5B Coupling annex F Thread protection §12.2 Belled (PSL1 only) As spec on PO Must be visually insp. Special couplings (PSL1 only) As spec. on PO Free from indents, projections or marks for 200mm from end Plain end (PSL 1&2) Unless agreed, $t > 3.2\text{mm}$	No	ISO/44 th PE for

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			Bevel 30° +5° -0° Root face: 1.6 ± 0.8mm End square (≥ 60.3mm OD): ≤ 1.6mm Free from ID burrs		Bevel 30° +5° -0° Root face 1.6 ± 0.8mm End square: ≤ 1.6mm Free from burrs Square Cut (PSL 1&2) Unless agreed, $t < 3.2\text{mm WT}$		$t > 3.2$ otherwise square cut.
8.7.1	Internal Taper	7.9.3	Seamless (by WT) (see Annex A: Table 13) ≤ 10.6mm: 7° max ≥ 10.6mm & ≤ 14.1mm: 9.5° max > 14.1mm & ≤ 16.9mm: 11° max > 16.9mm: 14° max Welded (by WT) > 114.3mm OD: 7° max	9.12.5.4	Seamless (by WT) (see Annex A: Table 13) ≤ 10.5mm: 7° max (weld seam) ≥ 10.5mm & ≤ 14.0mm: 9.5° max > 14.0mm & ≤ 17.0mm: 11° max > 17.0mm: 14° max Welded (by WT): 7° max (weld seam)	Yes	ISO/44 th applies to weld seam
8.7.2	Flush off DSAW weld	7.9.3	ID: ≤ 101.6mm OD: Not defined	9.13.2.2	Weld bead blend smoothly with adjacent pipe surface (max 0.5mm height): ID: ≥ 100mm OD: If agreed, ≥ 150mm	No	similar
8.8.1	Radial offset of strip/plate edges	7.8.2 & 7.8.3	Pipe with filler metal (see Annex A: Table 14) $t \leq 12.7\text{mm}$: 1.6mm max. $t > 12.7\text{mm}$: 0.125 t (or 3.2mm, if less) ERW & LW 1.5mm max	9.13.1 & 9.13.3 (Table 14)	SAW & COW pipe (see Annex A: Table 14) $t \leq 15.0\text{mm}$: 1.5mm. $t > 15.0\text{mm}$ to ≤ 25.0mm: 0.1 t . $t > 25.0\text{mm}$: 2.5mm. ERW & LW Remaining WT at weld > min permissible WT.	Yes	ISO/44 th more restrictive.
8.8.2	Misaligned welds		Not cause for rejection provided NDT confirms complete penetration and fusion.	9.13.	Not cause for rejection provided within: $t \leq 20\text{mm}$: 3mm $t > 20\text{mm}$: 4mm; and provided NDT confirms complete penetration and fusion.	Yes	ISO/44 th defines dimensional criteria
8.8.3	Height of flash or long/helical weld bead/ reinforcement	7.8.4 - 7.8.6	SAW (ID & OD) $t \leq 12.7\text{mm}$, ≤ 3.2mm. $t > 12.7\text{mm}$, ≤ 4.8mm. Higher weld beads may be ground. ERW & LW OD flash trimmed essentially flush. ID flash ≤ 1.5mm For LW , Underfills allowed which do not exceed underfill tolerances.	9.13.2	SAW or COW (ID & OD) $t \leq 13.0\text{mm}$: 0 ≤ 3.5mm $t > 13.0\text{mm}$: 0 ≤ 3.5mm ID, & 0 ≤ 4.5mm OD Except @ undercuts, weld bead ≥ adjacent pipe surface. Higher weld beads may be ground. EW & LW OD flash trimmed essentially flush. ID flash ≤ 1.5mm Wall thickness at trim not to be less than min. permissible wall.	Yes No	SAW: 44 th more restrictive EW: similar
8.8.4	EW/LW ID Trim depth	7.8.7	Depth of groove from trimming: $t \leq 3.8\text{mm}$: 0.10 t $t > 3.8\text{mm}$ to $t \leq 7.6\text{mm}$: ≤ 0.4mm $t > 7.6\text{mm}$: 0.05 t	9.13.2.1	Depth of groove resulting from trimming: $t \leq 4.0\text{mm}$: ≤ 0.10 t $t > 4.0\text{mm}$ to $t \leq 8.0\text{mm}$: ≤ 0.4mm $t > 8.0\text{mm}$: < 0.05 t	No	similar
8.9	Tolerances for mass	7.4 & Table 10	(see Annex A: Table 11) Single lengths, special plain end, or A25: +10% - 5%. Single lengths, other: +10% - 3.5%.	9.14	(see Annex A: Table 11) Single lengths, special plain end +10% -5%. Single lengths, grades L175 & A25: +10% -5%.	No	Similar No Carload requirements in

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			<p>Carloads, A25 $\geq 18,144\text{kg}$: -2.5%. Carloads other than A25, $\geq 18,144\text{kg}$: -1.75%. Carloads, all grades $< 18,144\text{kg}$: -3.5%. Order items, A25 $\geq 18,144\text{kg}$: -3.5%. Order items, other than A25, $\geq 18,144\text{kg}$: -1.75%. Order items, all grades, $< 18,144\text{kg}$: -3.5%. Where negative tolerance smaller than those listed in Table 9 are specified, the plus tolerance for single lengths shall be increased to 22.5% less the applicable minus tolerance.</p>		<p>Single lengths, other grades: +10% - 3.5%.</p> <p>Order items, $\geq 18,000\text{kg}$, grades L175 & A25: -3.5%. Order items, $\geq 18,000\text{kg}$, other grades: -1.75%. If PO specifies minus tolerance smaller than applicable values in Table 11, the plus tolerance shall be increased by the percentage equivalent to the applicable reduction of the minus tolerance.</p>		ISO/44th
8.10	Weldability of PSL 2 pipe	6.1.1	<p>For grades X42 and higher, by agreement between the purchaser and the manufacturer, elements other than those listed in Tables 2A & 2B (...) may be used; however care should be exercised in determining the alloy content for any given size and wall thickness of pipe, because the addition of such otherwise desirable element may affect the weldability of the pipe.</p>	9.15	<p>If agreed, the manufacturer shall supply weldability data for the type of steel concerned or perform weldability tests, for which the details for carrying out the tests and the acceptance criteria shall be as specified in the purchase order.</p> <p>The requirements for the chemical composition of the steels and, in particular, the limiting values of $CE_{P_{cm}}$ and $CE_{I_{W}}$ have been selected to facilitate weldability; however, account should be taken of the fact that the behaviour of the steel during and after welding is dependent not only upon the steel composition, but also upon the welding consumables used and the conditions of preparing for, and carrying out, welding.</p>	No	Similar and implied
9.0	Inspection						
9.1	General	NA	No equivalent	10.1.1	Specific inspection criteria defined in ISO 404. Inspection documents printed or generated in EDI conforming to agreement with purchaser.	No	Defines inspection philosophy
9.2	Inspection documents	NA	No equivalent	10.1.2 10.1.3	<p><u>PSL1:</u> ISO 10474:1991 inspection certificate 3.1.A, 3.1.B or 3.1.C or EN 10204:2004 inspection certificate 3.1 or 3.2</p> <p><u>PSL2:</u> ISO 10474:1991 inspection certificate 3.1.B, or EN 10204:2004 inspection certificate 3.1 Unless, ISO 10474:1991 inspection certificate 3.1.A or 3.1.C or inspection report 3.2, or EN 10204:2004 inspection certificate 3.2 or inspection report 3.2 is specified in PO.</p>	Yes	Defines what records/ certification required More documentation may be required in ISO/44 th
9.3	Inspection frequency PSL 1 & 2 (see Annex A: Tables 17 & 18)						
9.3.1	Chemical Analysis frequency	9	<p>Heat analysis: 1/heat Product analysis: 2/heat</p>	10.2.1.2 (Table 17/18)	<p>Heat analysis: 1/heat Product analysis: 2/heat</p>	No	Same
9.3.2	Tensile Test frequency	9	<p>Body: A25 welded (PSL1 only) 1/ 25 or 50 Mg D$\leq 141.3\text{mm}$ (welded) and all SMLS</p>	10.2.1.2 (Table 17/18)	<p>Body: L175 / A25 (PSL1 only): 1/test unit ≤ 25 or 50 Mg SMLS, welded Gr.$>$L175 / A25</p>	yes	ISO/44th test frequency is less for smaller OD

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Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/No	Details
			<p>1/400 pipe/heat; D>141.3 & ≤323.9mm: 1/200 pipe/heat/% exp D>323.9mm: 1/100 pipe/heat/% exp Weld: Long & helix welds D≥219.1mm & ≤323.9mm 1/200 pipe/heat/% exp* D>323.9mm: 1/100 pipe/heat/% exp* Skelp end welds D≥219.1mm & ≤323.9mm: 1/200 pipe/heat/% exp* D>323.9mm: 1/100 pipe/heat/% exp* * also ≥1/welder/week</p>		<p>1/test unit/exp % Weld: Long & Helic welds D≥ 219.1mm: 1/test unit/ exp %* Skelp end welds D≥ 219.1mm: 1/100 lengths/test unit/exp% * also ≥1/welder/week</p>		
9.3.3	Flattening & bend test frequency	9	<p>Flattening tests (EW) ≥L245/B (& LW PSL 1), <323.9mm: Multiple lengths non-exp Lead & tail - 0° & 90° Intermediate – 2 x 90° Single lengths – non-exp One end – 0° crush Other end - 90° crush Single lengths –expanded One end –90° crush <L245/B, D≥73.0mm: Single lengths – non-exp One end –90° crush Bend tests (PSL 1 only) D≤ 48.3mm: 1/22.7Mg pipe D=60.3mm: 1/45.5Mg pipe Guided-bend tests Long seam & skelp end: Root & face /50 pipe</p>	10.2.1.2 (Table 17/18)	<p>Flattening tests ≥L245/B EW & LW, <323.9mm: Multiple lengths non-exp Lead & tail - 0° & 90° Intermediate – 2 x 90° Single lengths – non-exp One end – 0° crush Other end - 90° crush Single lengths –expanded One end –90° crush <L245/B, D≥73.0mm: Single lengths – non-exp One end –90° crush Bend tests (PSL 1 only) D≤ 48.3mm: 1/22.7Mg pipe D=60.3mm: 1/45.5Mg pipe Guided-bend tests SAW & COW: root & face /50 pipe/% exp EW: not required Skelp end weld: Root & face /50 pipe/% exp LW D> 323.9mm: (PSL 1 only) Root & face /50 pipe</p>	No	similar
9.3.4	Metallographic and Hardness test frequency	9	<p>Hardness tests not required. Macrographic testing: Not required</p>	10.2.1.2 (Table 17/18)	<p>Hardness tests: Any hard spot exceeding 50mm in any direction of cold formed & welded pipe. Macrographic testing of weld of SAW or COW: 1/operating shift/pipe size. ERW: (or hardness test) 1/operating shift/grade/size /wall/heat treatment change.</p>	Yes	ISO/44 th SAW macrographic test frequency greater
9.3.5	Charpy /DWT test frequency	9	<p>Body (PSL 2 only) CVN: 1/heat lot*/% exp</p>	10.2.1.2 (Table)	<p>Body (PSL 2 only) CVN: 1/test unit*/% exp</p>	Yes	ISO/44 th body frequency less

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			DWTT (if agreed): 1/heat lot*/% exp <i>* heat lot frequency is the same as for body tensile tests</i>	17/18	DWTT (if agreed): 1/test unit*/% exp Weld (PSL 2 only) <u>SAW</u> Long or helical seam: CVN 1/test unit*/% exp Skelp end weld: CVN 1/≤10 pipe/test unit*/%exp <u>EW</u> Long seam (if agreed) CVN 1/test unit*/% exp <i>* heat lot frequency is the same as for body tensile tests</i>		Weld not addressed in 43 rd
9.3.6	Hydrostatic test frequency	9	each pipe.	10.2.1.2 (Table 17/18)	each pipe	No	Identical
9.3.7	Visual, weight & Dimensional inspection frequency	9	Visual inspection: each pipe. Diameter & out of roundness: ≥1/4hr/shift/size change. Wall thickness: each pipe. Length each pipe (unless uniform within 0.1'). Other dimensional testing: random, discretion of manufacturer. Weighing pipe: < 141.3mm: each pipe or pipe lot; ≥ 141.3mm: each pipe	10.2.1.2 (Table 17/18)	Visual inspection: each pipe. Diameter & out of roundness: ≥1/4hr/shift/size change. Wall thickness: each pipe. Other dimensional testing: random, discretion of manufacturer. Weighing pipe: < 141.3mm: each pipe or each lot of pipe; ≥ 141.3mm: each pipe for pipe	Yes	44 th leaves length frequency to discretion of manufacturer
9.4	Samples & test Pieces						
9.4.1	Product analysis samples & test pieces	9.2.2.2	Source of sample <u>Seamless</u> At the option of the manufacturer, samples taken either from tensile specimens or from the finished pipe. <u>Welded</u> At the option of the manufacturer, taken from either: finished pipe, plate, skelp, tensile specimens, or flattening specimens. Pipe location Long welded pipe:	10.2.2	Samples shall be taken, and test pieces prepared, in accordance with ISO 14284 or ASTM E1806. Such samples shall be taken from the pipe, plate or strip.	?	<i>A review of ASTM E1806 or ISO 14284 required</i>

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Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			<p>A minimum of 90° from the weld <u>Helical seam pipe:</u> A position not less than one quarter of the distance between adjacent weld convolutions as measured from either edge of the weld.</p> <p>Plate or skelp: location may be made by the plate or skelp supplier providing the analyses are made in accordance with the frequency requirement of this specification.</p>				
9.4.2	General mechanical tests Samples & test pieces	NA	Not specifically addressed	10.2.3.1	For any of the mechanical tests specified in Clause 9, any test piece that shows defective preparation or material imperfections unrelated to the intent of the particular mechanical test, whether observed before or after testing, may be discarded and replaced by another test piece from the same length of pipe.	No	Implied
9.4.3	Tensile tests samples & test pieces	9.3.1	<p>Body Orientation <u>Longitudinal:</u> SMLS * D<219.1mm welded: <u>Transverse (D>219.1mm):</u> Weld pipe expanded SMLS <u>Weld Transverse</u> D≥219.1mm weld pipe</p> <p>Sample Location: <u>Transverse:</u> SMLS: any location Long weld: opposite weld. SAWH (D≥273.1mm) centre of the test specimen located >1/2 long direction from seam weld. <u>Longitudinal:</u> SMLS: any location, Long seam: ~90° from weld. SAWH (D<273.1mm) centre of the test specimen located >1/4 long direction from seam weld. <u>Transverse weld:</u> Long seam: centred over weld Helical: transverse weld axis centred over weld</p> <p>Test pieces: At manufacturer's option, the specimen may be either</p>	10.2.3.2	<p>Body Orientation <u>Longitudinal:</u> SMLS * D<219.1mm welded: <u>Transverse (D>219.1mm):</u> Weld pipe expanded SMLS <u>Weld Transverse</u> D≥219.1mm weld pipe</p> <p>Sample Location: <u>Transverse:</u> SMLS: any location Long weld: opposite weld. SAWH: with the centre of the test specimen located >1/4 long direction from seam weld.</p> <p><u>Longitudinal:</u> SMLS: any location, Long seam: ~90° from weld. SAWH: with the centre of the test specimen located >1/4 of the long direction between adjacent weld convolutions. <u>Transverse weld:</u> Long seam: centred over weld Helical: transverse weld axis centred over weld</p> <p>Test pieces Shall be taken in accordance with ISO 6892 or ASTM A 370 and as shown in Figure 5</p>	<p>No</p> <p>Yes</p> <p>No?</p>	<p>Same</p> <p>SAWH trans. location different</p> <p>Assume similar</p>

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			<p>full section, strip specimen, or round bar specimens. The type, size, and orientation of the specimens shall be reported. The same method of testing shall be employed for all lots in an order item. All specimens shall represent the full wall thickness of the pipe from which the specimen was cut, except for round bar tensile specimens.</p> <p><u>Strip Specimens</u> Shall be with suitable curved-face testing grips, or flat-face testing grips if the grip areas of the specimens have been machined to reduce the curvature or have been flattened without heating.</p> <p>For strip specimens, the specified width in the gage length shall be: $D \leq 88.9 \text{ mm}$: 38.1 mm or 19.0 mm; $D > 88.9 \text{ mm}$ $D \leq 168.3 \text{ mm}$: 38.1 mm or 25.4 mm) $D > 168.3 \text{ mm}$: 38.1 mm</p>		<p><u>Strip Specimen:</u> Rectangular test pieces, representing the full wall thickness of the pipe.</p>	No	ISO/44 th doesn't allow modified length strip specimens?
		9.3.1.3	<p><u>Longitudinal body specimens</u> At the option of the manufacturer, may utilize: full section specimen, un-flattened strip specimen, or 12.7 mm diameter round bar specimen ($t > 19.1 \text{ mm}$)</p> <p>* By agreement for SMLS, a transverse round bar or ring expansion specimen may be substituted for the longitudinal specimen</p>		<p><u>Longitudinal body specimens</u> Should be strip specimens with the following exceptions: $t \geq 19.0 \text{ mm}$; 12.7 mm diameter round bar $D \leq 219.1 \text{ mm}$: At the option of the manufacturer, full-section test pieces may be used.</p> <p>* By agreement for SMLS, a transverse round bar or ring expansion specimen may be substituted for the longitudinal specimen</p>	No	ISO/44 th limits use of full section specimens Presently requires SMLS to use flattened transverse
		9.3.1.4	<p><u>Transverse Body specimens</u> a. YS, TS, and elongation values determined on either a flattened strip specimen or on a round bar specimen. b. The YS shall be determined by the ring expansion method with the TS and elongation values determined from a flattened rectangular specimen.</p> <p>Round bar specimens are to be secured from non-flattened pipe sections. The test specimen size shall be as given in Table 14A, unless the next larger test specimen size is used or unless</p>		<p><u>Transverse body specimens:</u> Strip specimens with the following alternatives: At manufacturer's option, the diameter of round bar test pieces shall be as given in Table 21, except that the next larger diameter may be used.</p> <p>Transverse test pieces shall be flattened. Alternatively, round test pieces obtained from non-flattened samples may be used.</p> <p>If agreed, ring expansion test pieces may be used for the determination of transverse yield strength.</p>	No	Similar

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Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
		9.3.1.5	<p>the manufacturer and purchaser agree to the use of the next smaller test specimen size. For pipe sizes too small to obtain a 6.4 mm specimen, round bar tensile test specimens shall not be used</p> <p><u>Transverse Weld specimens</u> shall represent the full wall thickness of the pipe from which the specimen was cut. Weld reinforcement may be removed at the manufacturer's option.</p>		<p><u>Transverse Weld specimens</u> Strip specimens shall be used and shall be flattened. Weld beads may be ground flush and local imperfections may be removed.</p>	No	similar
9.4.4	CVN impact test	9.3.5.1	<p>The Charpy test specimens shall be prepared in accordance with ASTM A 370, Methods and Definitions for Mechanical Testing of Steel Products.</p> <p>Specimen size, Orientation & Source (Table 14), except that it shall be permissible to use 2/3 or 1/2 size test specimens as required when the absorbed energy is expected to exceed 80% of the full scale capacity of the testing machine.</p> <p>The Charpy specimens shall be taken from the body of the pipe. For welded pipe, the location shall be 90° from the weld seam. Notch orientation shall be through the wall thickness as shown in Figure F-3 of Appendix F.</p>	10.2.3.3	<p>The test pieces shall be prepared in accordance with ASTM A 370 unless ISO 148-1 and the required striker radius (either 2 mm or 8 mm) are specified in the purchase order.</p> <p>Specimen Size, Orientation and Source (Table 22), except that the next smaller test piece size may be used if the absorbed energy is expected to exceed 80 % of the full-scale capacity of the impact testing machine.</p> <p>The axis of the notch shall be perpendicular to the pipe surface.</p> <p>The specimens are <u>only transverse</u>, non-flattened in sizes: full, ¾, 2/3, ½. Sizes not covered by table need not be tested.</p> <p>Weld notch location: For pipe weld and HAZ tests, each test piece shall be etched prior to notching in order to enable proper placement of the notch. <u>SAW and COW:</u> Weld metal - the axis of the notch shall be located on, or as close as practical to, the centreline of the outside weld bead. HAZ - the axis of the notch shall be located as close as practical to an edge of the outside weld bead as shown in Figure 7. <u>HFW:</u> Weld - the axis of the notch shall be located on, or as close as practical to, the weld line.</p>	Yes	<p>Similar with following exceptions/ comments</p> <p>43rd doesn't have ¾ sized specimens, allows ½- & 2/3 sized longitudinal specimens not defined for ISO/44th which allows for testing of smaller pipe D's & t's, even though not required in many cases.</p>
9.4.5	DWT test	9.3.5.3 (SR6.3)	The test specimens per API RP 5L3. The type of notch (pressed or chevron) shall be selected by agreement between the manufacturer and the purchaser.	10.2.3.4	Test pieces prepared in accordance with API 5L3	No	Similar

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Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
9.4.6	Bend test	9.3.3	ASTM A370	10.2.3.5	ISO 8491 or ASTM A370	No	Similar
9.4.7	Guided bend test	9.10.3	Reader directed to Figure 9 for sample size (38.1 mm). Weld reinforcement to be removed. t>19.1 mm, a reduced wall specimen as shown in Figure 10 may be used at the option of the manufacturer.	10.2.3.6	Test pieces prepared in accordance with ASTM A370 & Figure 8 (length ≥150mm x width ~38mm)	No	Similar
9.4.8	Flattening test	9.3.2	Per ASTM A370 and test specimens shall be at ≥63.5mm long per as shown in Figure 5. For Hot stretch reduced EW, the specimens shall be obtained either prior to or after such treatment, at the option of the manufacturer.	10.2.3.7	Test pieces prepared in accordance with ASTM A370 except the length of each test piece shall be ≥60mm. Minor surface imperfections may be removed by grinding	No	Similar
9.5	Test Methods						
9.5.1	Product analysis	9.10.1	Per ASTM A 751. Calibrations performed shall be traceable to established standards.	10.2.4.1	Unless agreed, the choice of suitable physical or chemical method is at the manufacturer's discretion. In cases of disputes, ISO/TR 9769 or ASTM A751 may be referenced.	No	ISO/44 th allows manufacturer option
9.5.2	Tensile tests	9.10.2.1 9.10.2.2	Per ASTM A 370. All tensile tests, except transverse weld and ring tests, shall include YS, TS, and elongation determinations and shall be performed with the specimens at room temperature. Equipment Tensile test machines shall have been calibrated within 15 months preceding any test in accordance with the procedures of ASTM E 4. Where YS is determined by the use of extensometers, such extensometers shall be calibrated within the preceding 15 months in accordance with the procedures of ASTM E 83, Method of Verification and Classification of Extensometers.	10.2.4.2	Per ASTM A370 or ISO 6892 Criteria Measured: Pipe body YS, TS, % elongation after fracture shall be determined Pipe weld tensile, TS shall be determined % elongation reported with reference to 50mm gauge length, with those tested with smaller gauges lengths converted to 50mm per ISO 2566-1 or ASTM A370.	No	Similar
9.5.3	CVN impact test	9.10.4	In accordance with ASTM A 370, except that the individual absorbed energy test value (actual for full-size specimens, and converted for sub-size specimens) is required to be ≥¾ of the required minimum average absorbed energy value specified for full-size specimens.	10.2.4.3 9.8.1.2	Per ASTM A370 unless ISO 148-1 & required striker radius are specified in PO. Individual test values ≥75% required min test energy	No	Similar
9.5.4	DWT test	SR6.3	in accordance with API RP 5L3.	10.2.4.4	Per API 5L3.	No	Similar
9.5.5	Bend test	9.3.3	One full section specimen of appropriate length shall be bent cold through 90°, around a mandrel having a diameter <12D, with the weld located ~45° from the point of contact of the specimen with the mandrel.	10.2.4.5	Per ASTM A370. For each test unit, one full-section test piece of appropriate length shall be bent cold through 90° around a mandrel diameter <12D.	No	Similar
9.5.6	Guided bend test	9.10.3	One face-bend and one root-bend specimen	10.2.4.6	Root and face bends per ASTM A370 or ISO 7438	No	Similar

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			shall be bent approximately 180° in a jig substantially in accordance with Figure 11. For any combination of D, t, and grade, the jig dimension A (Figure 10) may be calculated using equation. The manufacturer shall use a jig based on this or smaller dimension at his option; however, to minimize the number of jigs required, standard values for dimension A have been selected for D≥323.9mm, Appendix G. When dimension A>228.6 mm, the length of the specimen required to contact the male die need not exceed 228.6 mm. Reduced wall specimens shall be tested in a jig with the A dimension calculated for t=19.1 mm of the appropriate size and grade.		Mandrel A dimension per equation 5, jig per Figure 9, & strain values per Table 23.		
9.5.7	Flattening test	9.3.2	(EW) ≥L245/B (& LW PSL 1), <323.9mm: Multiple lengths non-exp Lead & tail - 0° & 90° Intermediate – 2 x 90° Single lengths – non-exp One end – 0° crush Other end - 90° crush Single lengths –expanded One end –90° crush <L245/B, D≥73.0mm: Single lengths – non-exp One end –90° crush	10.2.4.7	Per ASTM A370 or ISO 8492 ≥L245/B & LW, <323.9mm: Multiple lengths non-exp Lead & tail - 0° & 90° Intermediate – 2 x 90° Single lengths – non-exp One end – 0° crush Other end - 90° crush Single lengths –expanded One end –90° crush <L245/B, D≥73.0mm: Single lengths – non-exp One end –90° crush	No	Same
9.5.8	Hardness test	7.8.8	No method mentioned but hard spot testing refer to HRC or HB.	10.2.4.8	Hard spot per ISO 6506, 6507, 6508 or ASTM A370 using ASTM A956, A1038, E110	Yes	43 rd doesn't specify method
9.6.1	SAW & COW Macrographic & metallographic tests	7.8.2	No method of verification is mentioned.	10.2.5.1 10.2.5.2	SAW & COW ID & OD alignment confirmed by metallographic testing. If agreed, alternative methods may be used provided ability to detect such misalignment demonstrated & checked at least a beginning of production of each pipe size.	Yes	ISO/44 th requires regular SAW checks
9.6.2	EW & LW Metallographic tests	6.2.6	PSL 1 EW >X42, PSL 2 all EW, all LW: Excluding full body normalized pipe, the entire heat affected zone shall be demonstrated to be heat treated by weld cross section metallographic examination. Frequency: ≥1/operating shift (12 hours maximum), grade, diameter, or wall thickness change significant excursions from operating heat treatment conditions	10.2.5.3	For pipe requiring seam heat treatment, the heat treatment of full wall weld seam shall be verified by metallographic method For pipe not requiring seam heat treatment, metallographic testing shall verify no untempered martensite remains. In addition, a hardness test and maximum hardness may be specified	No	Implied

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
9.7.1	Hydrostatic test duration	9.4.1	Test hold time: All SMLS & welded ≤457mm: 5s welded >457mm: 10s	10.2.6.1	Test hold time: All SMLS & welded ≤457mm: 5s welded >457mm: 10s	No	Same
9.7.2	Hydrostatic test recording results and device calibration	9.4.2	Confirmation of test * recording pressure & time gauge for each length, or * tester equipped with positive and automatic or interlock to prevent pipe from being classified as tested until pressure & time requirements met. Calibration: With dead weight tester or equivalent ≤4 months prior to use. Records retained	10.2.6.2	Confirmation of test * recording pressure & time gauge for each length, or * tester equipped with positive and automatic or interlock to prevent pipe from being classified as tested until pressure & time requirements met. Calibration: With dead weight tester or equivalent ≤4 months prior to use.	No	Same
9.7.3	Hydrostatic Test for threaded pipe	9.4.1 9.4.3	T&C pipe with couplings if power tight is specified on PO, except D≤323.9mm: may be tested PE. For threaded pipe, test shall be made in PE, threads only or coupled, unless specified on PO. References Table 4/5 for light/heavy wall threaded pipe.	10.2.6.1 10.2.6.3 10.2.6.4	T&C pipe D≤323.9mm: may be tested PE if agreed For threaded pipe, test shall be made in PE, threads only or coupled, unless specified on PO. References Table 4/5 for light/heavy wall threaded pipe identical from 43 rd edition of 5L.	No	Same
9.7.4	Hydrostatic test pressure formula	9.4.3	Gr. A & B pressures for 10.3-48.3mm arbitrarily assigned (Table 6A) Other requirements per P=2St/D Calculated to 100 kPa Alternative higher test pressure by agreement	10.2.6.5	Gr. A25, A & B pressures for 10.3-48.3mm assigned (Table 24 & 25) Others tested to P=2St/D & table 26 Calculated to 0.1MPa Alternative higher test pressure by agreement	No	Similar
9.7.5	Hydrostatic test pressure formula alternative with end-sealing ram	Appendix K	By agreement, compressive longitudinal stress corrective factor for ≥90% SMYS pressures.	10.2.6.6	Compressive longitudinal stress corrective factor for ≥90% SMYS pressures.	Yes	Agreement not required in ISO/44 th ed
9.7.6	Use of minimum permissible wall thickness in lieu of specified wall	NA	Not addressed	10.2.6.7	If agreed, min permissible t may be used in place of specified t for the determination of required test pressure, provided the hoop stress is at least 95% of the SMYS is used.	No	New option.
9.8	Visual Inspection	9.6 9.7	Surface Entire OD surface and as much as practical in ID surface Alternative methods: VT may be replaced by other methods with demonstrated capability of detecting surface defects Qualifications: * trained to detect & evaluate surface imperfections * have visual acuity per ASNT SNT-TC-1A, or equivalent	10.2.7	Surface Entire OD surface and as much as practical in ID surface ≥300 lx illuminance Alternative methods: VT may be replaced by other methods with demonstrated capability of detecting surface defects Qualifications: * trained to detect & evaluate surface imperfections * have visual acuity per ISO 1184 or ASNT SNT-TC-1A, or equivalent	No No	Similar With added illuminance standard Similar
9.8.2	Visual inspection – Hard spots	NA	Not specifically addressed	10.2.7.4	Non-mechanical damage geometric deviations to be assessed for potential hard spot.	No	Implied
9.9.1	Diameter &	7.2	Diameter & OOR :	10.2.8.1	Diameter:	Yes	Ring gauge not

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
	Out of Round testing		D≤508mm ring gauge measurements last 101.6mm of pipe end 1/4hr/shift (slotted for SAW). Also can use snap gauge, calliper, or other device measuring diameter across plane. D>508mm: diameter tape measurements each 4 hr/shift. Out of tolerance requires reinspect all pipe to last two acceptable pipe. By agreement, OD end tolerance can apply to ID.	10.2.8.2 10.2.8.3	once/4 hrs/ operating shift. Unless method specified, use circ tape, ring gauge, snap gauge, calliper, or optical device If agreed, for expanded D≥219.1mm & non-expanded pipe, inside diameter measurements shall be used to determine conformance to diameter tolerances. Out of roundness: once/4 hrs/ operating shift. Except below, difference between largest and smallest diameter in same plane If agreed, the OOR may be determined as the difference between largest & smallest inside diameter in same plane.		required in ISO/44 th ISO/44 th allows ID measurements
9.9.2	Peaks & flat spot testing	NA	Not addressed	10.2.8.4	SAW or COW: Measured as greatest deviation from normal pipe contour at the weld at the pipe end with template oriented transverse to pipe axis 0.25D or 200mm, whichever less.	yes	New in ISO/44 th
9.9.3	Wall thickness testing	7.3	Each length of pipe measured for conformance with mechanical calliper or properly calibrated NDI device of appropriate accuracy. In case of disputes, mechanical calliper shall govern. The mechanical calliper shall be fitted with 6.4mm diameter contact pins, with ends rounded to ≤38.1mm radius (D≥168.3m) or 3.2mm<radius<d/4. The pin end contacting the OD shall be flat of rounded to radius >38.1mm.	10.2.8.6	Each length of pipe measured for conformance with mechanical calliper or properly calibrated NDI device of appropriate accuracy. In case of disputes, mechanical calliper shall govern. The mechanical calliper shall be fitted with 6.4mm diameter contact pins, with ends rounded to ≤38.1mm radius (D≥168.3m) or 3.2mm<radius<d/4. The pin end contacting the OD shall be flat of rounded to radius >38.1mm.	No	Same
9.9.4	Other dimensional testing	NA	Not addressed	10.2.8.6	Verification of other dimensional/geometric requirements specified in 9.11 to 9.13 shall use suitable methods at manufactures discretion, unless specified in PO	No	Implied
9.10	Weighing	7.4	D≥141.3mm: weighed separately D<141.3mm: Weighed separately or in convenient groups at manufactures option - For all pipe sizes, the order weight & carload weights determined	10.2.9	D≥141.3mm: weighed separately D<141.3mm: weighed individually or convenient lots selected by manufacturer.	No	ISO/44 th does not require order and carload weights be determined
9.11	NDT	9.8.2	Addressed in Annex E discussion	10.2.10	Addressed in Annex E	-	See Annex E discussion
9.12	Sorting & Reprocessing	9.13	If any mechanical property test result for a lot of pipe fails to conform to the applicable requirements, the manufacturer may elect to heat treat the lot of pipe in accordance with requirements of 5.4, consider it a new test lot, test it in accordance with all requirements of 6.2, & 9.3, SR5, & SR6 that are applicable to the order item, and proceed in accordance with the applicable requirements of the standard. After	10.2.11 Annex N	Sorting In accordance with ISO 404 Reprocessing: If any mechanical property test result for a lot of pipe fails to conform to the applicable requirements, the manufacturer may elect to heat treat the lot of pipe in accordance with requirements of Table 3, consider it a new test lot, test it in accordance with all requirements of 10.2.112 & 10.2.4 that are applicable to the order item, and proceed in accordance with the	Yes	Sorting new Reprocessing: Similar.

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			one reprocessing heat treatment, any additional reprocessing heat treatment shall be subject to agreement with the purchaser. For non-heat treated pipe, any reprocessing heat treatment shall be subject to agreement with the purchaser. For heat treated pipe, any reprocessing with a different type of heat treatment shall be subject to agreement with the purchaser.		applicable requirements of the standard. After one reprocessing heat treatment, any additional reprocessing heat treatment shall be subject to agreement with the purchaser. For non-heat treated pipe, any reprocessing heat treatment shall be subject to agreement with the purchaser. For heat treated pipe, any reprocessing with a different type of heat treatment shall be subject to agreement with the purchaser.		
9.13.1	Retesting Product analysis	9.12.1	Recheck analysis: If the product analysis representing the heat fail to conform to the specified requirements, at the manufacturer's option either the heat shall be rejected or the remainder of the heat shall be tested individually for conformance to specified requirements. If the product analysis of only one of the samples representing the heat fails to conform to the specified requirements, at the manufacturer's option either the heat shall be rejected or two recheck analyses shall be made using two additional samples from the heat. If both rechecks conform to the specified requirements, the heat shall be accepted, except the pipe, plate or skelp from which the initial sample that failed was taken. If one or both of the rechecks fail to conform to the specified requirements, at the manufacturer's option either the heat shall be rejected or the remainder of the heat shall be tested individually for conformance to the specified requirements. For such individual testing, analysis for only the rejecting element or elements need be determined. Samples for recheck analysis shall be taken in the same location as specified for product analysis samples. Tensile retests: Similar to ISO 3183	10.2.12 Annex N	Except as below, per ISO 404. If one or both of the retests representing a test unit fail to conform to the specified requirements, the manufacturer may elect to test each of the remaining lengths in the test unit for conformance to the specified requirements, with any non-conforming lengths being rejected. For such individual length tests, it is necessary that the determinations be made only for the particular elements or parameters that failed to comply in the preceding tests. Identical to API 5L 43 rd edition with addition of the following sentence: If applicable reprocessing shall be defined in 10.2.11	No	Similar
9.13.2	Tensile retests	9.12.2	If the tensile test specimen representing a lot of pipe fails to conform to the specified requirements, the manufacturer may elect to retest two additional lengths from the same lot. If both retested specimens conform to the specified requirements, all lengths in the lot shall be accepted, except the length from which the initial specimen was taken. If one or both of the retested specimens fail to conform to the	10.2.12	Except as below, per ISO 404. If one or both of the retests representing a test unit fail to conform to the specified requirements, the manufacturer may elect to test each of the remaining lengths in the test unit for conformance to the specified requirements, with any non-conforming lengths being rejected. For such individual length tests, it is necessary that the determinations be made only for the particular	No	Same

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			specified requirements, the manufacturer may elect to individually test the remaining lengths from the lot, in which case determinations are required only for the particular requirements with which the specimen failed to comply in the preceding tests. Specimens for retest shall be taken in the same manner as the specimen that failed to meet the minimum requirements.	Annex N	elements or parameters that failed to comply in the preceding tests. Identical to API 5L 43 rd edition with addition of the following sentence: If applicable reprocessing shall be defined in 10.2.11		
9.13.3	Flattening retests	9.12.3	<p>a) <u>non-expanded EW pipe in grades >A25 & non-expanded LW pipe D<323.9mm produced in single lengths</u> – the manufacturer may elect to retest any failed end until the requirements are met, providing the finished pipe is not less than 80% of its length after initial cropping.</p> <p>b) <u>Non-expanded EW pipe in grades >A25 and non-expanded LW pipe D<323.9mm produced in multiple lengths</u> – The manufacturer may elect to retest each end of each individual length if any test fails. The retests of each individual length shall be made with the weld alternatively at 0° and 90°.</p> <p>c) <u>cold expanded EW pipe in grades >A25; all welded A25 in sizes D>2 7/8; and cold expanded LW pipe D<323.9mm</u> – The manufacturer may elect to retest one end from each of two additional lengths of the same lot. If both retests are acceptable, all lengths in the lot shall be accepted, except the original failed length. If one or both of the retests fail, the manufacturer may elect to repeat the test on specimens cut from one end of each of the remaining individual lengths in the lot.</p>	10.2.12	<p>Except as below, per ISO 404. If one or both of the retests representing a test unit fail to conform to the specified requirements, the manufacturer may elect to test each of the remaining lengths in the test unit for conformance to the specified requirements, with any non-conforming lengths being rejected. For such individual length tests, it is necessary that the determinations be made only for the particular elements or parameters that failed to comply in the preceding tests.</p> <p>Annex N Identical to API 5L 43rd edition with addition of the following sentence: If applicable reprocessing shall be defined in 10.2.11</p>	No	Same
9.13.4	Bend test retests	9.12.4	If the specimen fails to conform to the specified requirements, the manufacturer may elect to make retests on specimens cut from two additional lengths from the same lot. If all retest specimens conform to the specified requirements, all lengths in the lot shall be accepted, except the length from which the initial specimen was taken. If one or more of the retest specimens fail to conform to the specified requirements, the manufacturer may elect to repeat the test on specimens cut from the individual lengths remaining in the lot.	10.2.12	<p>Except as below, per ISO 404. If one or both of the retests representing a test unit fail to conform to the specified requirements, the manufacturer may elect to test each of the remaining lengths in the test unit for conformance to the specified requirements, with any non-conforming lengths being rejected. For such individual length tests, it is necessary that the determinations be made only for the particular elements or parameters that failed to comply in the preceding tests.</p> <p>Annex Identical to API 5L 43rd edition with addition of the</p>	No	Similar

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
				N	following sentence: If applicable reprocessing shall be defined in 10.2.11		
9.13.5	Guided bend test retests	9.12.5	If one or both of the guided-bend specimens fail to conform to the specified requirements, the manufacturer may elect to repeat the test on specimens cut from two additional lengths from the same lot. If such specimens conform to the specified requirements, all lengths in the lot shall be accepted, except the length from which the initial specimen was taken. If any of the retested specimens fail to pass the specified requirements, the manufacturer may elect test specimens cut from the individual lengths remaining in the lot. The manufacturer may also elect to retest any length that has failed to pass the test by cropping back and cutting two additional specimens from the same end. If the requirements of the original test are met by both of these original tests, the length shall be acceptable. No further cropping or retesting is permitted. Specimens shall be taken in the same manner as specified in 9.10.3.	10.2.12 Annex N	Except as below, per ISO 404. If one or both of the retests representing a test unit fail to conform to the specified requirements, the manufacturer may elect to test each of the remaining lengths in the test unit for conformance to the specified requirements, with any non-conforming lengths being rejected. For such individual length tests, it is necessary that the determinations be made only for the particular elements or parameters that failed to comply in the preceding tests. Identical to API 5L 43 rd edition with addition of the following sentence: If applicable reprocessing shall be defined in 10.2.11	No	Same
9.13.6	CVN retesting	9.12.6	In the event that a set of charpy test specimens fail to meet the acceptance criteria, the manufacturer may elect to replace the lot of material involved or alternatively to test two more lengths from that lot. If both of the new tests meet the acceptance criteria, then all pipe in the heat, with the exception of the original length shall be considered to meet the requirements. Failure of either of the two additional tests shall require testing of each length for lot acceptance.	10.2.12.6	Except as below, per ISO 404. If one or both of the retests representing a test unit fail to conform to the specified requirements, the manufacturer may elect to test each of the remaining lengths in the test unit for conformance to the specified requirements, with any non-conforming lengths being rejected. For such individual length tests, it is necessary that the determinations be made only for the particular elements or parameters that failed to comply in the preceding tests. Identical to API 5L 43 rd edition with addition of the following sentence: If applicable reprocessing shall be defined in 10.2.11	No	Same
10.0	Marking						
10.1	Marker	10.1	Pipe & coupling markings applied by manufacturer	11.1.1	Pipe & coupling markings to be applied by manufacturer	No	Same
10.2	Marking Location	10.2	<u>D<48.3mm</u> : Metal tag fixed to bundle Printed on straps or banding clips	11.2.2	<u>D<48.3mm</u> : Metal tag fixed to bundle Printed on straps or banding clips On one end of each pipe Continuous along length	No	Similar but ISO/44 th gives more flexibility on location

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			<u>SMLS&weld D<406.4mm:</u> Paint stencil OD starting 457-762mm from pipe end, except by agreement in ID <u>Welded D>406.4mm</u> Paint stencil on ID starting ≥152mm from pipe end, unless agreed		<u>SMLS&weld D>48.3 <406.4mm:</u> Unless otherwise agreed Paint stencil OD starting 450-760mm from one pipe end, or Paint stencil on ID starting ≥152mm from pipe end <u>Welded D>406.4mm</u> Unless otherwise agreed Paint stencil OD starting 450-760mm from one pipe end, or Paint stencil on ID starting ≥152mm from pipe end		
10.3	Sequence of Markings	10.3	Sequence is: Manufacture Specification Compatible standards Specified dimensions Grade/class Product spec level Process of manufacture Heat treatment Test pressure Supplemental req'ts Other info	11.2.	Sequence shall be: Name/mark of manufacturer Standard designator Specified OD Specified WT Pipe steel grade Product specification level Type of pipe (table 2) Mark of customer's inspector Identification # correlated to product or delivery unit	No	Similar – Non-standard test pressure not required
10.4	Die stamping	10.1.2 10.7	Couplings to be die stamped unless agreed paint stencilled. Prohibited on t≤4.0mm & grades>A25 & not subsequently heat treated, except by agreement. <u>Hot (>93C) die stamping plate/pipes ok</u> <u>Cold die stamping ok if heat treated.</u> To be done with round/blunt dies, 25mm from a weld.	11.1.2 11.2.3	Couplings may be die stamped or paint stencilled. Pipe: If agreed, marks - on pipe bevel face or at least 150mm from bevelled end , - such marks shall also be 25mm from any weld, - cold die-stamping with round /blunt dies only	yes	ISO/44 th only allows on bevel face
11.0	Coating & Thread Protectors						
11.1	Coating	11.1	Pipe is to be supplied bare or with a thin temporary coating	12	* Pipe is to be supplied bare unless a thin protective coating is agreed to , * If agreed the pipe ends shall be coated * If agreed pipe shall be delivered with a lining	No	Similar
11.2	Thread protectors	11.2	D<48.3mm: suitable fabric wrappings or metal, fiber or plastic protectors D≥48.3mm: shall be designed with material and mechanical strength to protect threaded end.	12.2	<48.3mm: suitable fabric wrappings or metal, fiber or plastic protectors D≥48.3mm: shall be designed with material and mechanical strength to protect threaded end.	No	Same.
12.0	Retention of Records	12.2	Manufacturer shall retain documents for a minimum of 3 years , Items required for retention are included in Table 27 Chemical Properties Heat analysis Product Analysis Mechanical Tests	13	Required retention is 3 years after date of purchase - Heat and Product Analysis - Tensile Tests - Guided bend tests - CVN tests - DWT tests - Hydrostatic tester recorder charts	No	Includes all NDI personnel qualification records

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			Tensile tests Weld Tensile tests Guided bend tests Fracture toughness tests Hydrostatic tests Tester recorder charts Supplementary hydro Non destructive inspection Radiographic images Fluoroscope Operator Qualifications Welded jointers Radiographic images Repair Welding Procedure Transverse welder test Transverse Guided bend test Nick break test		- Radiographic images for pipe inspection - Non destructive inspection by other methods where applicable - Qualifications of NDE personnel - Radiographic images for jointer welds - Repair welding procedure tests - Records of any other test specified as annexes to the PO including all PQR WPS		
13	Pipe loading	13	Items list four specifications As recommended but limited to practices AAR general rules governing the loading of commodities on Open top cars AAR Rules governing the loading of steel products including pipe on open top cars. References API 5L1 and API 5LW	14	Note adds the API 5L1 and 5LW as recommended practices	No	Industry practice
14.0 Welded Jointers							
14.1.1	Welding	A.1	Any type provided generally recognized sound practice, unless specified by purchaser	A.1.1	Any type provided generally recognized sound practice, unless specified by purchaser	No	Same
14.1.2	Qualifications	A.1	Procedures, welders/operators qualified per API 1104	A.1.2	Procedures, welders/operators qualified per standard approved by purchaser	Yes	ISO/44 th less prescriptive
14.1.3	WPS,PQR docs	A.1	Copies provided to purchaser upon request	A.1.3	Copies provided to purchaser upon request	No	Same
14.2.1	End preparation	A.2	Ends to be welded prepared per WPS	A.2.1	Ends to be welded prepared per qualified WPS	No	Similar
14.2.2	Jointers straightness	A.2 (7.6)	Entire length – ≤0.2% of length	A.2.2 (9.11.3.4)	Entire length – ≤0.2% of length <u>Local end 1000mm length - ≥4.0mm</u>	Yes	Assess local straightness
14.2.3	Weld tolerances	A.2	Substantially uniform cross section Max weld height – DSAW: ≤3.2mm Other process: ≤1.6mm Min weld height: Original prolongation of parent metal	A.2.3 (Table 16)	Substantially uniform cross section Max weld height (Grinding allowed) DSAW: ≤3.5mm (except OD bead with WT≤13.0mm may be ≤4.5mm) Other process: ≤1.6mm Min weld height: parent metal	Yes	ISO/44 th is less restrictive for DSAW
14.2.4	Weld seam circumferential	A.2	Long seam weld – 51mm to 203mm, unless otherwise specified	A.2.4	Long seam weld – 51mm to 203mm, unless otherwise agreed	Yes	Similar ISO/44 th is less

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
	separation		Helical or skelp end weld – 51mm to 203mm, unless otherwise specified	A.2.5	Helical & skelp end weld – >50mm		restrictive
14.3	Marking	A.3	Each jointer marked using paint identifying welder or operator	A.3	Each jointer legibly marked identifying welder or operator	No	Same
14.4	NDE	A.4	100% RT per API 1104 Welds failing RT may be repaired and re-RT per API 1104 RT images traceable to pipe	A.4	100% UT, RT or both per ISO 3183 Annex E or K	Yes	ISO/44 th allows UT option. 43 rd allows repair per 1104
15.0 Manufacturing Procedure Qualification for PSL2 pipe							
15.1	Introduction	NA	No equivalent	B.1	Applies if ordered (cl.7.2c 41) or with Annex H (Sour) or J (offshore) Verification of manufacturing procedures may be by acceptable data from previous production or by qualification	Yes	New requirement
15.2	Additional info supplied by purchaser	NA	No equivalent	B.2	Purchaser to indicate: - If B.3, B.4 or both applies - Frequency & amount of testing - Hardenability tests, & - Welding parameters & accept criteria for hardenability tests	Yes	New requirement
15.3	Characteristics of Manufacturing procedure	NA	No equivalent	B.3	Before production @ manufacturer's risk, to supply info manufacturing procedure: <u>All pipe:</u> - steel producer; - steelmaking /casting techniques; - target chemistry; - hydrotest procedures; and - NDI procedures. <u>Welded Pipe:</u> - strip/plate manuf. method - NDI procedures for plate/strip - pipe forming procs - Pipe heat treatment - seam welding specs <u>SMLS pipe:</u> - pipe forming process - pipe heat treatment process	Yes	New option
15.4	Manufacturing procedure qualification tests	NA	No equivalent	B.4	- Test per Table 18, H.3 or H.7 as applicable at start of production - Frequency/amount in PO - Purchaser may ask for other data (e.g. weldability) - manufacturer may offer data from previous production - If agreed, hardenability tests may be requested	Yes	New option
16.0 Treatment of Surface Imperfections and Defects							
16.1	Surface	NA	Not specifically addressed	C.1	Surface imperfections not classified as defects may	No	Implied

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
	imperfections				remain or cosmetically dressed/ground		
16.2	Dressable surface defects	9.9a	Shall be dressed-out by grinding Dressing shall blend smoothly Min WT maintained	C.2	Shall be dressed-out by grinding Dressing shall blend smoothly Defect removal verified by local visual, aided, where necessary by NDT	No	Similar & implied
16.3	Non-dressable surface defects	9.9b,c,d	Dispositioned as: - PSL 2 weld defects may be repaired (Appendix B) - cut out defect as ring - reject entire pipe length	C.3	Dispositioned as: - SAW/COW weld defects repaired (C.4) - cut out defect as ring - reject entire pipe length	No	Similar
16.4	Repair of defects by welding	B.	PSL1: SMLS & welded pipe allow body repairs & EW/LW weld repairs with post weld NDT - PSL2 allow repairs on SAW/GMAW welds - ≥50mm repair length - some repairs require cavity MT inspection - ≤3.2mm grind rim into body - repairs with SAW, GMAW, or SMAW with low H electrodes - hydrotest after repair - >10C min repair temp for some repairs - Inspect weld repair area by UT or RT.	C.4	- Body repairs ok in PSL1 pipe but not PSL2 pipe. - Unless agreed, weld repairs in cold expanded pipe must be done before expansion - Total repair length ≤5% - ≥100mm separation between repairs (otherwise combine). - ≥2 passes/ repair - repairs performed per WPS (annex D) - Inspect repair area by UT or RT	Yes	Similar 44 th doesn't have additional dimensional limits and implies good weld procedure ISO/44 th does not require re-hydro of weld repairs
17.0 Repair Welding							
17.1.1	Repair Weld requirements	C.1	Must be made: * Horizontal plane * per qualified WPS * by qualified operator/welder	D1.1	Must be made: * Horizontal plane * per qualified WPS * by qualified operator/welder	No	Same
17.1.2	Repair Weld method	B.2.3 B.3.2 B.4.3	One or more of: * Automatic SAW * Auto or semi-auto GMAW * Manual SMAW using low H electrodes	D1.2.	One or more of: * Automatic SAW * Auto or semi-auto GMAW * Manual SMAW using low H electrodes	No	Same
17.1.3	Welding material handling/storage	C.1	per manufacturer's recommendations	D.1.3	per manufacturer's recommendations	No	Same
17.1.4	Test weld	C.1	On plate stock or pipe	D.1.4	On strip, plate or pipe	No	Same
17.1.5	Records	C.1	WPS & PQR results retained and available to purchaser upon request	D.1.5	WPS & PQR results retained and available to purchaser upon request	No	Same
17.2.1	Repair weld qualification	C.2	Per App.C or ASME Sec.IX.	D.2.1.1 D.2.1.2	Per Annex D or per API 5L (43 rd) app.C, ISO 15614-1 or ASME IX	No	Similar
17.2.2	Define automatic welding	C.2	Both machine and automatic welding per ASME Sec.IX	D.2.1.3	Machine, mechanized or automatic welding per ASME Sec.IX	No	Same
17.2.3	Essential Variables	C.2.1	Welding process Δ process Δ method Pipe material (any ind Δ) Δ grade category	D.2.2	Welding process Δ process (eg SAW to GMAW) Δ method (manual to semi-auto) Pipe material (any indiv Δ) Δ grade category ≤L290 or X42	Yes	ISO/44 th is a more comprehensive list

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			<p>Δ thicker material Δ CE >0.03%</p> <p>Welding Materials Δ filler metal classification Δ electrode diameter Δ shielding gas compos'n Δ shielding gas flow rate Δ SAW flux designation</p> <p>Welding parameters Δ current type (AC to DC) Δ polarity Δ I > 10%, V>7%, speed>10% Δ weld bead width >50% Δ Pre/post-weld Heat treatment</p>		<p>>L290/X42 to ≤L450/X65 > L450/X65 Δ thicker material Δ CE >0.03% of mat'l qualified Δ Delivery condition Welding Materials Δ filler metal classification Δ consumable brand name (if CVN req'd) Δ electrode diameter Δ composition of shielding gas Δ shielding gas flow rate Δ SAW flux designation Welding parameters Δ current type (AC to DC) Δ polarity Δ I > 10%, V>7%, speed>10%, or >10% HI Δ weld bead width >50% Δ Pre/post-weld Heat treatment</p>		
17.3.1	Trans weld Tensile	C.2.2.2	Two non-reduced section tensile (reinforcement removed, long edges machined) TS ≥ min TS for grade	D.2.3.2	Two non-reduced section tensile (reinforcement removed, long edges machined or torch cut) TS ≥ min TS for grade	Yes	ISO/44 th allows torch cut edges?
17.3.2	Transverse Guided Bend	C.2.2.3 (Fig C-2 & 3 & Table C-1)	Two welds in groove bent 180° around die. Die dimensions similar to ISO. Acceptable if no WM or BM crack/defect >3.2mm, or edge cracks/defects >6.4mm	D.2.3.3	Two welds in groove bent 180° around die. Die dimensions similar to API. Acceptable if no WM or BM crack/defect >3.2mm, or edge cracks/defects >6.4mm	No	Similar
17.3.4	CVN Impact	NA	Not addressed	D.2.3.4	Test pieces from weld repair & HAZ PQR prepared/tested per ISO standard. Must meet min 3 specimen avg energy @0C or lower for seam weld/HAZ.	Yes	New requirement in ISO/44 th
17.3.5	Nick Break test	C.2.2.4	Per API 5L 43 rd requiring notches in weld broken by pulling or hammer blows.	NA	Not required	Yes	Eliminated 43 rd nick break tests
17.4	NDT of RW procedure qualification	NA	Not required	D.2.4 (E.3-5)	Inspected per E.3 (RT) or E.4 (UT) or E.5 (UT & RT) meeting requirements of E.4.5 or E.5.5	Yes	NDE required in ISO/44 th
17.5.1	Welder Qualification	C.3.1.1	Qualification per standard Operator qualified on one grade is qualified on any lower grade provided same weld process	D.3.1.1	Qualifications by API 5L (43 rd) appendix C, ASME IX, ISO 9606-1, EN287-1 Operator qualified on one grade is qualified on any lower grade provided same weld process	No	Similar
17.5.2	Inspection/testing	C.3.1.2	Acceptable tests for" - film radiography - 2 trans GBT - 2 nick breaks	D.3.1.2	Acceptable tests for" - film radiography (annex E) - 2 trans GBT	Yes	Similar other than no nick breaks in 43 rd
17.5.3	Test failures	C.3.1.3	If 1 or more of above tests fail, welder may make one additional qualification weld. If one or more fails the welder is disqualified until further	D.3.1.3	If 1 or more of above tests fail, welder may make one additional qualification weld. If one or more fails the welder is disqualified until further training	No	Similar

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th																																																					
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details																																																				
			training																																																								
17.5.4	Re-Qualification	C.3.2	Required after: - 1 year since qualification - if not using procedure for >3months - reason to question welder's ability	D.3.2	Required after: - 1 year since qualification - if not using procedure for >3months - reason to question welder's ability	No	Similar																																																				
18.0	Nondestructive inspection																																																										
18.1	Personnel qualifications	9.8.1	ASNT SNT-TC-1A or equivalent.	E.1	ISO 11484 or ASNT SNT-TC-1A or equivalent.	No	Similar																																																				
18.2	Standard practices for inspection	2.9.8.2	EMI (flux leakage) ASTM E570	E.2	EMI (flux leakage) ISO 9402 / 9598 or ASTM E570	No	Same																																																				
			EMI (eddy-current) ASTM E309		EMI (eddy-current) ISO 9304 or ASTM E309	No	Same																																																				
			UT (lamination) none		UT (lamination) ISO 9303 / 9305 / 10124 / 11496 / 12094 / 13663 or ASTM E213 / A435 / A578	Yes	New																																																				
			UT (weld seam/body) ASTM E213 and E273		UT (weld seam) ISO 9764/9765 or ASTM E213	Yes	No E273?																																																				
			MP: ASTM E709		MP: ISO 13664/13665 or ASTM E709	No	Same																																																				
			RT: ASTM E94		RT: ISO 12096 or ASTM E94	No	Same																																																				
18.3.1	Weld Inspection	9.8.3 (Table 24)	Except for Grade A25, OD≥ 60.3mm weld seam: <table><tr><td>Weld</td><td>EMI</td><td>UT</td><td>RT</td></tr><tr><td>EW</td><td>A</td><td>A</td><td>N</td></tr><tr><td>LW</td><td>N</td><td>R</td><td>N</td></tr><tr><td>SAW</td><td>N</td><td>R*</td><td>N*</td></tr></table> <table><tr><td>GMAW</td><td>N</td><td>R</td><td>N</td></tr><tr><td>Skelp end</td><td>N</td><td>R*</td><td>N*</td></tr></table> A=1 or comb methods req N= not required R=required * unless RT agreed By agreement, electric welds and laser welds shall be inspected as per SR17.	Weld	EMI	UT	RT	EW	A	A	N	LW	N	R	N	SAW	N	R*	N*	GMAW	N	R	N	Skelp end	N	R*	N*	E.3.1.1 (Table E.1)	For grades ≥ L210 or A, inspect OD≥ 60.3mm weld seam: <table><tr><td>Weld</td><td>EMI</td><td>UT</td><td>RT</td></tr><tr><td>EW</td><td>A</td><td>A</td><td>N</td></tr><tr><td>LW</td><td>N</td><td>R</td><td>N</td></tr><tr><td>SAW</td><td>N</td><td>R*</td><td>N*</td></tr><tr><td>COW</td><td>N</td><td>R</td><td>N</td></tr><tr><td>GMAW</td><td>N</td><td>R</td><td>N</td></tr><tr><td>Skelp end</td><td>N</td><td>R*</td><td>N*</td></tr></table> A=1 or comb methods req'd N= not required R=required * unless RT agreed	Weld	EMI	UT	RT	EW	A	A	N	LW	N	R	N	SAW	N	R*	N*	COW	N	R	N	GMAW	N	R	N	Skelp end	N	R*	N*	No	similar
Weld	EMI	UT	RT																																																								
EW	A	A	N																																																								
LW	N	R	N																																																								
SAW	N	R*	N*																																																								
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COW	N	R	N																																																								
GMAW	N	R	N																																																								
Skelp end	N	R*	N*																																																								
18.3.2	Body Inspection (Seamless)	9.8.3 (Table 25)	<table><tr><td>PSL</td><td>EMI/UT/RT</td></tr><tr><td>2</td><td>A / A / A</td></tr><tr><td>1, Gr.B Q&T</td><td>A / A / A</td></tr><tr><td>1, other</td><td>AI / AI / AI</td></tr></table> A= 1 or comb methods required AI =1 or comb methods required if spec'd on PO.	PSL	EMI/UT/RT	2	A / A / A	1, Gr.B Q&T	A / A / A	1, other	AI / AI / AI	E.3.1.2 (Table E.2)	Pipe inspected full length (100%) <table><tr><td>PSL</td><td>EMI/UT/RT</td></tr><tr><td>2</td><td>A / A / A</td></tr><tr><td>1, Gr.B Q&T</td><td>A / A / A</td></tr><tr><td>1, other</td><td>AI / AI / AI</td></tr></table> A= 1 or comb methods req'd AI =1 or comb methods req'd, if agreed	PSL	EMI/UT/RT	2	A / A / A	1, Gr.B Q&T	A / A / A	1, other	AI / AI / AI	No	Similar																																				
PSL	EMI/UT/RT																																																										
2	A / A / A																																																										
1, Gr.B Q&T	A / A / A																																																										
1, other	AI / AI / AI																																																										
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1, other	AI / AI / AI																																																										

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
18.4	Location of equipment	9.8.3	At the discretion of the manufacturer, except: -weld seam inspection of cold expanded pipe shall take place after expansion -SMLS pipe after all heat treating and cold expansion	E.3.1.3	At the discretion of the manufacturer, except: -weld seam of cold expanded pipe shall take place after expansion -SMLS pipe after all heat treating and cold expansion -by agreement, the weld seams in EW and HFW after hydro	No	Similar ISO/44 th now requires agreement on EW welds
18.5.1	End inspection – welded	9.8.3.1	The weld at the end of the pipe that is not covered by the automated UT or EMI system shall be inspected by UT or RT methods. <u>SAW and GMAW:</u> RT weld at each pipe end for a ≥ 200 mm.	E.3.2.1 E.3.2.2	Welds at pipe ends shall be manually inspected or cut-off, if the automatic system does not cover the entire weld seam. <u>SAW and COW:</u> RT weld at each pipe end for a ≥ 200 mm	No	Similar
18.5.2	End lam inspection - welded	NA 7.8.10	NA VT lam in bevel face >6.4 mm is defect.	E.3.2.3 9.10.4	If agreed, UT shall be used to verify that the 25 mm wide zone at each pipe end is free of laminar imperfections > 6.4 mm. VT lam in bevel face >6.4 mm is defect	No	 VT Similar
18.5.3	End Inspection - Seamless	9.8.3.2	The ends that is not covered by the automated UT or EMI system shall be inspected by UT or MT methods.	E.3.3.1	Pipe ends shall be manually or semi-automatically inspected by UT or MT or cut-off, if the automatic system does not cover the entire pipe.	Yes	similar
18.5.4	End lam inspection - seamless	NA	Not addressed	E.3.3.2	If agreed, for $t \geq 5.0$ mm UT shall be used to verify that the 25 mm wide zone at each pipe end is free of laminar imperfections > 6.4 mm.	No	New if agreed for ISO/44 th .
18.6.1	RT inspection of weld seams	NA	Not addressed	E.4.1	When applicable, RT inspection shall be to image quality class R1 as per ISO 12096 or ASTM E94.	Yes ?	New requirement
18.6.2	RT Equipment	9.8.4.1	By X-ray: a) onto film b) fluorescent screen c) another X-ray imaging medium.	E.4.2.1	By X-ray onto film or another imaging medium provided required sensitivity is maintained.	No	Similar
18.6.3	RT film class	NA	Not addressed	E.4.2.2	Film shall be ISO 11699 class T2 or T3 or ASTM E1815 class I or II, and shall be used with lead screens.	Yes	New requirement in ISO/44 th .
18.6.4	RT density	NA	Not addressed	E.4.2.3	Density of radiograph shall not be less than 2.0 and chosen so: - the density through the thickest portion of the weld shall not be less than 1.5. -maximum contrast is achieved for the type of film used.	Yes	New requirement in ISO/44 th .
18.6.5	Image quality indicators (IQI)	9.8.4.2 9.8.4.4 9.8.4.3	Hole type IQI's shall be as per ASTM E1025. ISO Wire type IQI's shall be Fe 1/7, Fe 6/12 or Fe 10/16 as per ISO 1027 . ASTM Wire type IQI's shall be as per E747.	E.4.3.1 E.4.3.2 E.4.3.3	Wire type IQI's shall be used. If ISO 19232 IQI's are used, they shall be W1FE, W6FE or W10FE, and the wire diameter shall be as per Table E.3. If ASTM IQI's are used, they shall be as per E747, and the wire diameter shall be as per Table E.4.	Yes	44th does not allow the use of hole type IQI's. ISO wire type IQI's for RT is ~equivalent but smaller than fluoroscopic inspection.
18.6.	Placement of IQI	9.8.4.3	Hole type IQI placed parallel & adjacent to weld	E.4.3.4	Except as per E.4.3.5, the IQI shall be placed	Yes	44 th identifies

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
6		9.8.4.4	on radiographically similar shim material Wire-type IQI placed across representative full weld reinforcement with both essential wires. Alternatively, one on weld and one on base metal.	E.4.3.5	across the weld representing full weld thickness, and shall contain both wire diameters (one for full weld and one for weld without reinforcement). Two IQI's may be used, one on the weld and one on the parent material.		placed across weld with & without reinforcement ?
18.6.7	Verification of instrument standardization	9.8.4.5	For dynamic methods at operational speeds, an IQI shall be used to verify the sensitivity and adequacy once per 50 pipe, but at least once per 4 hours per operating shift.	E.4.4.1	For dynamic methods at operational speeds, an IQI shall be used to verify the sensitivity and adequacy once per 50 pipe, but at least once per 4 hours per operating shift.	No	Similar.
		9.8.4.5	For initial adjustment of the technique using the IQI, the pipe may be stationary.	E.4.4.2	For initial adjustment of the technique using the IQI, the pipe may be stationary.		
18.6.8	Standardization frequency for film	9.8.4.5	IQI on each film exposure is required.	E.4.4.3	For film methods, IQI on each exposure is required.	No	Same
18.6.9	Acceptance limits for imperfections found by RT	9.8.4.7 (Table 21)	Elongated inclusions <u>Individual</u> – ≤1.6mm in width x ≤12.7mm limits dependant on separation & frequency <u>Accumulated length</u> – 12.7mm in 150mm of weld length (see table)	E.4.5 (Table E.5)	Elongated inclusions <u>Individual</u> – 1.6mm in width x ≤13mm limits dependant on separation & frequency <u>Accumulated length</u> – 13mm in 150mm of weld length (see table)	No	Similar
		(Table 22)	Circular slag & gas pockets <u>Individual</u> – ≤3.2mm diameter dependant on separation & frequency <u>Accumulated length</u> – 6.4mm in 152mm of weld length (see table)	(Table E.6)	Circular slag & gas pockets <u>Individual</u> – ≤3.2mm diameter dependant on separation & frequency <u>Accumulated length</u> – 6.4mm in 150mm of weld length (see table)		
18.6.10	Other defects found by RT	9.8.4.8	Cracks, lack of penetration and lack of complete fusion are defects.	E.4.6	Cracks, lack of penetration and lack of complete fusion defects.	No	Same.
18.6.11	Disposition of RT defects	9.9	Defect disposition may be 1 or more of following: a) removed by grinding b) repaired by welding c) cut out d) entire pipe rejected	E.10	Defect disposition may be 1 or more of following: a) removed by grinding b) repaired by welding c) cut out d) entire pipe rejected	No	Similar
18.6.12	Radiographic image traceability	9.8.4.9	Traceable to the pipe.	E.4.7	Traceable to the pipe.	No	Same
18.7.1	UT & EMI Equipment	9.8.5.1	UT and EMI equipment capable of continuous and uninterrupted inspection of the weld seam of welded pipe or the OD and/or ID surface of SMLS pipe shall be used.	E.5.1.1	UT equipment capable of continuous and uninterrupted inspection of the weld seam of welded pipe or the OD and/or ID surface of SMLS pipe shall be used.	No	Similar
18.7.2	UT & EMI inspection coverage	9.8.5.1	For welded pipe, must be capable of inspecting through weld thickness and 1.6mm on either side of fusion line (EW/LW) or deposited weld metal.	E.5.1.2	For welded pipe, must be capable of inspecting through weld thickness and 1.6mm on either side of fusion line (EW/LW) or deposited weld metal.	No	Same
18.7.3	UT and EMI reference standard material	9.8.5.2	Each reference standard shall have its OD and WT within the tolerances specified for the production pipe. Reference standards may be of any convenient length.	E.5.2.1	Each reference standard shall have its OD and WT within the tolerances specified for the production pipe.	No	Same
				E.5.2.2	Reference standards may be of any convenient length.		

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th																																																																																		
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details																																																																																	
18.7.4	UT/EMI Reference Standard	9.8.5.2 (Table 26)	Reference indicators shall be separated by an amount sufficient to enable separate and distinguishable signals to be produced. <table><tr><th>Item</th><th>Notch Orient</th><th>Notch depth</th><th>Hole dia</th></tr><tr><td>EW</td><td>L</td><td>10%</td><td>3.2</td></tr><tr><td>LW</td><td>L</td><td>5%</td><td>1.6</td></tr><tr><td>SAW</td><td>L/T*</td><td>5%</td><td>1.6</td></tr><tr><td>COW</td><td>L/T*</td><td>5%</td><td>1.6</td></tr><tr><td>End w</td><td>L/T*</td><td>5%</td><td>1.6</td></tr><tr><td>Jointer</td><td>L/T*</td><td>5%</td><td>1.6</td></tr><tr><td>SMLS 2</td><td>L</td><td>12.5%</td><td>3.2</td></tr><tr><td>SMLS 1</td><td>see table</td><td></td><td></td></tr></table> Notes: * or 1.6mm hole - All notches ≤50mm long x ≤1mm wide - ID & OD notches req'd - SMLS PSL 1 has other limits	Item	Notch Orient	Notch depth	Hole dia	EW	L	10%	3.2	LW	L	5%	1.6	SAW	L/T*	5%	1.6	COW	L/T*	5%	1.6	End w	L/T*	5%	1.6	Jointer	L/T*	5%	1.6	SMLS 2	L	12.5%	3.2	SMLS 1	see table			E.5.2.3 E.5.2.4 Table E.7	Reference indicators shall be separated by an amount sufficient to enable separate and distinguishable signals to be produced. <table><tr><th>Item</th><th>Notch loc'n</th><th>Notch Orient</th><th>Notch depth</th><th>Hole dia</th></tr><tr><td>EW</td><td>ID/OD</td><td>L</td><td>10%</td><td>3.2</td></tr><tr><td>LW</td><td>ID/OD</td><td>L</td><td>5%</td><td>1.6</td></tr><tr><td>SAW</td><td>ID/OD</td><td>L/T*</td><td>5%</td><td>1.6</td></tr><tr><td>COW</td><td>ID/OD</td><td>L/T*</td><td>5%</td><td>1.6</td></tr><tr><td>End w</td><td>ID/OD</td><td>L/T*</td><td>5%</td><td>1.6</td></tr><tr><td>Jointer</td><td>ID/OD</td><td>L/T*</td><td>5%</td><td>1.6</td></tr><tr><td>SMLS 2</td><td>ID/OD</td><td>L</td><td>12.5%</td><td>3.2</td></tr><tr><td>SMLS 1</td><td>ID/OD</td><td>L</td><td>12.5%</td><td>3.2</td></tr></table> Notes: * or 1.6mm hole - All notches ≤50mm long x ≤1mm wide - SMLS PSL 1 has other limits	Item	Notch loc'n	Notch Orient	Notch depth	Hole dia	EW	ID/OD	L	10%	3.2	LW	ID/OD	L	5%	1.6	SAW	ID/OD	L/T*	5%	1.6	COW	ID/OD	L/T*	5%	1.6	End w	ID/OD	L/T*	5%	1.6	Jointer	ID/OD	L/T*	5%	1.6	SMLS 2	ID/OD	L	12.5%	3.2	SMLS 1	ID/OD	L	12.5%	3.2	No	Same It is unclear whether a hole and notch are required for EW & SMLS pipe
Item	Notch Orient	Notch depth	Hole dia																																																																																					
EW	L	10%	3.2																																																																																					
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SMLS 1	ID/OD	L	12.5%	3.2																																																																																				
18.7.5	UT/EMI Ref standard verification	9.8.5.2	Reference standards shall be identified. The dimensions and type of reference indicators shall be verified by a documented procedure.	E.5.2.5	Reference standards shall be identified. The dimensions and type of reference indicators shall be verified by a documented procedure.	No	Same																																																																																	
18.7.6	UT/EMI Instrument standardization	9.8.5.2	Documented procedure to be used to establish reject threshold for UT and EMI. The reference indicators shall be capable of being dynamically detected under normal operating conditions using a speed of movement between the pipe and transducers that simulates that used for production.	E.5.3.1	Documented procedure to be used to establish reject threshold for UT and EMI. The reference indicators shall be capable of being dynamically detected under normal operating conditions using a speed of movement between the pipe and transducers that simulates that used for production.	No	Same																																																																																	
18.7.7	UT/EMI Standardization frequency	9.8.5.1	Equipment shall be standardized 1/8hr/shift Equipment shall be adjusted to produce well defined indications with reference standard.	E.5.3.2 E.5.3.3	Standardization at least twice per shift, with second standardization being 3 to 4 hours after the first and at the end of production. Adjust the instrument to produce well defined indications.	Yes	Frequency higher in ISO/44 th																																																																																	
18.7.8	Standardization comparison of notches to hole	9.8.5.2	If the hole is used for EMI of pipe with D ≥ 60.3 mm for weld seam inspection of welded pipe or the OD and ID surfaces of seamless pipe, it shall be additionally verified that the equipment produces signals from ID and OD notches greater than the reject threshold using the hole.	E.5.3.4	If the hole is used for EMI of pipe with D ≥ 60.3 mm for weld seam inspection of welded pipe or the OD and ID surfaces of seamless pipe, it shall be additionally verified that the equipment produces signals from ID and OD notches greater than the reject threshold using the hole.	No	Same																																																																																	
18.7.9	UT/EMI inspection records	9.8.5.3	Must be maintained to document system verification.	E.5.4 E.5.4.1	Required records verifying system capability include: coverage calculation, capability for WT, repeatability, transducer orientation, exhibits confirming defects found are representative, threshold setting parameters.	Yes	Intent is the same. More comprehensive record required																																																																																	

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			Records to include standardization/ operating procedures, equipment description, personnel qualifications, dynamic test data showing system detection capabilities.	E.5.4.2	Documentation required includes: operating procedures, equipment description, personnel qualifications, dynamic test data showing system detection capabilities		in ISO/44 th
18.7.10	Alternate acceptance limits	9.8.5.4	Allows alternate acceptance limits (33% FSH) for SAW, COW, LW, repair welds which use N10 (vs.N5) notch and 3.2mm (vs. 1.6mm) hole when compared to 100% FSH for standard	E.5.5.1 & Table E.8	Allows alternate acceptance limits (33% FSH) for SAW, COW, LW, repair welds which use N10 (vs.N5) notch and 3.2mm (vs. 1.6mm) hole when compared to 100% FSH for standard	No	Same
18.7.11	EW pipe defect disposition	9.8.5.4	For welded pipe, any imperfection that produces an indication > applicable acceptance limits is a defect unless it is determined to be an acceptable surface imperfection per cl.7.8.	E.5.5.2	For UT inspection of welded pipe in the dynamic mode, any imperfection that produces an indication greater than the acceptance limit is a defect, unless: a) UT in the static produces a signal less than the acceptance limit. b) The indication is a surface imperfection that is not a defect as per 9.10.	No	Similar requirements
18.7.12	SAW pipe defect disposition	9.8.5.4	For welded pipe, any imperfection that produces an indication > applicable acceptance limits is a defect unless it is determined to be an acceptable surface imperfection per cl.7.8.	E.5.5.2	For UT inspection of welded pipe in the dynamic mode, any imperfection that produces an indication greater than the acceptance limit is a defect, unless: a) UT in the static produces a signal less than the acceptance limit. b) The indication is a surface imperfection that is not a defect as per 9.10. c) For SAW and COW pipe, RT determines the imperfection is a slag inclusion or gas pocket that meets the requirements of E.4.5.	Yes	44 th addresses volumetric inclusions
18.7.13	SMLS pipe defect disposition	9.8.5.4	For SMLS pipe any imperfection that produces an indication greater than the acceptance limit is a defect, unless it is determined that it is not a defect as per cl.7.8.	E.5.5.3	For SMLS pipe any imperfection that produces an indication greater than the acceptance limit is a defect, unless it is determined that it is not a defect as per 9.10.	No	Similar requirements.
18.7.14	COW pipe defect disposition	9.8.5.4	For GMAW, any continuous indication > 25 mm in length, regardless of the indication height (provided it is > than the background noise) shall be re-inspected by RT, or other agreed technique.	E.5.5.4	For COW seams, any continuous indication > 25 mm in length, regardless of the indication height (provided it is > than the background noise) shall be re-inspected by RT.	No	Similar
18.7.15	Weld Repair	9.8.5.6	Defects in weld seam made with filler metal found with UT may be repaired per App. B. PSL1 – defects in welds without filler metal may be repaired, with agreement PSL2 – defects in welds without filler metal may not be repaired by welding.	E.5.7	For SAW and COW seams, defects found by UT may be repaired by welding and re-inspected as per C.4.5. Inspection of the repair shall be performed using the same method as the original weld.	Yes	NDI of weld repair by method originally finding imperfection
18.8.1	MPI of SMLS Inspection area	9.8.6.1	If MPI is used to inspect for longitudinal defects, the entire outside surface shall be inspected.	E.6.1.1	If MPI is used to inspect for longitudinal defects, the entire outside surface shall be inspected.	No	Same
18.8.2	MPI of SMLS reject criteria	9.8.6.1	Surface imperfections revealed by MP shall be investigated, classified and treated as follows: If $\leq 0.125t$ and does not encroach on min WT, acceptable.	E.6.1.2	Surface imperfections revealed by MP shall be investigated, classified and treated as follows: a) $\leq 0.125t$ and do not encroach on min WT, acceptable	No	Similar

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
					b) > 0.125t and do not encroach on min WT are defects and shall be removed by grinding or treated as per C.3 c) encroach on min WT are defects and shall be treated as per C.3		
18.8.3	MPI Equipment	9.8.6.2	Equipment used for MP shall produce a field to find cracks, seams and slivers.	E.6.2	Equipment used for MP shall produce a field to find cracks, seams and slivers.	No	Same
18.8.4	MPI reference standard	9.8.6.3	If requested by purchaser, manufacturer shall demonstrate capability of finding defects stated in 9.8.6.2	E.6.3	If requested by purchaser, manufacturer shall demonstrate capability of finding defects stated in E.6.2.	No	Same
18.9.1	Residual Magnetism (RM)	9.8.7	Only applies to testing within pipe works.	E.7.1	Only applies to testing within pipe works.	No	Same
18.9.2	RM criteria	9.8.7a	The longitudinal magnetic field shall be measured on pipe with $D \geq 168.3$ mm and all smaller pipe that is inspected full length by magnetic methods or is handled by magnetic equipment prior to loading. Measurements shall be on the root face or square cut face.	E.7.2	The longitudinal magnetic field shall be measured on pipe with $D \geq 168.3$ mm and all smaller pipe that is inspected full length by magnetic methods or is handled by magnetic equipment prior to loading. Measurements shall be on the root face or square cut face.	No	Same
		9.8.7e	Four reading $\sim 90^\circ$ apart. Average ≤ 3.0 mT and no reading shall exceed 3.5 mT	E.7.6	Four reading $\sim 90^\circ$ apart. Average ≤ 3.0 mT and no reading shall exceed 3.5 mT		
18.9.3	RM measuring equipment	9.8.7b	Measurements shall be made using a Hall-effect gaussmeter or other type of calibrated instrument.	E.7.3	Measurements shall be made using a Hall-effect gaussmeter or other type of calibrated instrument.	No	Same
18.9.4	RM test frequency	9.8.7c	Each end of one pipe per 4 hours.	E.7.4	Each end of one pipe per 4 hours.	No	Same
18.9.5	RM handling of pipe	9.8.7d	Measurements shall be made after any inspection that uses a magnetic field but prior to loading. <u>Pipe handled with magnetic equipment shall be performed in a manner demonstrated not to cause residual magnetism exceeding the levels specified.</u>	E.7.5	Measurements shall be made after any inspection that uses a magnetic field but prior to loading.	No	Similar
18.9.6	RM defect bracketing	9.8.7f	Any pipe exceeding cl.9.8.7e is defective and all pipe produced between the defective pipe and the last acceptable pipe shall be individually measured or in reverse sequence until 3 consecutive acceptable pipe. Pipe produced after the defective pipe shall be measured until at least three consecutive pipe meet the requirements.	E.7.7	Any pipe exceeding E.7.6 is defective and all pipe produced between the defective pipe and the last acceptable pipe shall be measured.	No	Similar.
				E.7.8	If pipe production sequence is documented, pipe may be measured in reverse sequence until three consecutive pipe are acceptable.		
				E.7.9	Pipe produced after the defective pipe shall be measured until at least three consecutive pipe meet the requirements.		
18.9.7	Disposition of magnetized pipe	9.8.7	All defective pipe shall be de-magnetized and remeasured.	E.7.10	All defective pipe shall be de-magnetized and remeasured.	No	Same
18.1.0.1	Laminar imperfections in pipe body	NA	<u>Not addressed</u>	E.8.1	If agreed, for EW pipe shall be used to verify that the pipe body is free of laminar imperfections greater than those permitted by: a) ISO 12094, acceptance level B2, if inspection is	No	If agreed, new requirement in ISO/44 th

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
				E.8.2	done prior to pipe forming b) ISO 10124, acceptance level B3, if inspection is done after welding. If agreed, for SAW and COW pipes, UT shall be used to verify that the strip/plate or pipe body is free of laminar imperfections greater than those permitted by ISO 12094, acceptance level B2.		
18.1 0.2	Laminar imperfections along the strip/plate edges or pipe weld seam	N/A	Not addressed	E.9	If agreed, for EW, SAW and COW pipe, UT shall be used to verify that the 15 mm wide zone along each of the strip/plate edges or along each side of the weld seam is free of laminar imperfections greater than those permitted by: a) ISO 12094, acceptance level E2, if inspection is done prior to pipe forming b) ISO 13663, acceptance level E2, if inspection is done after welding.	No	If agreed, new requirement in ISO/44 th
18.1 1	Disposition of pipes containing defects	9.9	Pipes containing defects shall be given one or more of the following dispositions: a) The defects shall be removed by grinding b) The defective area shall be repaired by welding c) The sections of pipe containing defects shall be cut-off d) The entire pipe shall be rejected.	E.10	Pipes containing defects shall be given one or more of the following dispositions: a) The defects shall be removed by grinding b) The defective area shall be repaired by welding c) The sections of pipe containing defects shall be cut-off d) The entire pipe shall be rejected.	No	Same
19.0	Requirements for Couplings (PSL1 only)						
19.1	Material	8.1	<u>Gr.A or B:</u> SMLS and of grade \geq pipe <u>Gr.A25:</u> SMLS or welded and made of steel $D > 355.4\text{mm}$. By agreement, welded couplings may be offered if marked	F.1	<u>Gr.A or B:</u> SMLS and of grade \geq pipe <u>Gr.A25:</u> SMLS or welded and made of steel $D > 355.4\text{mm}$. By agreement, welded couplings may be offered if marked	No	Same
19.2	Tensile tests	8.2	Records kept of a tensile test/heat & available upon request. If testing done on finished couplings, either round bar (ASTM E8) or strip used at manufacturers option	F.2	A tensile test is required for each heat of each coupling If testing done on finished couplings, either round bar (ISO 6892 or ASTM E8) or strip (ISO 6892 or ASTM A370) used at manufacturers option Records must be maintained @ available upon request	No	ISO/44 th requires records maintained
19.3	Dimensions	8.3 (Table 12 & fig 2)	Conform to requirements in Table & Figure - T&C weighed with couplings but without thread protectors, except for carload where allowances can be made. - T&C can be weighed without couplings, provided allowances made.	F.3 Table F.1 & Fig. F.1	Conform to requirements in Table & Figure - T&C weighed with couplings but without thread protectors, except for carload where allowances can be made.	Yes	ISO/44 th does not discuss weighing
19.4	Inspection	8.4	Free from blisters, pits, cinder marks, and other defects that can impair efficiency of the coupling or break continuity of the thread.	F.4	Free from blisters, pits, cinder marks, and other defects that can impair efficiency of the coupling or break continuity of the thread.	No	same
20.0	PSL2 pipe with resistance to Ductile Fracture Propagation						

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
20.1	Introduction	SR19	Doesn't address background	G.1	Annex provides CVN additional provisions and is ordered with resistance to ductile fracture propagation in gas pipelines. The guidance methods for control fracture propagation in buried onshore pipelines originate and are supported by extensive theoretical and test work conducted mainly on welded line pipe. The user should exercise caution if this info is used for SMLS ductile fracture control.	No	General info
20.2	Purchaser supplied info	SR19.1	Purchaser to supply a stress design factor to input into AISI method	G.2	Purchaser to provide min test or order item CVN energy as well as CVN & DWTT temperature.	Yes	Not so formally addressed
20.3	Acceptance criteria	SR5A SR6 SR19	CVN shear: ≥60% for tests ≥80% order all heat avg DWTT shear (D>508mm): ≥40% for ≥80% of heats CVN arrest energy: Greater of: a) 40J <X80 or 80J X80 b) value derived from AISI formula	G.3	CVN Ductility (D<508mm), average shear fracture area ≥85% for each test at test temp. DWTT Ductility (D>508mm):, average shear fracture area ≥85% for each test at test temp. CVN arrest energy: The PO may specify fracture arrest energy to apply either to each test or the average for the order item.	Yes	44 th requires ≥85% shear to apply to each test 44 th arrest energy to apply to each lot or each order item
20.4	Test frequency	SR5A SR6 SR19	CVN & DWTT (as applicable) 1/heat lot/% exp Heat lot: 1/100, 1/200 or 1/400 lengths/heat	G.4	CVN & DWTT (as applicable) shall tested at 1/test unit/% exp	Yes	44 th frequency is less
20.5	Pipe markings	SR5A.8 SR6.8 SR19.3	Marked with SR5, SR6, & SR19 per requirements	G.5	In addition to the marking in 11.2, the PSL designation to be followed by the letter G to indicate Annex G applies	Yes	Similar philosophy
20.6	Guidance for determining CVN energy for buried onshore gas pipelines	SR19.1	References AISI equation	G.6-G.11	Clause G.7 through G.11 describe 5 approaches that may be adopted for determining the pipe body CVN energy to control ductile fracture propagation. Details concerning the range of applicability are given for each approach. The CVN energy (or higher) derived from these approaches can be specified as either a minimum value for a test or a minimum average value for an order item Approaches 1 – EPRG guidelines 2 – Battelle simplified equation 3 – Battelle two-curve method 4 – AISI method 5 – Full-scale burst testing	Yes	44 th philosophy similar to 43 rd but discusses other methods
21.0	PSL2 pipe for Sour Service						
21.1	Additional info by	NA	Not addressed	H.2	Purchaser to indicate which of 23 provisions to	yes	New

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
	purchaser				apply		requirement
21.2	Manufacturing Procedure Qualification	NA	Not addressed	H.3.1	Requires Manufacturing procedure to be qualified per Annex B	yes	New requirement in ISO/44 th
21.3.1	Steelmaking	NA	Not addressed	H.3.2	- Killed with clean steel practice from BOF or EAF process - Vacuum degas should be applied - treated for inclusion shape control	No	New requirement in ISO/44 th
21.3.2	Pipe manufacturing	NA	Not addressed	H.3.3	<u>SMLS</u> – from strand or ingot cast. Cold finishing to be reported <u>Welded</u> – Unless agreed, strand or pressure cast via SAWH, SAWL or HFW processes. - If HFW, strip edges should be sheared, milled or machined before welding - Strip/plate shall be visually inspected after rolling. Strip inspection can be of edges. - If agreed, skelp UT for lam or mech damage or full body UT. - If agreed, helical seam pipe with end welds may be delivered if within 300mm from end & UT inspection. - intermittent tack welding unless manufacturer demonstrates all mech props are met on/off tack. <u>Jointers</u> – Only if agreed	Yes	New requirement in ISO/44 th
21.4.1	Chemical composition	NA (Table 2B)	Chemistry maxima (by agreement in brackets) <u>PSL2 base limits</u> C .22-.24 Mn 1.20-1.85 P 0.025 S 0.015 Si NS V NS Nb NS Ti .04-.06 Al NS N NS Min Al/N NS Cu NS Ni NS Cr NS Mo NS B NS Ca NS Min Ca/S NS Nb+V+Ti .06-.15	H.4.1.1 (Table H.1)	Chemistry maxima (t≤25mm) (by agreement in brackets) Q&T SMLS TMCP <u>& Welded</u> <u>Welded</u> C .14-.16 0.10 Mn 1.35-1.65 1.25-1.60 P 0.020 0.020 S .003(.008) .002(.006) Si .40-.45 .40-.45 V .05-.10 .04-.10 Nb .04-.05 .04-.08 Ti .04-.06 .04-.06 Al .060 .060 N .012 .012 Min Al/N 2:1 2:1 Cu .35(.10) .35(.10) Ni .30(.50) .30 Cr .30(.45) .30(.45) Mo .15(.35) .15(.35) B .0005 .0005 Ca .006(?) .006(?) Min Ca/S (S>.0015) 1.5 1.5(?) Nb+V+Ti .15 .15	Yes ?	44 th is in general more (or as) restrictive

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			CEIiw .43 Pcm .25		CEIiw .34-.43 - Pcm .19-.22 .19-.22 Chemistry maxima (t>25mm) By agreement		
21.4.2	Tensile requirements	(Table 3B)	Min/max body Grade <u>YS</u> <u>TS</u> B 241/448 414/758 X42 290/496 414/758 X46 317/524 434/758 X52 359/531 455/758 X56 386/544 490/758 X60 414/565 517/758 X65 448/600 531/758 X70 483/621 565/758 Weld tensile min same as body (no max)	H.4.2 (Table H2)	Min/max body Grade <u>YS</u> <u>TS</u> L245/B 245/450 415/760 L290/X42 290/495 415/760 L320/X46 320/525 435/760 L360/X52 360/530 460/760 L390/X56 390/545 490/760 L415/X60 415/565 520/760 L450/X65 450/600 535/760 L485/X70 485/635 570/760 Weld tensile min same as body (no max) <u>Y:T ratio 0.93 for pipe D>323.9mm</u>	no	Criteria is very similar to ISO/44 th non-sour requirements
21.4.3	HIC/SWC	NA	Not addressed	H.4.3 H.7.2.2 H.7.3.1	Criteria for HIC tests in solution A equal to or greater than: <u>CSR ≤2%, CLR≤15%, CTR≤5%</u> Results to be reported with crack photos supplied if agreed. If conducted in alternate media, alternate criteria may be agreed. Samples/test pieces & testing per NACE TM0284	Yes	Mandatory testing with acceptance criteria. It also allows testing outside the TM0284 (based on service conditions)
21.4.4	Hardness test	NA	Not addressed	H.4.4 H.7.2.4 H.7.3.3	<u>Max hardness</u> in body, weld & HAZ ≤250 HV10 or 22HRC in unexposed cap, external HAZ & base metal may be 275 HV10 or 26 HRC, where agreed. <u>Sampling</u> at pipe end with long/helical seam at center <u>Methods:</u> Parent metal - Vickers or Rockwell macro-hardness HAZ & weld – Vickers macro-hardness <u>Traverses:</u> Diagrams detail for SMLS, HFW or SAW pipe	Yes	ISO/44 th new requirement
21.4.5	SSC test	NA	Not addressed	H.4.5 H.7.2.3 H.7.3.2	Tension surface examined @ X10 magnification with any surface breaking fissures or cracks shall constitute failure. One long sample (3 test piece) from Manufacturing Procedure Qualification Unless agreed, 115mm x 15mm x 5mm with weld at center, flattened if necessary NACE TM0177 Solution A Method per ISO 7539-2 or ASTM G39 for 720h	yes	ISO/44 th new requirement

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
					stressed to .72x SMYS, or as agreed and reported		
21.5.1	Visual surface Imperfections	NA	Not addressed	H.5.1	Surface imperfections (other than undercuts) with: - depth ≤0.05t and meet min WT may be left or cosmetically dressed; - depth >0.05t & meet min WT may be ground, cut, repaired or rejected; - do not meet min WT may be cut or rejected.	Yes	Deeper imperfections require grinding
21.5.2	Hard spots	7.8.8	> 35 HRC & >50.8mm in any direction is defect and cut out as cylinder	H.5.2	For welded pipe, hard spots >50mm is defect if surface hardness test: Internal surface: >250 HV10/ 22HRC/ 240HBW External surface: >275 HV10/ 27 HRC/ 260 HBW	Yes	ISO/44 th limits hard spots to 250 HV10 (22HRC)
21.5.3	ID weld flash on HFW	7.8.5	≤1.5mm max	H.6	≤0.3mm+0.05t or ≤0.8mm for 10mm WT pipe	Yes	ISO/44 th more restrictive
21.6	Inspection frequency	NA	Hardness (ERW): Not defined Hard spots test each visually apparent area Pipe Diameter & OOR 1/4hr/shift NDT (all pipe): per main body of standard HIC test: Not defined SSC test: Not defined	H.7	Hardness (all pipe) D<508mm: 1/test unit/100 pipe/ % exp D>508mm: 1/test unit/50 pipe/ % exp Long or helical seam: if agreed on PO Hard spots (all but SMLS) Each spot on ID or OD Pipe Diameter & OOR (all pipe) D≤168.3mm: 1/test unit/100 pipe D>168.3mm: 1/test unit/20 pipe NDT (all pipe): per annex K HIC test (all pipe): One test for each 1 st 3 heats, thereafter 1/10 heats or less. SSC test (all pipe): If agreed, 1/each Manuf. Proc. Qualification pipe	Yes	ISO/44 th is more conservative
21.7	Non -destructive Inspection	NA	Main body of spec	H.7.4.	Annex K	Yes	Iso/44 th new requirement
21.8	Markings	NA	Not specifically addressed	H.8	Pipe markings must provide traceability to inspection document Also, it will carry "S" designation in product specification level	Yes	Iso/44 th New requirement
22.0	Pipe ordered as "Through the Flowline" (TFL) pipe						
22.1	Purchaser supplied info	App.F SR7.1	Meet all requirements of SR7	I.1	Applies to pipe ordered as FTL. PO to indicate type of length and supply of jointers	No	Same
22.2	Dimensions & grades	SR7.2	Seamless or long seam pipe in D, t, & grades in table F.2	I.2	Seamless or long seam pipe in D, t, & grades in table I.1 (identical to 43 rd edition)	No	Same
22.3	Lengths & Jointers	SR7.3	Unless agreed, pipe to be double random with no jointers	I.3	Unless agreed, pipe to be double random with no jointers	No	Same
22.4	Drift test	SR7.4	Each length drifted with cylindrical mandrel per table. To be drifted when free of all foreign material and properly supported	I.5	Each length drifted with cylindrical mandrel per table I.2. To be drifted when free of all foreign material and properly supported	No	Same
22.5	Hydrostatic test	SR7.5	Per cl.9.4, except min pressures per Table F-2	I.6	Per cl.9.4, except min pressures per Table I.1	No	Same
22.6	Pipe markings	SR7.6	Shall be marked with "TFL" in addition to 10 or	I.7	In addition to markings in 11.2, the PSL designation	No	Same

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Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			appendix I		shall be followed by letter “I” to indicate annex I applies		
23.0	Pipe ordered for Offshore service						
23.1	Additional info by purchaser	NA	Not addressed	J.2	PO to indicate which of 28 options to include	Yes	44 th new requirement
23.2.1	Manufacturing Procedure Qualification	NA	Not addressed	J.3.1	Manufactured to procedure qualified to Annex B, possibly supplemented with additional testing	Yes	44 th new requirement
23.2.2	Steelmaking	NA	Not addressed	J.3.2	Clean steel practice from BOF or EAF& killed	Yes	44 th new requirement
23.2.3	Pipe manufacturing	NA	No limitation on casting methods No requirement for shearing, milling or inspecting edges No limitation on intermittent tack welding No limitation on application of jointers	J.3.3	SMLS: From continuously cast or ingot steel. Cold finishing to be stated in inspection documents. Welded: * Unless agreed, from strand or pressure cast. * For HFW, abutting edges should be sheared, milled or machined shortly before welding * visual inspection of strip/edges required * If agreed, strip/plate UT for laminar imperfections/mech damage per Annex K before cutting or pipe full body UT * If agreed, helical pipe from strip/plate end welds ok provided >300mm from end and NDT per Annex K. * Intermittent tack welds not used unless approved data supplied confirming properties consistent along length Jointers: Unless agreed, not allowed.	Yes	44 th new requirement
23.3.1	Chemical composition	NA (Table 2B)	Chemistry maxima (by agreement in brackets) PSL2 limits C .22-.24 Mn 1.20-1.85 P 0.025 S 0.015 Si NS V NS Nb NS Ti .04-.06 Al NS N NS Min Al/N NS Cu NS Ni NS Cr NS Mo NS B .001	J.4.1	Chemistry maxima (t≤25mm) (by agreement in brackets) Q&T SMLS TMCP & Welded Welded C .14-.17 0.12 Mn 1.35-1.85 1.25-1.85 P 0.020 0.020 S .010 .010 Si .40-.45 .40-.45 V .04-.10 .04-.10 Nb .04-.06 .04-.08 Ti .04-.06 .04-.06 Al .060 .060 N .012 .012 Min Al/N 2:1 2:1 Cu .35-.05 .35-.50 Ni .30-.50 .30-.50 Cr .30-.50 .30-.50 Mo .10-.50 .10-.50	Yes	44 th new requirement

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Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			Ca NS Min Ca/S NS Nb+V+Ti .06-.15 CEiiw .43 Pcm .25		B .0005 .0005 Nb+V+Ti .15/NS .15/NS CEiiw .34-.42 - Pcm .19-.23* .19-.24 * increase .03 for SMLS pipe Chemistry maxima (t>25mm) By agreement		
23.3.2	Tensile requirements	(Table 3B)	Min/max body Grade <u>YS</u> <u>TS</u> B 241/448 414/758 X42 290/496 414/758 X46 317/524 434/758 X52 359/531 455/758 X56 386/544 490/758 X60 414/565 517/758 X65 448/600 531/758 X70 483/621 565/758 X80 552/690 621/827 Weld tensile min same as body (no max)	J.4.2	Min/max body Grade <u>YS</u> <u>TS</u> L245/B 245/450 415/760 L290/X42 290/495 415/760 L320/X46 320/520 435/760 L360/X52 360/525 460/760 L390/X56 390/540 490/760 L415/X60 415/565 520/760 L450/X65 450/570 535/760 L485/X70 485/605 570/760 L555/X80 555/675 625/825 Weld tensile min same as body (no max) Y:T ratio 0.93 for D>323.9mm Sampling per body of standard	Yes	ISO/44 th similar to body of spec other than YS max
23.3.3	Hardness test	NA	Not addressed	J.4.3	Pipe body, weld & HAZ shall be: Gr.≤L450: ≤270HV10 or ≤25HRC Gr>L450: ≤300HV10 or ≤30 HRC	Yes	ISO/44 th new requirement
23.4	Visual surface Imperfections	7.8.14	Any OD or ID surface imperfection that has a depth >12.5%t shall be considered a defect.	J.5	Surface imperfections (other than undercuts) with: - depth ≤5%t and meet min WT may be left or cosmetically dressed; - depth >5%t and meet t _{min} may be ground, cut, repaired or rejected; - do not meet min WT may be cut or rejected.	Yes	ISO/44 th new requirement Deeper imperfections require grinding
23.5.1	Diameter & OOR tolerances	7.2 (Table 7 & 8)	<u>Body Diameter (All Pipe)</u> < 60.3mm: +0.41mm -0.8mm ≥ 60.3 & < 508mm: ±0.75% OD <u>Seamless</u> ≥ 508mm: ±1.00% OD <u>Welded</u> ≥ 508mm & ≤ 914mm: +0.75% -0.25% OD > 914mm: +6.4mm -3.2mm <u>End Diameter tolerance</u> ≤ 273.1mm: - 0.4mm +1.6mm > 273.1mm: -0.8mm +2.4mm End-end difference: 2.4mm	J.6.1	<u>Body diameter tolerance</u> <u>Seamless:</u> ≤610mm: greater of ±.5mm or ±.75%D >610 to ≤1422mm: ±.1%D <u>Welded:</u> ≤610mm: greater of ±.5mm or ±.75%D to ±3.2mm max >610 to ≤1422mm: ±0.5%D to ±4.0mm max <u>End diameter tolerance</u> <u>Seamless</u> ≤610mm: greater of ±.5mm or ±.5%D, but ±1.6mm max >610 to ≤1422mm: ±2.0mm <u>Welded</u> ≤610mm:	Yes	44th new requirement

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Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
			<u>End OOR Diameter: ±1% OD</u> <u>End max diff dia (D/t < 75):</u> > 508mm & ≤ 1067mm: ≤ 12.7mm > 1067mm: ≤ 15.9mm		greater of ±.5mm or ±.5%D, but ±1.6mm max >610 to ≤1422mm: ±1.6mm max <u>Out of round tolerance</u> <60.3mm end/body: by agreement ≥60.3-≤610mm: <u>Body: 1.5%D; End: 1%D</u> D>610 to ≤1422mm (D/t≤75) <u>Body: 1%D; End: 0.75%D</u> D>610 to ≤1422mm (D/t>75) Body/end: by agreement		OOO tolerances more restrictive
23.5.2	Wall thickness tolerance	7.3 (Table 9)	<i>All pipe</i> < 508mm OD +15% - 12.5% WT <i>Seamless</i> ≥ 508mm OD +17.5% -10.0% WT <i>Welded</i> ≥ 508mm OD +19.5% -8.0% WT Note :values for grade B and lower pipe not included	J.6.2	<i>Seamless</i> t<4.0: +0.6mm/-0.5mm t≥4.0 - <10.0: +0.15t/-0.125t t≥10.0 - <25.0: ±0.125t t>25.0: greater +3.7mm or 0.1t greater of -3.0mm or -0.1t <i>HFW</i> t≤6.0: ±0.4mm t>6.0 - ≤15.0: ±0.7mm t>15.0: ±1.0mm <i>SAW</i> t≤6.0: ±0.5mm t>6.0 - ≤10.0: ±0.7mm t>10.0 - ≤20.0: ±1.0mm t>20.0: +1.5mm / -1.0mm	Yes	ISO/44th new requirement Tolerances much more restrictive
23.5.3	Length tolerances	7.5 (Table 11, unless agreed)	Plain-end Pipe (m) Nom min min max Avg 12 4.27 10.67 13.72 Min. and max. lengths varied and not rounded from USC units.	J.6.3	Plain-end Pipe (m) Nom min min max Avg 12 11.7 12.1* 12.7 * unless agreed Max avg length to be defined if requested	Yes	ISO/44 th new requirement
23.5.4	Straightness tolerance	7.6	Low grade pipe < 114.3 reasonably straight. All other pipe not to exceed 0.2% of length.	J.6.4	Deviation over pipe length: ≤0.15% <u>Local deviation in 1.0m:</u> ≤3.0mm	Yes	ISO/44 th new requirement
23.6.1	Radial offset of edges	7.8.2 & 7.8.3	<i>Pipe with filler metal</i> t≤ 12.7mm: 1.6mm max. t> 12.7mm: 0.125 t (or 3.2mm, if less) <i>ERW:</i> 1.5mm max	J.7.1	<i>SAW:</i> t≤13.0mm: ≤1.3mm t>13.0 - ≤20.0mm: 0.1t t>20.0mm: 2.0mm <i>HFW:</i> shall not be below min t	Yes	ISO/44 th New requirement
23.6.2	HFW flash height	7.8.4 - 7.8.6	OD flash trimmed essentially flush. ID flash ≤1.5mm	J.7.2	ID flash ≤0.3mm + 0.05t	Yes	ISO/44 th New requirement
23.6.3	SAW bead misalignment		Not cause for rejection provided NDT confirms complete penetration and fusion.	J.7.3	SAW bead misalignment: t≤20.0mm: 3.5mm t>20.0mm: 4.5mm	Yes	ISO/44 th new requirement
23.7.	Tensile test	9	Body: (PSL2)	J.8.1	Body:	Yes	ISO/44 th New

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
1.1	frequency		<p>≤141.3mm (welded) and all SMLS 1/400 pipe/heat; >141.3 & ≤323.9mm: 1/200 pipe/heat/% exp >323.9mm: 1/100 pipe/heat/% exp Weld (long & helical): ≥219.1mm & ≤323.9mm: 1/200 pipe/heat/% exp* >323.9mm: 1/100 pipe/heat/% exp* * also ≥1/welder/week Skelp end welds ≥219.1mm & ≤323.9mm: 1/200 pipe/heat/% exp* >323.9mm: 1/100 pipe/heat/% exp*</p>		<p><508mm (all pipe): 1/100 lengths/% exp ≥508mm: 1/50 lengths/% exp Seam Weld (HFW & SAW): ≥ 219.1 -508mm: 1/100 lengths/% exp* >508mm: 1/50 lengths/% exp* * also ≥1/welder/week Skelp end weld: ≥ 219.1mm (SAWH): 1/50 lengths/% exp* * also ≥1/welder/week</p>		<p>requirement</p> <p>ISO/44th more frequent testing</p>
23.7. 1.2	CVN test frequency	9	<p>Body (PSL 2 only) CVN: 1/heat lot*/% exp DWTT (if agreed): 1/heat lot*/% exp * heat lot frequency is the same as for body tensile tests</p>	J.8.1	<p>Body 114.3≤D<508mm (all pipe): 1/100 lengths/% exp D≥508mm (all pipe): 1/50 lengths/% exp Seam Weld (welded pipe): 114.3≤D<508mm: 1/100 lengths/% exp D≥508mm: 1/50 lengths/% exp Skelp end weld: (SAWH): 1/50 lengths/% exp</p>	Yes	<p>ISO/44th new requirement</p> <p>ISO/44th more frequent testing</p>
23.7. 1.3	Inspection frequency	9	<p>Diameter & OOR: ≥1/4hr/shift/size change.</p>	J.8.1	<p>Pipe diameter & OOR D≤168.3mm: (all pipe): 1/100 lengths D>168.3mm: (all pipe): 1/20 lengths NDI (all pipe): Per annex K Hardness (all welded pipe) As agreed CTOD (if agreed): once for manuf. Procedure qualification only</p>	Yes	<p>ISO/44th new requirement</p> <p>ISO/44th more frequent testing</p>
23.7. 2	Samples & test pieces	9.3	Per body of standard	J.8.2 (Table J.8)	Sample number, orientation & location of test pieces defined in table. CTOD samples per ISO12135	Yes	ISO/44 th New requirement
23.7. 3	Test methods	9.10	Per body of standard	J.8.3	<p>Methods: CTOD: ISO 12135 or ASTM 1290 <u>Parent metal & HAZ/weld Vickers hardness:</u> ISO 6507-1 or ASTM E92 <u>Parent metal Rockwell hardness:</u> ISO 6805 or ASTM E18 Location hardness tests defined with figures</p>	Yes	ISO/44 th New requirement
23.7. 4	NDT	9.8	Per body of standard	J.8.4	See clause J.2 and Annex K	Yes	ISO/44 th New requirement
24.0	Non-Destructive Inspection for Pipe ordered for sour service and/or offshore service						
24.1	Introduction	NA	Not addressed	K.1	Annex K applicable only if Sour Service or Offshore is ordered. Annex E also applies except as modified herein.	Yes	ISO/44 th New requirement
24.2. 1	Laminar imperfections at	NA	Not addressed	K.2.1	Laminar imperfections > 6,4mm in circumferential direction and > 100 mm ² shall be rejects.	Yes	Not prev. covered by 43 rd

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
	pipe ends				For pipe with $t \geq 5,0\text{mm}$ 50mm zone at each pipe end must be UT inspected per ISO 11496 If agreed, 200mm must be insp'd If agreed, the end face/bevel must be MT insp'd per ISO 13664 or ASTM E709.		
24.2.2	Suspect pipe	NA	Not addressed	K.2.2	Pipe with indications producing a trigger/alarm condition shall be deemed suspect. Suspect pipe shall be dealt with in accordance with the applicable standard for NDT unless otherwise stated in annex K, H, or J. Repair by welding is permitted in accordance with C.4 Where dressing is carried out, complete removal is verified by visual aided by NDT if necessary Any manual NDT inspection applied to a local suspect area shall use the same sensitivity, parameters and acceptance level as used during original inspection. Manual UT scanning shall not exceed 150mm/sec.	Yes	ISO/44 th New requirement
24.3.1	SMLS – UT for long imperfections	9.8.3 Table 25	One or more of UT, EMI, or MT methods to be used	K.3.1	SMLS shall be full-body UT inspected for longitudinal imperfections in accordance with ISO 9303 or ASTM E 213; with acceptance limits per ISO 9303:1989 level L2/C.	Yes	ISO/44 th mandates UT inspection
24.3.2	SMLS – Laminar imperfections in pipe body	NA	Not addressed	K.3.2.1	For sour service, individual laminations and/or lamination densities exceeding limits set in Table K.1 for sour service shall be classified as defects. Service Offshore Sour Sour, _____ if agreed <i>Max individual imperfection area</i> A(mm ²) 1000 500 100 <i>Minimum imperfect'n considered</i> A(mm ²) 300 150 30 Length 35mm 15mm 5mm Width 8mm 8mm 5mm <i>Max population density/m²</i> 10 2.5 1.3	Yes	ISO/44 th New requirement
				K.3.2.2	Inspection shall be per ISO 10124:1994 (except 4.2) or ASTM A435 or A578. Coverage shall be min of 20% of pipe surface		

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
					For offshore, individual laminations and/or lamination densities exceeding limits set in Table K.1 for offshore shall be classified as defects. If agreed, inspection shall be per ISO 10124:1994 (except 4.2) or ASTM A435 or A578. Coverage shall be min of 20% of pipe surface		
24.3.3	SMLS – UT thickness measurements	NA	Not addressed	K.3.3	SMLS pipe shall be subjected to full peripheral UT inspection for compliance to wall thickness tolerance per ISO 10543 or ASTM E114 Coverage shall be >= 25% of the pipe surface; or greater if agreed	Yes	ISO/44 th New requirement
24.3.4	SMLS – Supplementary NDI	NA	Not addressed	K.3.4.1	If agreed, SMLS shall be UT inspected for transverse imperfections per ISO 9305:1989 acceptance level L2/C or ASTM E213	Yes	Non-mandatory ISO/44 th New requirement
				K.3.4.2	If agreed, SMLS shall be full body inspected using flux leakage per ISO 9402:1989 acceptance level L2 or ASTM E 570 for detection of longitudinal imperfections and/or ISO 9589:1989, acceptance level L2 or ASTM E 570 for detection of transverse imperfections.		
				K.3.4.3	If agreed, SMLS shall be full body inspected for the detection of imperfections per ISO 9304:1989 acceptance level L2/C or ASTM E 309		
				K.3.4.4	If agreed, subsequent to all other NDT and visual inspection, full body MT inspection shall be carried out per ISO 13665 or ASTM E 709 on one SMLS pipe per heat or steel or batch of 50 pipes produced, whichever is fewer, order to verify compliance to 9.10. Such pipes shall be selected at random and before inspection subjected to abrasive blasting to produce external surface of Sa 2 ½ in accordance with ISO 8501-1:1988.		
24.4.1	HFW – NDI of weld seam	9.8.2	ASTM E213 and E273	K.4.1	The full length of the weld seam shall be UT inspected for detection of longitudinal imperfections per one of the following: a) ISO 9764:1989 acceptance level L3/C or if agreed, L2/C b) ISO 9303:1989 acceptance level L3 or if agreed, L2 c) ASTM E 213	Yes	ISO/44 th mandates UT inspection 44 th eliminates option of E273
24.4.2	HFW – Body Laminar imperfections	NA	Not addressed	K.4.2	If agreed, the pipe body or strip/plate shall be UT inspected for detection of laminar imperfections per ISO 10124:1994 (except 4.2) or ISO 12094,	Yes	Non-mandatory ISO/44 th New requirement

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
				Table K.1	respectively, to acceptance limits for the relevant application as given in Table K.1. The coverage shall be $\geq 20\%$ of the pipe surface. Service Offshore Sour Sour, if agreed <i>Max individual imperfection area</i> A(mm ²) 1000 500 100 <i>Minimum imperfect'n considered</i> A(mm ²) 300 150 30 Length 35mm 15mm 5mm Width 8mm 8mm 5mm <i>Max population density/m²</i> 10 2.5 1.3		
24.4.3	HFW – edges/ends laminar imperfections	NA	Not addressed	K.4.3 Table K.1	If agreed, the strip/plate edges or the areas adjacent to the weld seam shall be UT inspected over a width of 15mm for the detection of laminar imperfections per ISO 12094 or ISO 13663, respectively for to the acceptance limits in K.1 for strip/plate edges or areas adjacent to the weld seam. <u>Service Sour or Offshore</u> <i>Max individual imperfection</i> Area 100 mm ² Length 20 mm <i>Minimum imperfect'n considered</i> Length 10 mm <i>Max population density</i> 3/1m length	Yes	Non-mandatory ISO/44 th New requirement
24.4.4	HFW - supplementary NDI	NA	Not addressed	K.4.4	If agreed, the pipe body of HFW pipe shall be inspected for the detection of longitudinal imperfections using UT per ISO 9303 or ASTM E213 or flux-leakage per ISO 9402:1989, acceptance level L3/C or if agreed L2/C, or ASTM E 570.	Yes	Non-mandatory ISO/44 th New requirement
24.5.1	SAW – UT weld for long & trans imperfections	9.8.2	ASTM E213 & E273 and body of standard	K.5.1	The full length of the weld seams of SAW pipe shall be UT inspected for the detection of longitudinal and transverse imperfections per ISO 9765:1990 acceptance level L2 as modified: a) The notch depth ≤ 2.0 mm b) The use of internal and external longitudinal notches located on the centre of the weld seam for equipment standardization is not permitted c) As an alternative to the use of the reference	Yes	ISO/44 th mandates UT inspection 44 th eliminates option of ASTM E213 or E273

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
					<p>hole for equipment calibration for the detection of transverse imperfections it is permissible to use acceptance level L2 internal and external notches lying at right angles to and centred on over the weld seam with reinforcements ground flush. The notches shall be separated and amplitude from each such notch shall be used to set trigger/alarm levels.</p> <p>As an alternative to the use of Acceptance Level L2 notches for equipment standardization, it is permissible, if agreed, to use a fixed-depth internal and external notch and increase the inspection sensitivity by electronic means (i.e. increase in decibels). In this case (known as the "two-lambda method"), the depth of the notches shall be twice the wavelength at the ultrasonic frequency in use. The wavelength is given by:</p> $\lambda = \frac{V_t}{f} \quad \text{where}$ <p>λ is wavelength, in m (ft); V_t is transverse ultrasonic velocity, in m/s (ft/s); f is frequency, in Hz</p> <p>[Thus for example, at 4 MHz test frequency, the wavelength is 0.8mm and the notch depth is 1.6mm.]</p> <p>The required increase in inspection sensitivity shall be based upon pipe thickness and the manufacturer shall demonstrate to the satisfaction of the purchaser that the inspection sensitivity achieved is essentially equivalent to that achieved when using Acceptance Level L2 notches.</p> <p>d) The manufacturer may apply the provisions of K.5.3 to retest the suspect areas.</p> <p>For SAWH pipe, the full length of the strip/plate end weld shall be UT inspected using the same inspection sensitivity and parameters as used on</p>		

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
					<p>the helical-seam weld in accordance with K.5.1.1.</p> <p>T-joints, where the extremities of the strip/plate end weld meet the helical-seam weld, shall be subjected to RT inspection per Clause E.4</p> <p>For jointers, the full length of the girth weld shall be UT inspected using the same inspection sensitivity and parameters as used on the helical or longitudinal seam weld in accordance with K.5.1.1.</p> <p>T-joints, where the girth weld intersects the longitudinal seam in SAWL or COWL pipe or the helical seam in SAWH or COWH pipe, shall be subjected to RT inspection in accordance with Clause E.4.</p>		
24.5.2	SAW – pipe body & strip edge laminar imperfections	NA	Not addressed	<p>K.5.2</p> <p>Table K.1</p> <p>Table K.1</p>	<p>The pipe body or strip/plate shall be UT inspected for detection of laminar imperfections per ISO 10124:1994 (except 4.2) or ISO 12094, respectively, to acceptance limits for the relevant application as given in Table K.1. The coverage shall be >= 20% of the pipe surface.</p> <p>Service Offshore Sour Sour, _____ if agreed</p> <p><i>Max individual imperfection area</i></p> <p>A(mm2) 1000 500 100</p> <p><i>Minimum imperfect'n considered</i></p> <p>A(mm2) 300 150 30</p> <p>Length 35mm 15mm 5mm</p> <p>Width 8mm 8mm 5mm</p> <p><i>Max population density/m2</i></p> <p>10 2.5 1.3</p> <p>Such inspection may be carried out at the strip/plate mill or in the pipe mill.</p> <p>The strip/plate edges including those adjacent to the strip/plate end weld of helical-seam pipe, shall be UT inspected over a width of 15mm for the detection of laminar imperfections per ISO 12094 or ISO 13663, respectively for to the acceptance limits in K.1 for strip/plate edges or areas adjacent to the weld seam.</p> <p>Service Sour or Offshore</p>	Yes	ISO/44 th mandates UT inspection

Detailed comparison of API 5L (43rd) & API 5L (44th) Requirements

Item		API 5L (43 rd ed)		ISO 3183 (2 nd ed.) / API 5L (44 th ed) – no errata		Significant Difference between API 5L 43 rd vs. ISO / 44 th	
Ref. #	Description	Cl. #	Content	Cl. #	Content	Yes/ No	Details
					<i>Max individual imperfection</i> Area 100 mm ² Length 20 mm <i>Minimum imperfection considered</i> Length 10 mm <i>Max population density</i> 3/1m length		
24.5.3	SAW – NDI of pipe ends/repared areas	NA	Not addressed	K.5.3	The length of weld seam at pipe ends that cannot be inspected by the automatic UT equipment and repaired areas of the weld seam (see Clause C.4), shall be subjected to the following: a) For the detection of longitudinal imperfections, manual or semi-automatic UT inspection using the same inspection sensitivity and parameters as in K.5.1.1 or unless otherwise agree, RT inspection in accordance with Clause E.4. b) For the detection of transverse imperfections, manual/semi-automatic UT inspection using the same inspection sensitivity and parameters as in K.5.1.1 or RT inspection in accordance with Clause E.4.	Yes	ISO/44 th mandates UT inspection
24.5.4	SAW – supplemental NDI	NA	Not addressed	K.5.4	If agreed, the external and internal surfaces of the ultimate 50 mm length of weld seam at both ends of each pipe shall be MT inspected per ISO 13665 or ASTM E 790. Any indication in excess of 3,0 mm shall be investigated and treated in accordance with Clause C.2.	Yes	Non-mandatory ISO/44 th New requirement

Annex A: Supplemental Comparison Tables

Table 4 — Chemical composition for PSL 1 pipe with t ≤ 25,0 mm (0.984 in)									
Edition	Steel grade (Steel name)	C	Mn	P		S	V	Nb	Ti
		max. ^b	max. ^b	min.	max.	max.	max.	max.	max.
Seamless pipe									
44th	L175 or A25	0,21	0,60	—	0,030	0,030	—	—	—
43rd	A25, CI I	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg
44th	L175P or A25P	0,21	0,60	0,045	0,080	0,030	—	—	—
43rd	A25, CI II	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg
44th	L210 or A	0,22	0,90	—	0,030	0,030	—	—	—
43rd	A	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg
44th	L245 or B	0,28	1,20	—	0,030	0,030	c,d	c,d	d
43rd	B	No Chg	No Chg	No Chg	No Chg	No Chg	b,c,d	b,c,d	0.04
44th	L290 or X42	0,28	1,30	—	0,030	0,030	d	d	d
43rd	X42	No Chg	No Chg	No Chg	No Chg	No Chg	c,d	c,d	0.04
44th	L320 or X46	0,28	1,40	—	0,030	0,030	d	d	d
43rd	X46	No Chg	No Chg	No Chg	No Chg	No Chg	c,d	c,d	0.04
44th	L360 or X52	0,28	1,40	—	0,030	0,030	d	d	d
43rd	X52	No Chg	No Chg	No Chg	No Chg	No Chg	c,d	c,d	0.04
44th	L390 or X56	0,28	1,40	—	0,030	0,030	d	d	d
43rd	X56	No Chg	No Chg	No Chg	No Chg	No Chg	c,d	c,d	0.04
44th	L415 or X60	0,28 ^e	1,40 ^e	—	0,030	0,030	f	f	f
43rd	X60 ⁱ	0,28	1,40	No Chg	No Chg	No Chg	c,d	c,d	0.04
44th	L450 or X65	0,28 ^e	1,40 ^e	—	0,030	0,030	f	f	f
43rd	X65 ⁱ	0,28	1,40	No Chg	No Chg	No Chg	c,d	c,d	0.06
44th	L485 or X70	0,28 ^e	1,40 ^e	—	0,030	0,030	f	f	f
43rd	X70 ⁱ	0,28	1,40	No Chg	No Chg	No Chg	c,d	c,d	0.06
Welded pipe									
44th	L175 or A25	0,21	0,60	—	0,030	0,030	—	—	—
43rd	A25, CI I	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg
44th	L175P or A25P	0,21	0,60	0,045	0,080	0,030	—	—	—
43rd	A25, CI II	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg
44th	L210 or A	0,22	0,90	—	0,030	0,030	—	—	—
43rd	A	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg	No Chg
44th	L245 or B	0,26	1,20	—	0,030	0,030	c,d	c,d	d
43rd	B	No Chg	No Chg	No Chg	No Chg	No Chg	b,c,d	b,c,d	0.04
44th	L290 or X42	0,26	1,30	—	0,030	0,030	d	d	d
43rd	X42	No Chg	No Chg	No Chg	No Chg	No Chg	c,d	c,d	0.04
44th	L320 or X46	0,26	1,40	—	0,030	0,030	d	d	d
43rd	X46	No Chg	No Chg	No Chg	No Chg	No Chg	c,d	c,d	0.04
44th	L360 or X52	0,26	1,40	—	0,030	0,030	d	d	d
43rd	X52	No Chg	No Chg	No Chg	No Chg	No Chg	c,d	c,d	0.04
44th	L390 or X56	0,26	1,40	—	0,030	0,030	d	d	d
43rd	X56	No Chg	No Chg	No Chg	No Chg	No Chg	c,d	c,d	0.04
44th	L415 or X60	0,26 ^e	1,40 ^e	—	0,030	0,030	f	f	f
43rd	X60 ⁱ	0,26	No Chg	No Chg	No Chg	No Chg	c,d	c,d	0.04
44th	L450 or X65	0,26 ^e	1,40 ^e	—	0,030	0,030	f	f	f
43rd	X65 ⁱ	0,26	1.45	No Chg	No Chg	No Chg	c,d	c,d	0.06
44th	L485 or X70	0,26 ^e	1,40 ^e	—	0,030	0,030	f	f	f
43rd	X70 ⁱ	0,26	1.65	No Chg	No Chg	No Chg	c,d	c,d	0.06
44th	^a 0,50 % maximum for copper; 0,50 % maximum for nickel; 0,50 % maximum for chromium; and 0,15 % maximum for molybdenum. For grades up to and including L360/X52, Cu, Cr and Ni shall not be added intentionally.								
43rd									
44th	^b For each reduction of 0,01 % below the specified maximum concentration for carbon, an increase of 0,05 % above the specified maximum concentration for manganese is permissible, up to a maximum of 1,65 % for grades ≥ L245 or B, but ≤ L360 or X52; up to a								
43rd	^b For each reduction of 0,01 % below the specified maximum carbon content, an increase of 0,05 % above the specified maximum manganese content is permissible, up to a maximum of 1,50 % for Grades X42 through X52, up to a maximum of 1,65 % for grades higher than X52 but less than X70, and up to								
44th	^c Unless otherwise agreed, the sum of the niobium and vanadium contents shall be ≤ 0,06 %.								
43rd	^d The sum of columbium [niobium] and vanadium contents shall not exceed 0,03 %, except that, by agreement between the purchaser								
44th	^e The sum of the niobium, vanadium and titanium concentrations shall be ≤ 0,15 %.								
43rd	^f The sum of the columbium [niobium], vanadium, and titanium contents shall not exceed 0,15 %.								
44th	^g Unless otherwise agreed. (Note this footnote for C and Mn elements only)								
43rd	^h Other chemical compositions may be furnished by agreement between purchaser and manufacturer, providing that the limits of								
44th	ⁱ Unless otherwise agreed, the sum of the niobium, vanadium and titanium concentrations shall be ≤ 0,15 %.								
43rd	^j The sum of the columbium [niobium], vanadium, and titanium contents shall not exceed 0,15 %.								
44th									
43rd	^k Columbium [niobium], vanadium, or combinations thereof may be used at the discretion of the manufacturer. (Note: this is near meaningless)								

Annex A: Supplemental Comparison Tables

Table 5 — Chemical composition for PSL 2 pipe with t ≤ 25,0 mm (0.984 in)												
Edition	Steel grade (Steel name)	Mass fraction, based upon heat and product analyses % maximum									Carbon equivalent ^a % maximum	
		C ^b	Si	Mn ^b	P	S	V	Nb	Ti	Other	CE _{IIW}	CE _{Pcm}
		Seamless pipe										
44th	L245R or BR	0,24	0,4	1,20	0,025	0,015	c	c	0,04	e	0,43	0,25
43rd	B	No Chg		No Chg	No Chg	No Chg	c,d,e	c,d,e	No Chg	c,d,e	No chg excpt footnote	
44th	L290R or X42R	0,24	0,4	1,20	0,025	0,015	0,06	0,05	0,04	e	0,43	0,25
43rd	X42	No Chg		1,30	No Chg	No Chg	c,d	c,d	0,04	c,d	No chg excpt footnote	
44th	L245N or BN	0,24	0,4	1,20	0,025	0,015	c	c	0,04	e	0,43	0,25
43rd	B	No Chg		No Chg	No Chg	No Chg	c,d,e	c,d,e	No Chg	c,d,e	No chg excpt footnote	
44th	L290N or X42N	0,24	0,4	1,20	0,025	0,015	0,06	0,05	0,04	e	0,43	0,25
43rd	X42	No Chg		1,30	No Chg	No Chg	c,d	c,d	No Chg	c,d	No chg excpt footnote	
44th	L320N or X46N	0,24	0,4	1,40	0,025	0,015	0,07	0,05	0,04	d,e	0,43	0,25
43rd	X46	No Chg		No Chg	No Chg	No Chg	c,d	c,d	No Chg	c,d	No chg excpt footnote	
44th	L360N or X52N	0,24	0,45	1,40	0,025	0,015	0,10	0,05	0,04	d,e	0,43	0,25
43rd	X52	No Chg		No Chg	No Chg	No Chg	c,d	c,d	No Chg	c,d	No chg excpt footnote	
44th	L390N or X56N	0,24	0,45	1,40	0,025	0,015	0,10 ^f	0,05	0,04	d,e	0,43	0,25
43rd	X56	No Chg		No Chg	No Chg	No Chg	c,d	c,d	No Chg	c,d	No chg excpt footnote	
44th	L415N or X60N	0,24 ^f	0,45 ^f	1,40	0,025	0,015	0,10 ^f	0,05 ^f	0,04 ^f	g,h	as agreed	
43rd	X60 ^f	No Chg		No Chg	No Chg	No Chg	c,d	c,d	0,04	c,d	0,43	0,25
44th	L245Q or BQ	0,18	0,45	1,40	0,025	0,015	0,05	0,05	0,04	e	0,43	0,25
43rd	B	0,24		1,20	No Chg	No Chg	c,d,e	c,d,e	No Chg	c,d,e	No chg excpt footnote	
44th	L290Q or X42Q	0,18	0,45	1,40	0,025	0,015	0,05	0,05	0,04	e	0,43	0,25
43rd	X42	0,24		1,30	No Chg	No Chg	c,d	c,d	No Chg	c,d	No chg excpt footnote	
44th	L320Q or X46Q	0,18	0,45	1,40	0,025	0,015	0,05	0,05	0,04	e	0,43	0,25
43rd	X46	0,24		No Chg	No Chg	No Chg	c,d	c,d	No Chg	c,d	No chg excpt footnote	
44th	L360Q or X52Q	0,18	0,45	1,50	0,025	0,015	0,05	0,05	0,04	e	0,43	0,25
43rd	X52	0,24		1,40	No Chg	No Chg	c,d	c,d	No Chg	c,d	No chg excpt footnote	
44th	L390Q or X56Q	0,18	0,45	1,50	0,025	0,015	0,07	0,05	0,04	d,e	0,43	0,25
43rd	X56	0,24		1,40	No Chg	No Chg	c,d	c,d	No Chg	c,d	No chg excpt footnote	
44th	L415Q or X60Q	0,18 ^f	0,45 ^f	1,70 ^f	0,025	0,015	g	g	g	h	0,43	0,25
43rd	X60 ^f	0,24		1,40	No Chg	No Chg	c,d	c,d	0,04	c,d	No chg excpt footnote	
44th	L450Q or X65Q	0,18 ^f	0,45 ^f	1,70 ^f	0,025	0,015	g	g	g	h	0,43	0,25
43rd	X65 ^f	0,24		1,40	No Chg	No Chg	c,d	c,d	0,06	c,d	No chg excpt footnote	
44th	L485Q or X70Q	0,18 ^f	0,45 ^f	1,80 ^f	0,025	0,015	g	g	g	h	0,43	0,25
43rd	X70 ^f	0,24		1,40	No Chg	No Chg	c,d	c,d	0,06	c,d	No chg excpt footnote	
44th	L555Q or X80Q	0,18 ^f	0,45 ^f	1,90 ^f	0,025	0,015	g	g	g	i,j	as agreed	
43rd	X80 ^f	0,24		1,40	No Chg	No Chg	c,d	c,d	0,06	c,d	No chg	
		Welded pipe										
44th	L245M or BM	0,22	0,45	1,20	0,025	0,015	0,05	0,05	0,04	e	0,43	0,25
43rd	B	No Chg		No Chg	No Chg	No Chg	c,d,e	c,d,e	No Chg	c,d,e	close	close
44th	L290M or X42Q	0,22	0,45	1,30	0,025	0,015	0,05	0,05	0,04	e	0,43	0,25
43rd	X42	No Chg		No Chg	No Chg	No Chg	c,d	c,d	No Chg	c,d	close	close
44th	L320M or X46M	0,22	0,45	1,30	0,025	0,015	0,05	0,05	0,04	e	0,43	0,25
43rd	X46	No Chg		1,40	No Chg	No Chg	No Chg	No Chg	No Chg	c,d	close	close
44th	L360M or X52M	0,22	0,45	1,40	0,025	0,015	d	d	d	e	0,43	0,25
43rd	X52	No Chg		No Chg	No Chg	No Chg	b,c,d	b,c,d	0,04	c,d	close	close
44th	L390M or X56M	0,22	0,45	1,40	0,025	0,015	d	d	d	e	0,43	0,25
43rd	X56	No Chg		1,40	No Chg	No Chg	c,d	c,d	0,04	c,d	close	close
44th	L415M or X60M	0,12 ^f	0,45 ^f	1,60 ^f	0,025	0,015	g	g	g	h	0,43	0,25
43rd	X60 ^f	0,22		1,40	No Chg	No Chg	c,d	c,d	0,04	c,d	close	close
44th	L450M or X65M	0,12 ^f	0,45 ^f	1,60 ^f	0,025	0,015	g	g	g	h	0,43	0,25
43rd	X65 ^f	0,22		1,45	No Chg	No Chg	c,d	c,d	0,06	c,d	close	close
44th	L485M or X70M	0,12 ^f	0,45 ^f	1,70 ^f	0,025	0,015	g	g	g	h	0,43	0,25
43rd	X70 ^f	0,22		1,65	No Chg	No Chg	c,d	c,d	0,06	c,d	close	close
44th	L555M or X80M	0,12 ^f	0,45 ^f	1,85 ^f	0,025	0,015	g	g	g	i	0,43 ^f	0,25
43rd	X80 ^f	0,22		No Chg	No Chg	No Chg	c,d	c,d	0,06	c,d	as agreed	
44th	L625M or X90M	0,10	0,55 ^f	2,10 ^f	0,025	0,010	g	g	g	i	—	0,25
43rd	X90 ^f											
44th	L690M or X100M	0,10	0,55 ^f	2,10 ^f	0,025	0,010	g	g	g	i,j	—	0,25
43rd	X100 ^f											
44th	L830M or X120M	0,10	0,55 ^f	2,10 ^f	0,025	0,010	g	g	g	i,j	—	0,25
43rd	X120 ^f											
44th	^a Based upon product analysis. For seamless pipe with t > 20,0 mm (0.787 in), the carbon equivalent limits shall be as agreed. The CE _{IIW} limits apply if the carbon mass fraction is greater than 0.12 % and the CE _{Pcm} limits apply if the carbon mass fraction is less than or equal to 0.12 %.											
43rd	see 6.1.3.2 The carbon equivalent shall not exceed the following: a. For Grade X80 pipe, for all grades of seamless pipe having a specified wall thickness greater than 0.800 in. (20.3 mm), and for pipe designated by the purchaser as high carbon equivalent pipe, the value agreed upon between the purchaser and the manufacturer. b. For pipe not covered in item a above, a CE(Pcm) of 0.25% or a CE(IIW) of 0.43%, whichever is applicable.											
44th	^f For each reduction of 0.01 % below the specified maximum for carbon, an increase of 0.05 % above the specified maximum for manganese is permissible, up to a maximum of 1.65% for grades W L245 or B, but ≤ L360 or X52; up to a maximum of 1.75% for grades > L360 or X52, but < L485 or X70; up to a maximum of 2.00 % for grades ≥ L485 or X70, but ≤ L555 or X80; and up to a maximum of 2.20% for grades > L555 or X80.											
43rd	^a For each reduction of 0.01% below the specified maximum carbon content, an increase of 0.05% above the specified maximum manganese content is permissible, up to a maximum of 1.50% for Grades X42 through X52, up to a maximum of 1.65% for grades higher than X52 but less than X70, and up to 2.00% for Grades X70 and higher.											
44th	^c Unless otherwise agreed, the sum of the niobium and vanadium contents shall be ≤ 0.06 %.											
43rd	^e The sum of the columbium [niobium], and vanadium contents shall not exceed 0.06% except that, by agreement between the purchaser and the manufacturer, an alternative maximum may be established.											
44th	^d The sum of the niobium, vanadium and titanium concentrations shall be ≤ 0.15 %.											
43rd	^d The sum of the columbium [niobium], vanadium, and titanium contents shall not exceed 0.15%.											
44th	^a Unless otherwise agreed, 0.50 % maximum for copper, 0.30 % maximum for nickel, 0.30 % maximum for chromium and 0.15 % maximum for molybdenum.											
43rd												
44th	^f Unless otherwise agreed. (Note: does not include S and P, nor does it allow violation of footnote d or the other footnotes)											
43rd	^f Other chemical compositions may be furnished by agreement between purchaser and manufacturer, providing that the limits of footnote d, and the tabular limits for phosphorus and sulfur are met.											
44th	^g Unless otherwise agreed, the sum of the niobium, vanadium and titanium concentrations shall be ≤ 0.15 %.											
43rd	^d The sum of the columbium [niobium], vanadium, and titanium contents shall not exceed 0.15%.											
44th	^h Unless otherwise agreed, 0.50 % maximum for copper, 0.50 % maximum for nickel, 0.50 % maximum for chromium and 0.50 %											
43rd												
44th	ⁱ Unless otherwise agreed, 0.50 % maximum for copper, 1.00 % maximum for nickel, 0.50 % maximum for chromium and 0.50 % maximum for molybdenum.											
43rd												
44th	^j 0.004 % maximum for boron.											
43rd												
44th												
43rd	^c Columbium [niobium], vanadium, or combinations thereof may be used at the discretion of the manufacturer. (Note: this is near meaningless)											

Annex A: Supplemental Comparison Tables

Table 6 — Requirements for the results of tensile tests for PSL 1 pipe					
Edition	Pipe grade	Pipe body of Seamless and welded pipes			Weld seam of EW, SAW and COW
		Yield strength ^a $R_{t0.5}$ Mpa (psi) minimum	Tensile strength ^a R_m Mpa (psi) minimum	Elongation A_f % minimum	Tensile strength ^b R_m Mpa (psi) minimum
44th	L175 or A25	175 (25 400)	310 (45 000)	c	310 (45 000)
43rd	A25	172 (25,000)	310 (45,000)	a	310 (45,000)
44th	L175P or A25P	175 (25 400)	310 (45 000)	c	310 (45 000)
43rd	A25	172 (25,000)	310 (45,000)	a	310 (45,000)
44th	L210 or A	210 (30 500)	335 (48 600)	c	335 (48 600)
43rd	A	207 (30,000)	331 (48,000)	a	331 (48,000)
44th	L245R or BR L245 or B	245 (35 500)	415 (60 200)	c	415 (60 200)
43rd	B	241 (35,000)	414 (60,000)	a	414 (60,000)
44th	L290R or X42R L290 or X42	290 (42 100)	415 (60 200)	c	415 (60 200)
43rd	X42	290 (42,000)	414 (60,000)	a	414 (60,000)
44th	L320 or X46	320 (46 400)	435 (63 100)	c	435 (63 100)
43rd	X46	317 (46,000)	434 (63,000)	a	434 (63,000)
44th	L360 or X52	360 (52 200)	460 (66 700)	c	460 (66 700)
43rd	X52	359 (52,000)	455 (66,000)	a	455 (66,000)
44th	L390 or X56	390 (56 600)	490 (71 100)	c	490 (71 100)
43rd	X56	386 (56,000)	490 (71,000)	a	490 (71,000)
44th	L415 or X60	415 (60 200)	520 (75 400)	c	520 (75 400)
43rd	X60 ^f	414 (60,000)	517 (75,000)	a	517 (75,000)
44th	L450 or X65	450 (65 300)	535 (77 600)	c	535 (77 600)
43rd	X65 ^f	448 (65,000)	531 (77,000)	a	531 (77,000)
44th	L485 or X70	485 (70 300)	570 (82 700)	c	570 (82 700)
43rd	X70 ^f	483 (70,000)	565 (82,000)	a	565 (82,000)
44th	^a For intermediate grades, the difference between the specified minimum tensile strength and the specified minimum yield strength for the pipe body shall be as given in the table for the next higher grade.				
43rd					
44th	^b For intermediate grades, the specified minimum tensile strength for the weld seam shall be the same value as was determined for the pipe body using footnote a).				
43rd					
44th	^c The specified minimum elongation, A_f , expressed in percent and rounded to the nearest percent, shall be as determined using the following equation: $A_f = \dots$ where C is 1 940 for calculations using SI units and 625 000 for calculations using USC units; - - -				
43rd	^a The minimum elongation in 2 in. (50.8 mm) shall be that determined by the following equation: $e = \dots$ where C is 1 944 for calculations using SI units and 625 000 for calculations using USC units; - - -				

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Table 7 — Requirements for the results of tensile tests for PSL 2 pipe								
Edition	Pipe grade	Pipe body of Seamless and welded pipes						Weld seam of EW, SAW and COW
		Yield strength ^a		Tensile strength ^a		Ratio ^{a, b, c}	Elongation	Tensile strength ^b
		$R_{10.5}$ ^b Mpa (psi) minimum	maximum	R_m Mpa (psi) minimum	maximum	R_m Mpa (psi) minimum	A_f % minimum	R_m Mpa (psi) minimum
44th	L245R or BR L245N or BN L245Q or BQ L245M or BM	245 (35 500)	450 ^e (65 300) ^e	415 (60 200)	760 (110 200)	0,93	f	415 (60 200)
43rd	B	241 (35,000)	448 (65,000)	414 (60,000)	758 110,000		a	414 (60,000)
44th	L290R or X42R L290N or X42N L290Q or X42Q L290M or X42M	290 (42 100)	495 (71 800)	415 (60 200)	760 (110 200)	0,93	f	415 (60 200)
43rd	X42	290 (42,000)	496 (72,000)	414 (60,000)	758 110,000		a	414 (60,000)
44th	L320N or X46N L320Q or X46Q L320M or X46M	320 (46 400)	525 (76 100)	435 (63 100)	760 (110 200)	0,93	f	435 (63 100)
43rd	X46	317 (46,000)	524 (76,000)	434 (63,000)	758 110,000		a	434 (63,000)
44th	L360N or X52N L360Q or X52Q L360M or X52M	360 (52 200)	530 (76 900)	460 (66 700)	760 (110 200)	0,93	f	460 (66 700)
43rd	X52	359 (52,000)	531 (77,000)	455 (66,000)	758 110,000		a	455 (66,000)
44th	L390N or X56N L390Q or X56Q L390M or X56M	390 (56 600)	545 (79 000)	490 (71 100)	760 (110 200)	0,93	f	490 (71 100)
43rd	X56	386 (56,000)	544 (79,000)	490 (71,000)	758 110,000		a	490 (71,000)
44th	L415N or X60N L415Q or X60Q L415M or X60M	415 (60 200)	565 (81 900)	520 (75 400)	760 (110 200)	0,93	f	520 (75 400)
43rd	X60 ^f	414 (60,000)	565 (82,000)	517 (75,000)	758 110,000		a	517 (75,000)
44th	L450Q or X65Q L450M or X65M	450 (65 300)	600 (87 000)	535 (77 600)	760 (110 200)	0,93	f	535 (77 600)
43rd	X65 ^f	448 (65,000)	600 (87,000)	531 (77,000)	758 110,000		a	531 (77,000)
44th	L485Q or X70Q L485M or X70M	485 (70 300)	635 (92 100)	570 (82 700)	760 (110 200)	0,93	f	570 (82 700)
43rd	X70 ^f	483 (70,000)	621 (90,000)	565 (82,000)	758 110,000		a	565 (82,000)
44th	L555Q or X80Q L555M or X80M	555 (80 500)	705 (102 300)	625 (90 600)	825 (119 700)	0,93	f	625 (90 600)
43rd	X80 ^f	552 (80,000)	690 (100,000)	621 (90,000)	827 (120,000)		a	621 (90,000)
44th	L625M or X90M	625 (90 600)	775 (112 400)	695 (100 800)	915 (132 700)	0,95	f	695 (100 800)
43rd								
44th	L690M or X100M	690 (100 100)	840 (121 800)	760 (110 200)	990 (143 600)	0,97 ^g	f	760 (110 200)
43rd								
44th	L830M or X120M	830 (120 400)	1 050 (152 300)	915 (132 700)	1 145 (166 100)	0,99 ^g	f	915 (132 700)
43rd								
44th	^a For intermediate grades, the difference between the specified maximum yield strength and the specified minimum yield strength shall be as given in the table for the next higher grade, and the difference between the specified minimum tensile strength and the specified minimum yield strength shall be as given in the table for the next higher grade. For intermediate grades lower than Grade L555 or X80, the tensile strength shall be <= 760 MPa (110 200 psi). For intermediate grades higher than Grade L555 or X80, the maximum permissible tensile strength shall be obtained by interpolation. For SI units, the calculated value shall be rounded to the nearest 5 MPa. For USC units, the calculated value shall be rounded to the nearest 100 psi.							
43rd	^b Maximum yield strength for an intermediate grade shall be the maximum for the next higher listed grade.							
43rd	^c All intermediate grades have a maximum ultimate tensile strength of 110,000 psi (758 MPa). ^r							
44th	^d For grades > L625 or X90, $R_{p0.2}$ applies.							
43rd								
44th	^e This limit applies for pipe with D > 323,9 mm (12,750 in).							
43rd								
44th	^f For intermediate grades, the specified minimum tensile strength for the weld seam shall be the same value as was determined for the pipe body using footnote a).							
43rd								
44th	^g For pipe with D < 219,1 mm (8,625 in), the maximum yield strength shall be <= 495 MPa (71 800 psi).							
43rd								
44th	^h The specified minimum elongation, A_f , expressed in percent and rounded to the nearest percent, shall be as determined using the following equation: $A_f = \dots$ where C is 1 940 for calculations using SI units and 625 000 for calculations using USC units; - - -							
43rd	^a The minimum elongation in 2 in. (50,8 mm) shall be that determined by the following equation: $e = \dots$ where C is 1 944 for calculations using SI units and 625 000 for calculations using USC units; - - -							
44th	^g Lower $R_{10.5} / R_m$ ratio values may be specified by agreement for L690 or X100 and L830 or X120 pipe.							
43rd								

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Table 8 — CVN absorbed energy requirements for pipe body of PSL 2 pipe								
	Specified outside diameter D mm (in)	Full-size CVN absorbed energy, minimum K _v J (ft·lbf)						
		Grade						
		<= L415 or X60	> L415 or X60 <= L450 or X65	> L450 or X65 <= L485 or X70	> L485 or X70 <= L555 or X80	> L555 or X80 <= L625 or X90	> L625 or X90 <= L690 or X100	> L690 or X100 <= L830 or X120
44th	<= 508 (20.000)	27 (20)	27 (20)	27 (20)	40 (30)	40 (30)	40 (30)	40 (30)
43rd		27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)
44th	> 508 (20.000) to <= 762 (30.000)	27 (20)	27 (20)	27 (20)	40 (30)	40 (30)	40 (30)	40 (30)
43rd		27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)
44th	> 762 (30.000) to <= 914 (36.000)	40 (30)	40 (30)	40 (30)	40 (30)	40 (30)	54 (40)	54 (40)
43rd		27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)
44th	> 914 (36.000) to <= 1 219 (48.000)	40 (30)	40 (30)	40 (30)	40 (30)	40 (30)	54 (40)	68 (50)
43rd		27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)
44th	> 1 219 (48.000) to <= 1 422 (56.000)	40 (30)	54 (40)	54 (40)	54 (40)	54 (40)	68 (50)	81 (60)
43rd		27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)
44th	> 1 422 (56.000) to <= 2 134 (84.000)	40 (30)	54 (40)	68 (50)	68 (50)	81 (60)	95 (70)	108 (80)
43rd		27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)	27 (20)
44th	All 44th Ed. Full-size test values above are based on a CVN notch perpendicular to the pipe surface (see 10.2.3.3) and transverse to the pipe or weld axis whichever is applicable (see Table 22 footnotes).							
43rd	All 43th Ed. values above are based on a CVN specimen whose notch would be perpendicular to the pipe surface and transverse to the pipe axis only . All 43rd Ed longitudnal specimens (see 6.2.5.2) have been eliminated.							

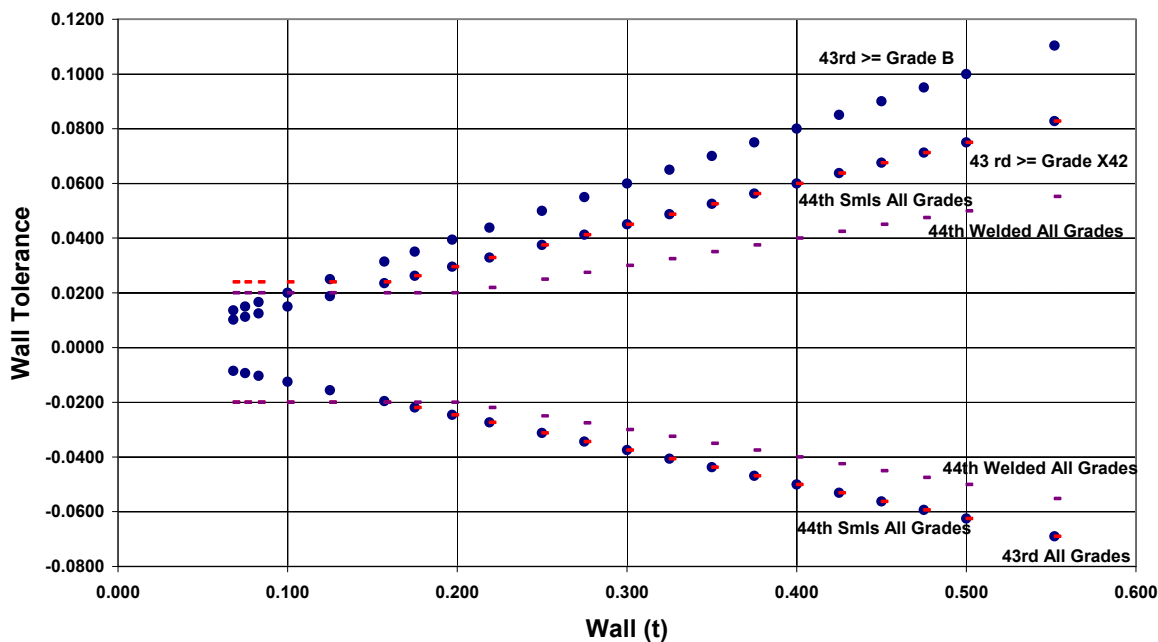
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44th Ed.	Table 10 — Tolerances for diameter and out-of-roundness						
	Specified outside diameter D mm (in)	Diameter tolerances mm (in)				Out-of-roundness tolerances mm (in)	
		Pipe except the end ^a		Pipe end ^{a,b,c}		Pipe except the end ^a	Pipe end ^{a,b,c}
		SMLS pipe	Welded pipe	SMLS pipe	Welded pipe		
	< 60,3 (2.375) to >= 60,3 (2.375)	– 0,8 (0.031) to + 0,4 (0.016)		– 0,4 (0.016) to + 1,6 (0.063)		d	
	<= 168,3 (6.625)	± 0,007 5 D					
> 168,3 (6.625) to <= 610 (24.000)	± 0,007 5 D	± 0,007 5 D, but maximum of ± 3,2 (0.125)	± 0,005 D, but maximum of ± 1,6 (0.063)		0,020 D	0,015 D	
> 610 (24.000) to <= 1 422 (56.000)	± 0,01 D	± 0,005 D, but maximum of ± 4,0 (0.160)	± 2,0 (0.079)	± 1,6 (0.063)	0,015 D, but maximum of 15 (0.6), for D/t <= 75	0,01 D, but maximum of 13 (0.5), for D/t <= 75	
> 1 422 (56.000)	as agreed						
^a The pipe end includes a length of 100 mm (4.0 in) at each of the pipe extremities.							
^b For SMLS pipe, the tolerances apply for t <= 25,0 mm (0.984 in), and the tolerances for thicker pipe shall be as agreed.							
^c For pipe with D >= 219,1 mm (8.625 in), the diameter tolerance and the out-of-roundness tolerance may be determined using the calculated inside diameter (the specified outside diameter minus two times the specified wall thickness) or measured inside diameter rather than the specified outside diameter. (See 10.2.8.3.)							
^d Included in the diameter tolerance.							
43th Ed. see Tables 7 and 8	Table 10 — Tolerances for diameter and out-of-roundness						
	Specified outside diameter D mm (in)	Diameter tolerances ^c mm (in)				Out-of-roundness tolerances ^b mm (in)	
		Pipe except the end ^a		Pipe end ^{b,c}		Pipe except the end ^a	Pipe end ^{a,c}
		SMLS pipe	Welded pipe	SMLS pipe	Welded pipe		
	< 60,3 (2.375) to >= 60,3 (2.375)	– 0,8 (0.031) to + 0,4,1 (0.016)		– 0,4 (0.016) to + 1,6 (0.063)		d	
	<= 114,3 (4.500)	± 0,01 D continuous welded					
	> 60,3 (2.375) to <= 168,3 (6.625)	± 0,007 5 D		– 0,4 (0.016) to + 1,6 (0.063)		d	d
	> 168,3 (6.625) to <= 273,05 (10.750)	± 0,007 5 D	± 0,007 5 D, but no maximum of ± 3,2 (0.125)	– 0,4 (0.016) to + 1,6 (0.063) no ± 0,005 D, meets maximum of ± 1,6 (0.063)			
	> 273,05 (10.750) to <= 508 (20.000)	± 0,007 5 D	± 0,007 5 D, but no maximum of ± 3,2 (0.125)	– 0,8 (0.031) to + 2,4 (0.094) no ± 0,005 D, no maximum of + 1,6 (0.063)		0,02 D	0,02 D but maximum of 12,7 (0.500) for D/t <= 75 no 0,015 D
	> 508 (20.000) to <= 610 (24.000)	± 0,01 D	+0,007 5 D – 0.0025 D but no maximum of ± 3,2 (0.125)	– 0,8 (0.031) to + 2,4 (0.094) no ± 0,005 D, no maximum of + 1,6 (0.063)			
	> 610 (24.000) to <= 914,4 (36.000)	± 0,01 D	+0,007 5 D – 0.0025 D but no maximum of ± 4,0 (0.160)	– 0,8 (0.031) to + 2,4 (0.094) no max of + 2,0 (0.079)	– 0,8 (0.031) to + 2,4 (0.094) no max of + 1,6 (0.063)	0,02 D, but no maximum of 15 (0.600), for D/t <= 75 no by agreement for D/t > 75	0,02 D, but maximum of 12,7 (0.500), for D/t <= 75 no by agreement for D/t > 75
	> 914,4 (36.000) to <= 1 066,8 (42.000)	± 0,01 D	+ 6,4 – 3,2 (+0.250, – 0.125) no ± 0,005 D, no maximum of + 4,0 (0.160)	– 0,8 (0.031) to + 2,4 (0.094) no max of + 2,0 (0.079)	– 0,8 (0.031) to + 2,4 (0.094) no max of + 1,6 (0.063)	0,02 D, but no maximum of 15 (0.600), for D/t <= 75 no by agreement for D/t > 75	0,02 D, but maximum of 12,7 (0.500), for D/t <= 75 no by agreement for D/t > 75
	> 1 066,8 (42.000) to <= 1 422 (56.000)	± 0,01 D	+ 6,4 – 3,2 (+0.250, – 0.125) no ± 0,005 D, no maximum of + 4,0 (0.160)	– 0,8 (0.031) to + 2,4 (0.094) no max of + 2,0 (0.079)	– 0,8 (0.031) to + 2,4 (0.094) no max of + 1,6 (0.063)	0,02 D, but no maximum of 15 (0.600), for D/t <= 75 no by agreement for D/t > 75	0,02 D, but maximum of 15,9 (0.625), for D/t <= 75 no by agreement for D/t > 75
	> 1 422 (56.000)	± 0,01 D no as agreed	+ 6,4 – 3,2 (+0.250, – 0.125) no as agreed	– 0,8 (0.031) to + 2,4 (0.094) no max of + 2,0 (0.079) no as agreed	– 0,8 (0.031) to + 2,4 (0.094) no max of + 1,6 (0.063) no as agreed	0,02 D, but no maximum of 15 (0.600), for D/t <= 75 no by agreement for D/t > 75	0,02 D, but maximum of 15,9 (0.625), for D/t <= 75 no by agreement for D/t > 75
	^a In the case of pipe hydrostatically tested to pressures in excess of standard test pressures, other tolerances may be agreed upon between the manufacturer and the purchaser.						
^b Out-of-roundness tolerances apply to maximum and minimum diameters as measured with a bar gage, caliper, or device measuring actual maximum and minimum diameters.							
^c The average diameter (as measured with a diameter tape) of one end of pipe shall not differ by more than 3/32 in. (2.4 mm) from that of the other end.							
^d Included in the diameter tolerance.							

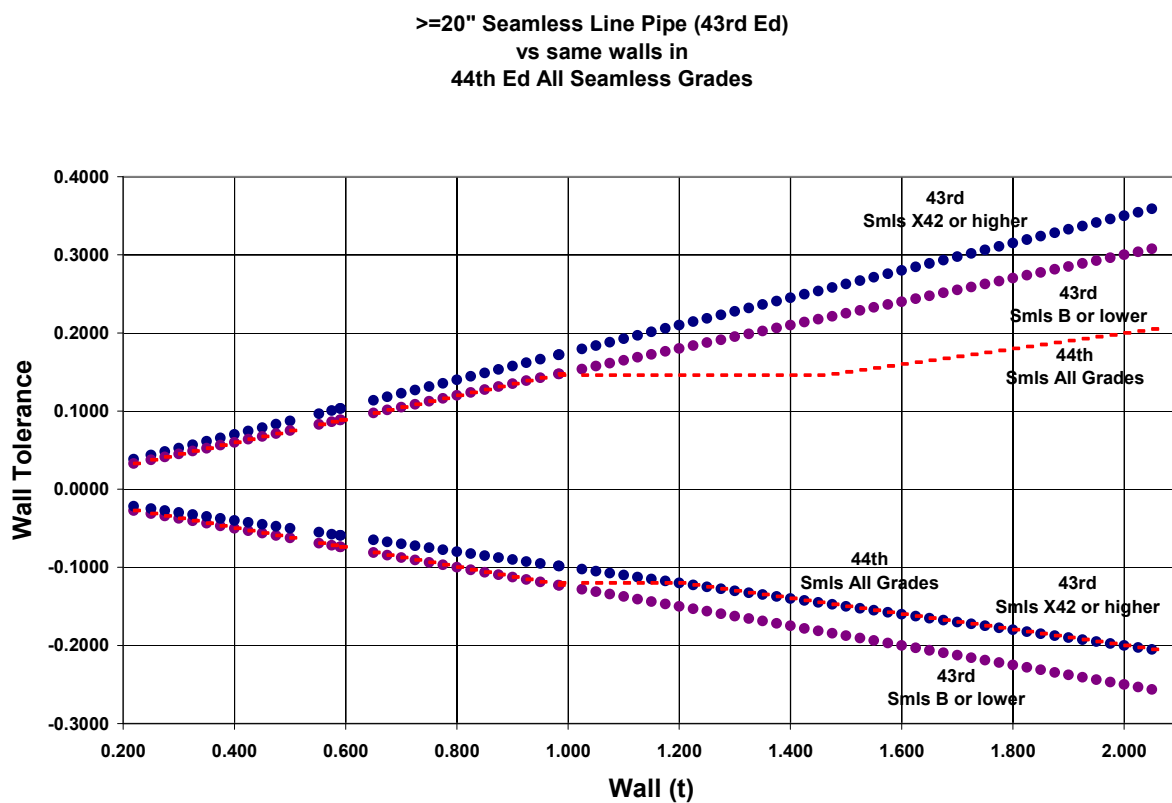
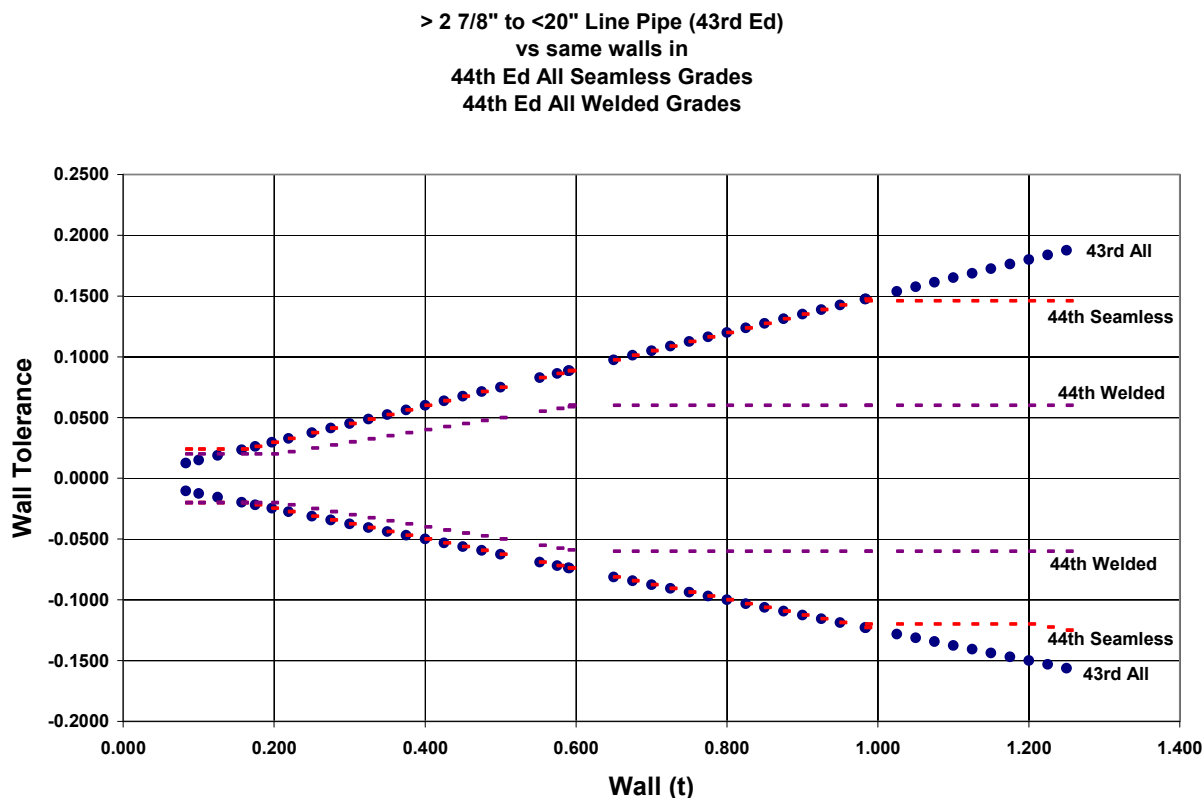
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44th Ed.	Table 11 — Tolerances for wall thickness	
	Wall thickness t mm (in)	Tolerances ^a mm (in)
	SMLS pipe ^b	
	≤ 4,0 (0.157)	+ 0,6 (0.024) − 0,5 (0.020)
	> 4,0 (0.157) to < 25,0 (0.984)	+ 0,150 t − 0,125 t
	≥ 25,0 (0.984)	+ 3,7 (0.146) or + 0,1 t, whichever is the greater − 3,0 (0.120) or − 0,1 t, whichever is the greater
	Welded pipe ^{c,d}	
	≤ 5,0 (0.197)	+/- 0,5 (0.020)
	> 5,0 (0.197) to < 15,0 (0.591)	+/- 0,1 t
	≥ 15,0 (0.591)	± 1,5 (0.060)
	^a If the purchase order specifies a minus tolerance for wall thickness smaller than the applicable value given in this table, the plus tolerance for wall thickness shall be increased by an amount sufficient to maintain the applicable tolerance range. ^b For pipe with D ≥ 355,6 mm (14.000 in) and t ≥ 25,0 mm (0.984 in), the wall-thickness tolerance locally may exceed the plus tolerance for wall thickness by an additional 0,05 t, provided that the plus tolerance for mass (see 9.14) is not exceeded. ^c The plus tolerance for wall thickness does not apply to the weld area. ^d See 9.13.2 for additional restrictions.	

≤ 2 7/8 Welded & Smls Line Pipe (43rd Ed)
vs same walls in
44th Ed Seamless All Grades
44th Ed Welded All Grades

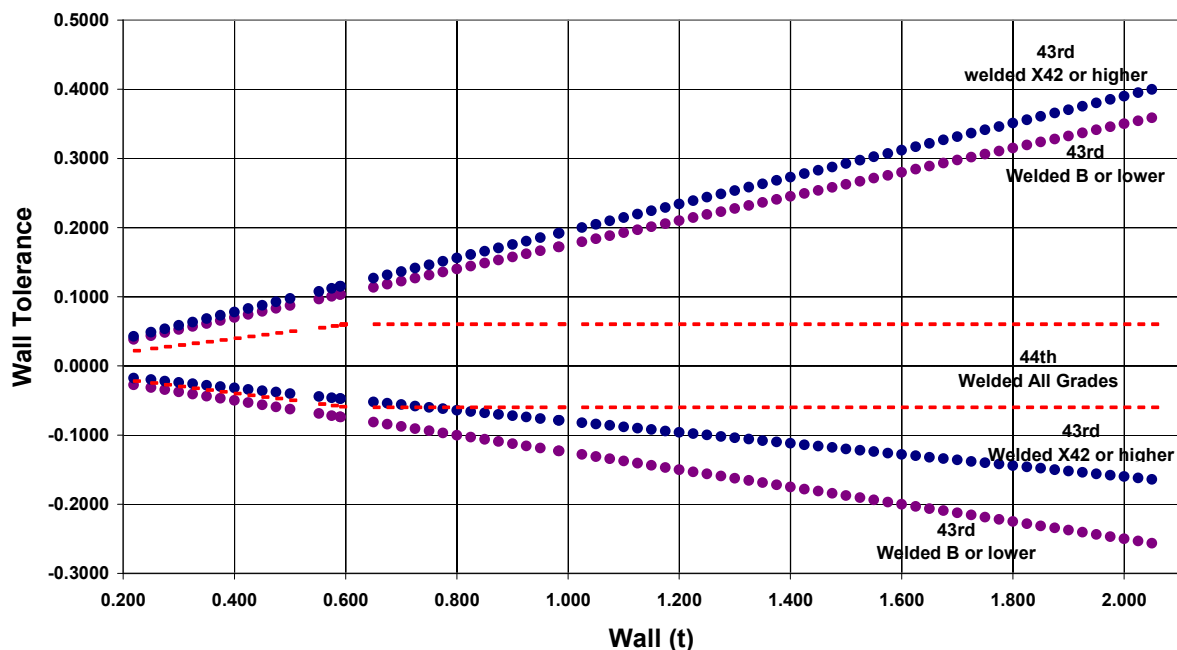


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>=20" Welded Line Pipe (43rd Ed)
vs same walls in
44th Ed All Welded Grades



44th Ed	Table 13 — Maximum angle of internal taper for SMLS pipe	
	Specified wall thickness t mm (in)	Maximum angle of taper degrees
	< 10,5 (0.413)	7,0
	>=10,5 (0.413) to < 14,0 (0.551)	9,5
	>=14,0 (0.551) to < 17,0 (0.669)	11,0
	>=17,0 (0.669)	14,0
43th Ed	Table 13 — Maximum angle of internal taper for SMLS pipe	
	Specified wall thickness t mm (in)	Maximum angle of taper degrees
	< 10,6 (0.418)	7,0
	>=10,6 (0.418) to < 14,1 (0.555)	9,5
	>=14,1 (0.556) to < 16,9 (0.666)	11,0
	>=16,9 (0.666)	14,0

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Table 14 — Maximum permissible radial offset for SAW and COW pipes		
	Specified wall thickness t mm (in)	Maximum permissible radial offset ^a mm (in)
44th	≤ 12,7 (0.500)	1,5 (0.060)
43rd	≤ 12,7 (0.500)	1,6 (0.0625)
44th	> 12,7 (0.500) to ≤ 15,0 (0.590)	1,5 (0.060)
43rd	> 12,7 (0.500) to ≤ 15,0 (0.590)	1,87 (0.074)
44th	> 15,0 (0.590) to ≤ 25,0 (0.984)	0,1 t = [1,5 (0.059) to 2,5 (0.098)]
43rd	> 15,0 (0.590) to ≤ 25,0 (0.984)	0,125 t = [1,88 (0.074) to 3,1 (0.123)]
44th	> 25,0 (0.984)	2,5 (0.098)
43rd	> 25,0 (0.984)	3,1 (0.123) to 3,18 (0.125)
^a These limits apply also to strip/plate end welds.		

Table 15 — Maximum permissible depth of groove for EW and LW pipes		
	Specified wall thickness t mm (in)	Maximum permissible depth of groove ^a mm (in)
44th	≤ 4,0 (0.156)	0,10 t
43rd	≤ 3,8 (0.150)	0,10 t
44th	> 4,0 (0.156) to ≤ 8,0 (0.312)	0,40 (0.016)
43rd	> 3,8 (0.150) to ≤ 7,6 (0.301)	0,40 (0.015)
44th	> 8,0 (0.312)	0,05 t
43rd	> 7,6 (0.301)	0,05 t
44th	^a The depth of groove is the difference between the wall thickness approximately 25 mm (1 in) from the weld line and the minimum wall thickness at the trim.	
43rd	^a The depth of groove is the difference between the wall thickness approximately 25,4 mm (1 in) from the weld line and the minimum wall thickness at the trim.	

Table 16 — Maximum permissible weld bead height for SAW and COW pipes (except at pipe ends)			
	Specified wall thickness t mm (in)	Weld bead height ^a mm (in) maximum	
		Internal bead	External bead
44th	≤ 13,0 (0.512)	3,5 (0.138)	3,5 (0.138)
43rd SAW	≤ 12,7 (0.500)	3,2 (0.125)	3,2 (0.125)
44th	> 13,0 (0.500)	3,5 (0.138)	4,5 (0.177)
43rd SAW	> 12,7 (0.500)	3,2 (0.125)	4,8 (0.188 or 3/16)
44th	^a At the option of the manufacturer, weld beads higher than permitted may be ground to acceptable heights.		
43rd SAW	^a At the option of the manufacturer, weld beads higher than permitted may be ground to acceptable heights.		

Annex A: Supplemental Comparison Tables

Table 17 — Inspection frequency for PSL 1 pipe			
	Type of inspection	Type of pipe	Frequency of inspection
43rd & 44th	Heat analysis	All pipe	One analysis per heat of steel
43rd & 44th	Product analysis	SMLS, CW, LFW, HFW, LW, SAWL, SAWH, COWL or COWH	Two analyses per heat of steel (taken from separate product items)
44th added Grade L175 and test unit restriction	Tensile testing of the pipe body of welded pipe with D ≤ 48,3 mm (1.900 in), in Grade L175 or A25	CW, LFW, HFW,	Once per test unit^e of not more than 25 tonnes (28 tons) of pipe
44th added Grades L175P and A25P and test unit restriction	Tensile testing of the pipe body of welded pipe with D ≤ 48,3 mm (1.900 in), in Grade L175P or A25P	CW	
44th added Grade L175 and test unit restriction	Tensile testing of the pipe body of welded pipe with D > 48,3 mm (1.900 in), in Grade L175 or A25	CW, LFW, HFW,	Once per test unit of not more than 50 tonnes (55 tons) of pipe
44th added Grades L175P and A25P and test unit restriction	Tensile testing of the pipe body of welded pipe with D > 48,3 mm (1.900 in), in Grade L175P or A25P	CW	
44rd no longer restricts the size of a heat to 400 or 200 lengths and does away with the ≤5 9/16, 8 5/8, and 12 3/4 pipe size criteria	Tensile testing of the pipe body of seamless pipe	SMLS	Once per test unit of pipe with the same cold-expansion ratio ^a
44th added Grade L175 and no longer restricts the size of a heat to 400 lengths and does away with the ≤5 9/16 pipe size criteria	Tensile testing of the pipe body of welded pipe in grades higher than Grade L175 or A25	LFW, HFW, LW, SAWL, SAWH, COWL or COWH	
44th no longer restricts the size of a heat to 200 or 100 lengths and does away with the 12 3/4 pipe size criteria	Tensile testing of the longitudinal or helical seam weld of welded pipe with D ≥ 219,1 mm (8.625 in)	LFW, HFW, LW, SAWL, SAWH, COWL or COWH	Once per test unit of pipe with the same cold-expansion ratio ^{a,b,c}
44th changed the 200 length lot maximum to 100 lengths and did away with the 12 3/4 pipe size criteria	Tensile testing of the strip/plate end weld of welded pipe with D ≥ 219,1 mm (8.625 in)	SAWH or COWH	Once per test unit of not more than 100 lengths of pipe with the same cold-expansion ratio ^{a,c,d}
44th added Grades L175, L175P and A25P, and a test unit restriction 43rd had a frequency: 22,7 tonnes (25 tons)	Bend testing of the longitudinal seam weld of welded pipe with D ≤ 48,3 mm (1.900 in), in Grade L175, L175P, A25 or A25P	CW, LFW, HFW or LW	Once per test unit of not more than 25 tonnes (28 tons) of pipe
44th added Grades L175, L175P and A25P, and a test unit restriction 43rd had a frequency: 45,5 tonnes (50 tons)	Bend testing of the longitudinal seam weld of welded pipe with 48,3 mm (1.900 in) < D ≤ 60,3 mm (2.375 in), in Grade L175, L175P, A25 or A25P	CW, LFW, HFW or LW	Once per test unit of not more than 50 tonnes (55 tons) of pipe
44th eliminated guided-bend test for ERW, added test unit criteria	Guided-bend testing of the longitudinal or helical-seam weld of welded pipe	SAWL, SAWH, COWL or COWH	Once per test unit of not more than 50 lengths of pipe of the same grade
44th eliminated guided-bend test for ERW, added test unit criteria	Guided-bend testing of the strip/plate end weld of welded pipe	SAWH or COWH	Once per test unit of not more than 50 lengths of pipe of the same grade ^d
44th added a 12 3/4 size criteria for LW pipe and added test unit criteria	Guided-bend testing of the longitudinal seam weld of welded pipe with D ≥ 323,9 mm (12.750 in)	LW	Once per test unit of not more than 50 lengths of pipe of the same grade
43rd and 44th	Flattening test of welded pipe	CW, LFW, HFW or LW	As shown in Figure 6
43rd did not require	Hardness testing of hard spots in coldformed welded pipe	LFW, HFW, LW, SAWL, SAWH, COWL or COWH	Any hard spot exceeding 50 mm (2.0 in) in any direction
43rd and 44th	Hydrostatic testing	SMLS, CW, LFW, HFW, LW, SAWL, SAWH, COWL or COWH	Each pipe
43rd did not require	Macrographic testing of the longitudinal or helical-seam weld of welded pipe	SAWL, SAWH, COWL or COWH	At least once per operating shift plus whenever any change of pipe size occurs during the operating shift; or, if 10.2.5.3 applies, at the beginning of the production of each combination of specified outside diameter and specified wall thickness
43rd did not require	Metallographic testing of the longitudinal seam weld of welded pipe	LFW or HFW	At least once per operating shift plus whenever changes of grade, specified outside diameter or specified wall thickness are made; plus whenever significant excursions from operating heat treatment conditions are encountered
43rd and 44th Near equivalent	Visual inspection	SMLS, CW, LFW, HFW, LW, SAWL, SAWH, COWL or COWH	Each pipe, except as allowed by 10.2.7.2
43rd and 44th	Pipe diameter and out-of-roundness	SMLS, CW, LFW, HFW, LW, SAWL, SAWH, COWL or COWH	At least once per 4 h per operating shift plus whenever any change of pipe size occurs during the operating shift
43rd and 44th	Wall thickness measurement	All pipes	Each pipe (see 10.2.8.5)
43rd and 44th except 43rd required Length measurement unless variation was less than 0.1"	Other dimensional testing	SMLS, CW, LFW, HFW, LW, SAWL, SAWH, COWL or COWH	Random testing, with the details left to the discretion of the manufacturer
43rd and 44th	Weighing of pipe with D < 141,3 mm (5.563 in)	SMLS, CW, LFW, HFW, LW, SAWL, SAWH, COWL or COWH	Each pipe or each lot, with the choice being at the discretion of the manufacturer
43rd and 44th	Weighing of pipe with D ≥ 141,3 mm (5.563 in)	SMLS, CW, LFW, HFW, LW, SAWL, SAWH, COWL or COWH	Each pipe
See Annex E for details	Non-destructive inspection	SMLS, CW, LFW, HFW, LW, SAWL, SAWH, COWL or COWH	In accordance with Annex E
<p>44th footnotes are almost equivalent to the 43rd Table 13 footnotes</p> <p>^a The cold-expansion ratio is designated by the manufacturer, and is derived using the designated before-expansion outside diameter or circumference and the after-expansion outside diameter or circumference. An increase or decrease in the cold-expansion ratio of more than 0,002 requires the creation of a new test unit.</p> <p>^b For double-seam pipe, both longitudinal weld seams in the pipe selected to represent the test unit shall be tested.</p> <p>^c In addition, for each welding machine, at least one pipe per week shall be tested.</p> <p>^d Applies only to finished helical-seam pipe containing strip/plate end welds.</p> <p>^e "Test unit" is as defined in 4.49: prescribed quantity of pipe that is made to the same specified outside diameter and specified wall thickness, by the same pipe-manufacturing process, from the same heat and under the same pipe-manufacturing conditions</p>			

Annex A: Supplemental Comparison Tables

Table 18 — Inspection frequency for PSL 2 pipe			
	Type of inspection	Type of pipe	Frequency of inspection
43rd & 44th	Heat analysis	All pipe	One analysis per heat of steel
43rd & 44th	Product analysis	SMLS, CW, LFW, HFW, LW, SAWL, SAWH, COWL or COWH	Two analyses per heat of steel (taken from separate product items)
44rd no longer restricts the size of a heat to 400 or 200 lengths and does away with the <=5 9/16, 8 5/8, and 12 3/4 pipe size criteria	Tensile testing of the pipe body of seamless pipe	SMLS, HFW, SAWL, SAWH, COWL or COWH	Once per test unit of pipe with the same cold-expansion ratio ^a
44th no longer restricts the size of a heat to 200 or 100 lengths and does away with the 12 3/4 pipe size criteria	Tensile testing of the longitudinal or helical seam weld of welded pipe with D ≥ 219,1 mm (8.625 in)	HFW, SAWL, SAWH, COWL or COWH	Once per test unit of pipe with the same cold-expansion ratio ^{a,b,c}
44th changed the 200 length lot maximum to 100 lengths and did away with the 12 3/4 pipe size criteria	Tensile testing of the strip/plate end weld of welded pipe with D ≥ 219,1 mm (8.625 in)	SAWH or COWH	Once per test unit of not more than 100 lengths of pipe with the same coldexpansion ratio ^{a,c,d}
43rd & 44th	CVN impact testing of the pipe body of pipe with specified outside diameter and specified wall thickness as given in Table 22	SMLS, HFW, SAWL, SAWH, COWL or COWH	Once per test unit of pipe with the same cold-expansion ratio ^a
43rd did not require	If agreed, CVN impact testing of the longitudinal seam weld of welded pipe with specified outside diameter and specified wall thickness as given in Table 22	HFW	Once per test unit of pipe with the same cold-expansion ratio ^{a,b}
43rd did not require	CVN impact testing of the longitudinal or helical seam weld of welded pipe with specified outside diameter and specified wall thickness as given in Table 22	SAWL, SAWH, COWL or COWH	Once per test unit of pipe with the same cold-expansion ratio ^{a,b,c}
43rd did not require	CVN impact testing of the strip/plate end weld of welded pipe with specified outside diameter and specified wall thickness as given in Table 22	SAWH or COWH	Once per test unit of not more than 10 lengths of pipe with the same coldexpansion ratio ^{a,b,d}
43rd & 44th	If agreed, DWT testing of the pipe body of welded pipe with D W 508 mm (20.000 in)	HFW, SAWL, SAWH, COWL or COWH	Once per test unit of pipe with the same cold-expansion ratio ^a
44th eliminated guided-bend test for ERW, added test unit criteria and cold-expansion ratio criteria	Guided-bend testing of the longitudinal or helical-seam weld of welded pipe	SAWL, SAWH, COWL or COWH	Once per test unit of not more than 50 lengths of pipe of with the same coldexpansion ratio ^a
44th eliminated guided-bend test for ERW, added test unit criteria and cold-expansion ratio criteria	Guided-bend testing of the strip/plate end weld of welded pipe	SAWH or COWH	Once per test unit of not more than 50 lengths of pipe with the same cold-expansion ratio ^{a,b,d}
43rd and 44th	Flattening test of welded pipe	HFW	As shown in Figure 6
43rd did not require	Hardness testing of hard spots in coldformed welded pipe	HFW, SAWL, SAWH, COWL or COWH	Any hard spot exceeding 50 mm (2.0 in) in any direction
43rd and 44th	Hydrostatic testing	SMLS, HFW, SAWL, SAWH, COWL or COWH	Each pipe
43rd did not require	Macrographic testing of the longitudinal or helical-seam weld of welded pipe	SAWL, SAWH, COWL or COWH	At least once per operating shift plus whenever any change of pipe size occurs during the operating shift; or, if 10.2.5.3 applies, at the beginning of the production of each combination of specified outside diameter and specified wall thickness
43rd did not require	Metallographic testing of the longitudinal seam weld of welded pipe	HFW	At least once per operating shift plus whenever changes of grade, specified outside diameter or specified wall thickness are made; plus whenever significant excursions from operating heat treatment conditions are encountered
43rd and 44th Near equivalent	Visual inspection	SMLS, HFW, SAWL, SAWH, COWL or COWH	Each pipe, except as allowed by 10.2.7.2
43rd and 44th	Pipe diameter and out-of-roundness	SMLS, HFW, SAWL, SAWH, COWL or COWH	At least once per 4 h per operating shift plus whenever any change of pipe size occurs during the operating shift
43rd and 44th except 43rd required Length measurement unless variation was less than 0.1"	Wall thickness measurement	All pipes	Each pipe (see 10.2.8.5)
	Other dimensional testing	SMLS, HFW, SAWL, SAWH, COWL or COWH	Random testing, with the details left to the discretion of the manufacturer
43rd and 44th	Weighing of pipe with D < 141,3 mm (5.563 in)	SMLS, HFW, SAWL, SAWH, COWL or COWH	Each pipe or each lot, with the choice being at the discretion of the manufacturer
43rd and 44th	Weighing of pipe with D ≥ 141,3 mm (5.563 in)	SMLS, HFW, SAWL, SAWH, COWL or COWH	Each pipe
See Annex E for details	Non-destructive inspection	SMLS, HFW, SAWL, SAWH, COWL or COWH	In accordance with Annex E
44th footnotes are almost equivalent to the 43rd Table 13 footnotes	^a The cold-expansion ratio is designated by the manufacturer, and is derived using the designated before-expansion outside diameter or circumference and the after-expansion outside diameter or circumference. An increase or decrease in the cold-expansion ratio of more than 0,002 requires the creation of a new test unit.		
	^b In addition, pipe produced by each welding machine shall be tested at least once per week.		
	^c For double-seam pipe, both longitudinal weld seams in the pipe selected to represent the test unit shall be tested.		
	^d Applies only to finished helical-seam pipe containing strip/plate end welds.		
	^e "Test unit" is as defined in 4.49: prescribed quantity of pipe that is made to the same specified outside diameter and specified wall thickness, by the same pipe-manufacturing process, from the same heat and under the same pipe-manufacturing conditions		