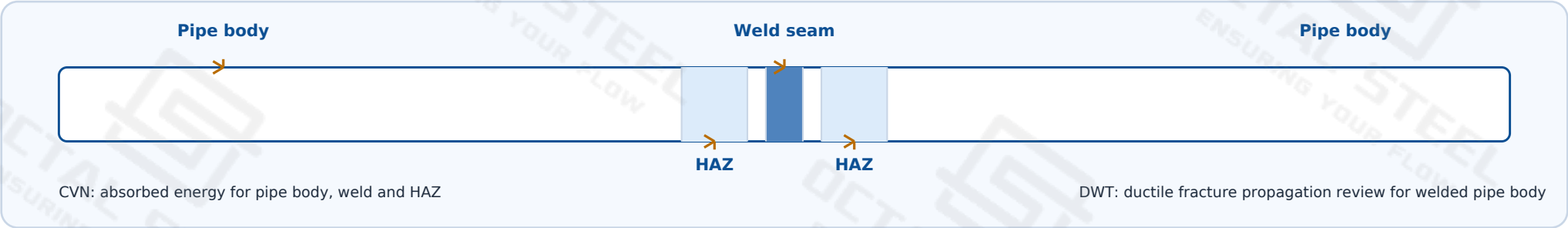
API 5L X80 Toughness Control: CVN, DWT, Weld and HAZ Review

Technical PDF for API 5L X80 / L555 PSL2 line pipe toughness review - focused on CVN absorbed energy, DWT shear area, pipe body, weld seam and heat-affected zone acceptance.

Grade focus API 5L X80 / L555 PSL2 High-strength line pipe	Test temperature 0°C (32°F) or agreed lower temperature	CVN values Pipe body: Table 8 by OD Weld/HAZ: 27 J or 40 J basis	DWT control Average shear fracture area >= 85% where required

Why this sheet matters

X80 pipe can meet the X80 / L555 strength level and still require close project review if the pipe body, weld seam or HAZ toughness record does not support the intended gas pipeline service. For PSL2 welded pipe, toughness review should connect the test location, absorbed-energy requirement, shear-fracture-area result, test temperature and final traceability records.



Core review logic

Control area	What the record should show	Project meaning
Pipe body CVN	Full-size or converted subsize Charpy absorbed energy; test temperature stated.	Base-metal fracture-initiation resistance for X80 pipe body.
Weld seam CVN	Weld-metal toughness record for HFW / SAW / COW pipe where applicable.	Protects the longitudinal or helical seam from becoming the weak toughness zone.
HAZ CVN	Heat-affected-zone toughness record and location.	Confirms the welding thermal cycle did not create a brittle HAZ region.
DWT result	Average shear fracture area, test temperature and applicability.	Supports ductile fracture propagation review in high-pressure gas pipeline service.

Pipe Body CVN Absorbed Energy - X80 / L555 PSL2

For PSL2 pipe body CVN testing, the minimum average value is based on a set of three test pieces, full-size absorbed energy values and a test temperature of 0°C (32°F) or an agreed lower temperature. Subsize values are converted by the width ratio, and individual test pieces should not fall below 75% of the required minimum average.

Specified outside diameter D	X80 / L555 pipe body CVN minimum average	Technical reading
D <= 508 mm (20 in.)	**40 J (30 ft-lbf)**	Small-to-medium OD X80 still needs higher absorbed energy than lower-grade pipe in the same OD band.
508 < D <= 762 mm (20-30 in.)	**40 J (30 ft-lbf)**	Common transmission sizes require the same X80 pipe body energy level.
762 < D <= 914 mm (30-36 in.)	**40 J (30 ft-lbf)**	Base metal toughness remains a controlled acceptance item.
914 < D <= 1219 mm (36-48 in.)	**40 J (30 ft-lbf)**	Large-diameter pipe body toughness should be tied to MTC and test-unit identity.
1219 < D <= 1422 mm (48-56 in.)	**54 J (40 ft-lbf)**	Higher OD band requires higher pipe-body energy for fracture-initiation resistance.
1422 < D <= 2134 mm (56-84 in.)	**68 J (50 ft-lbf)**	Very large OD X80 pipe needs stronger pipe-body toughness review.

Review notes

- Pipe body CVN is not the same as weld or HAZ CVN; the required values come from different clauses or tables.
- The test temperature must be visible in the record. Lower temperature testing may be acceptable when the energy and shear-area requirements are still met.
- For welded pipe with D < 508 mm, shear fracture area on pipe-body CVN may be specified by agreement; otherwise it may be reported for information where applicable.

Toughness acceptance is a location-based review, not a single number

Pipe body CVN
Table 8 by OD and grade

Weld seam CVN
27 J or 40 J basis

HAZ CVN
Same weld/HAZ basis

DWT
>= 85% shear area

Document package should connect pipe marking, MTC, CVN/DWT records, weld/HAZ data, NDT and hydrotest release.

Weld Seam, HAZ and DWT Review

For welded API 5L X80 PSL2 pipe, toughness review should separate the pipe body, weld metal and HAZ. A weld can satisfy tensile strength and still require further review if weld or HAZ CVN values, DWT results, NDT records or WPS/PQR evidence are not aligned with the project requirements.

Toughness area	Typical API 5L / PSL2 basis	Why it matters for X80
Weld seam CVN	27 J (20 ft-lbf) for D < 1422 mm and grade <= L555 / X80; 40 J (30 ft-lbf) for D >= 1422 mm or grades above X80.	Confirms weld-metal toughness and prevents the seam from becoming the limiting zone.
HAZ CVN	Same weld / HAZ toughness basis where applicable; test temperature 0°C or agreed lower temperature.	Checks whether the welding thermal cycle created a local toughness weakness.
Pipe body DWT	Average shear fracture area >= 85% for each set of two test pieces, where DWT is required. Acceptance for wall thickness >25.4 mm by agreement.	Supports ductile fracture propagation control in gas pipeline service.
WPS/PQR support	Weld and HAZ CVN and hardness testing may be defined by agreement for procedure qualification.	Connects mill test data with field girth-welding risk and HAZ hardness/toughness control.

Data-linked acceptance checklist

Document / record	What should be visible	Release risk if missing
MTC	Grade, PSL, delivery condition, heat number, chemistry, tensile and toughness records.	X80 identity cannot be fully verified.
CVN report	Location: pipe body / weld / HAZ; test temperature; specimen size; average and individual values.	Pipe may meet strength but fail toughness acceptance.
DWT report	DWT applicability, test temperature, set of two pieces and average shear fracture area.	Fracture-propagation review is incomplete.
NDT record	Pipe body and weld seam inspection scope, method and acceptance.	Defect-control evidence is not tied to the released pipe.
Marking / packing	Pipe marking, heat number, test-unit identity, length and shipment list.	Traceability breaks between test record and delivered pipe.

Technical takeaway

A complete X80 toughness review should answer four questions: where was the test taken, what value was required, at what temperature was it tested, and can the result be traced to the delivered pipe? This is the difference between a simple parameter page and a project-ready X80 PSL2 technical review.

Reference basis: API Specification 5L / ISO 3183 line pipe requirements. Project specification, purchase order, supplementary annexes and agreed service conditions override general reference values.