

CONSTRUCTION COMPARISON

Construction Route and External Profile

HWDP construction and external profile are separate specification decisions.

WELDED HWDP	INTEGRAL HWDP	SPIRAL HWDP
		
<p>ASSEMBLY CONTROL Tube heat + tool-joint heat + two weld records</p> <ul style="list-style-type: none"> • Thick-wall seamless alloy-steel tube • Separate quenched-and-tempered tool joints • Friction or inertia welded at enlarged end sections • Post-weld heat treatment under a qualified procedure • Two weld zones in a complete joint • Flexible tube and tool-joint combinations 	<p>ONE-PIECE CONTROL Bar cleanliness, heat treatment, bore and OD geometry</p> <ul style="list-style-type: none"> • Machined from one hot-rolled or forged alloy-steel bar • Trepanned or bored internal passage • No tube-to-tool-joint friction weld • One-piece heat-treatment route • Full-length geometry and bore-concentricity control 	<p>PROFILE CONTROL Groove depth, pitch, residual section and wear pattern</p> <ul style="list-style-type: none"> • External machined profile • Can be applied to welded or integral construction • Reduced continuous wellbore contact area • Standard, full-spiral or tri-spiral form • Does not independently eliminate differential sticking or hole-cleaning problems

SPECIFICATION LOGIC

1) Assembly route: welded or integral 2) External profile: standard / center upset / full spiral / tri-spiral

Spiral is a profile - not a separate alloy or material grade.

COMPONENT MATERIAL CONTROL


Material Control by Component

Component-level requirements prevent a single material label from masking different metallurgical routes.

WELDED ASSEMBLY - MATERIAL MAP

TOOL JOINT
Forged / bar steel
Quenched + tempered

TUBE BODY
Seamless alloy steel
N, N+T or Q+T




HAZ WELD HAZ

WELD + HAZ
WPS / PQR / PWHT
Hardness < 37 HRC

INTEGRAL ROUTE - ONE BAR

One-piece bar – continuous bore



Hot-rolled or forged steel bar
Drill-collar material route for the corresponding tool-joint diameter
Control: bar NDT, heat treatment, bore concentricity and match point

4145H should not be used as a blanket material description for every welded HWDP component.

COMPONENT	MATERIAL / HEAT-TREATMENT ROUTE	RELEASE EVIDENCE
Welded tube body	Normalized, normalized and tempered, or quenched-and-tempered seamless alloy steel.	Tube heat ID; chemistry; tensile test; elongation; full surface/internal examination record.
Tool joint	Forging, forged bar or hot-rolled steel; quenched and tempered under a documented procedure.	Heat and heat-treatment lot; tensile/hardness; CVN; surface/internal examination.
Integral bar	Hot-rolled or forged steel bar meeting drill-collar requirements for the same size as the tool-joint diameter.	Bar heat ID; drill-collar property route; full-length NDT; bore and OD inspection.
Friction-weld and HAZ	Qualified WPS with PWHT. Weld strength basis must exceed the tube-section strength basis.	WPS/PQR/WPQ; weld-zone hardness; alignment; weld traceability; PWHT record.

655 MPa
MIN. TUBE TENSILE
95,000 psi

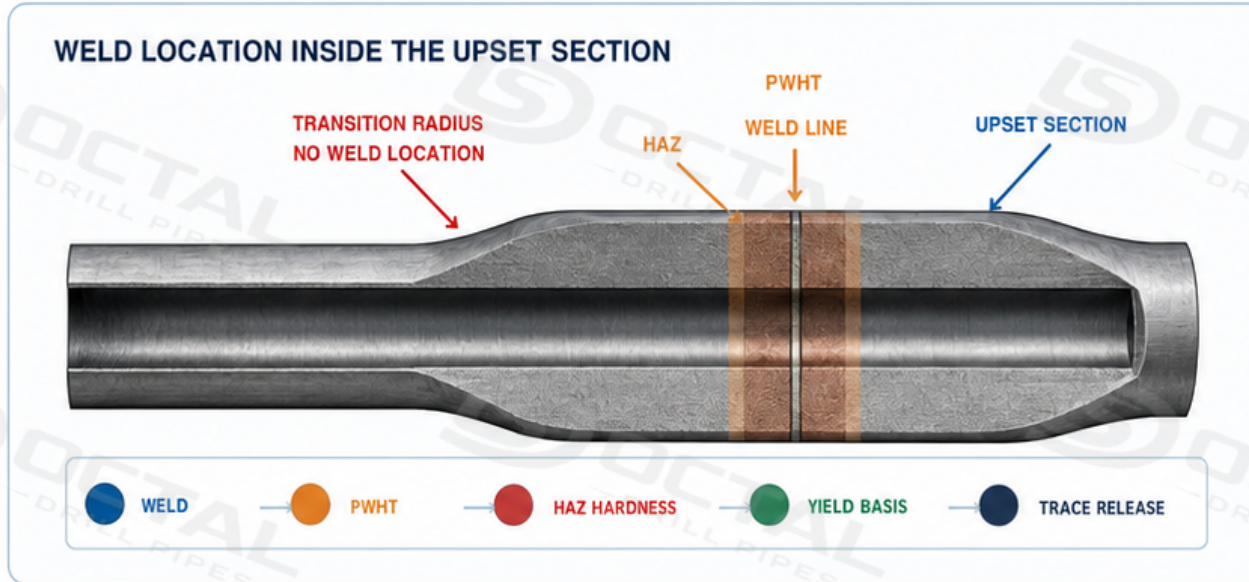
379 MPa
MIN. TUBE YIELD
55,000 psi

18%
MIN. ELONGATION
Welded HWDP tube body

WELD AND MECHANICAL ACCEPTANCE

Weld Location, Heat Treatment and Mechanical Acceptance

Acceptance is based on the complete route: weld geometry, PWHT, hardness, impact testing and alignment.



TOOL-JOINT CVN AND LOT CONTROL

CVN 1
10 x 10 mm

CVN 2
10 x 10 mm

CVN 3
10 x 10 mm

✓ FULL-SIZE SET: AVERAGE >= 54 J
NO INDIVIDUAL RESULT BELOW 47 J

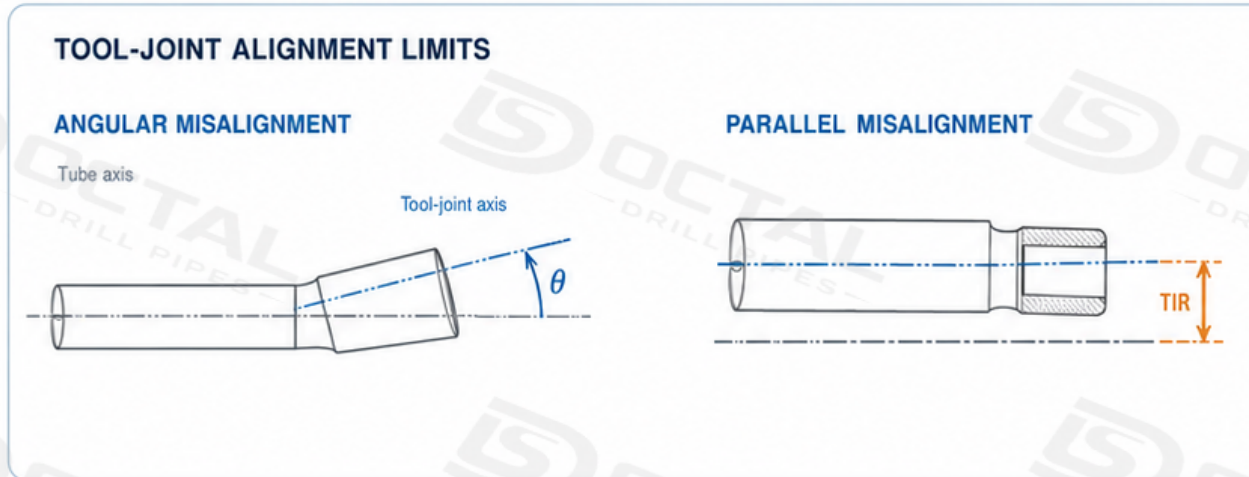
HEAT -> HEAT-TREATMENT LOT -> TEST SET

HEAT
Chemical identity

HT LOT
Same controlled cycle

TEST
3 CVN specimens

Test frequency: one set of 3 specimens per heat per heat-treatment lot.



NUMERICAL ACCEPTANCE LIMITS

SIZE 4 IN. AND SMALLER	10 mm/m	0.010 in./in.
LARGER THAN 4 IN.	8 mm/m	0.008 in./in.
PARALLEL MISALIGNMENT	3.2 mm	0.125 in. TIR

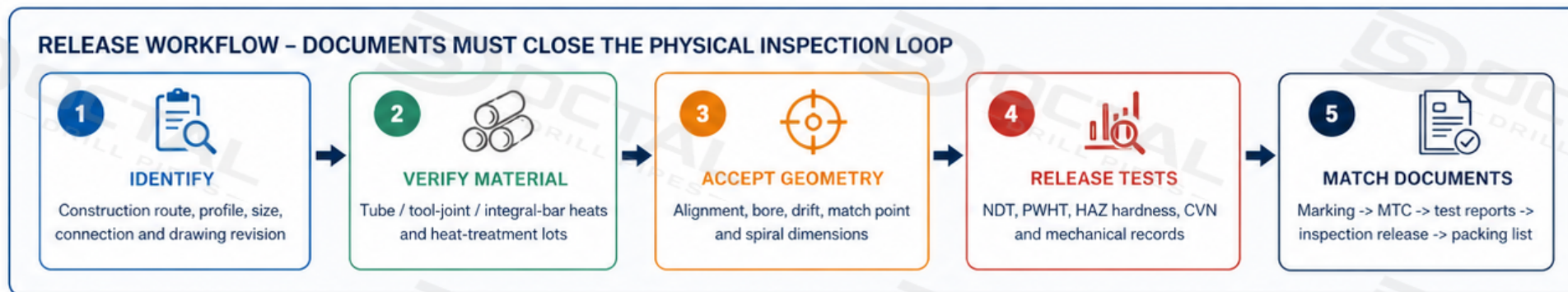
Measurement location: longitudinal mid-point of the tool-joint OD (tong length).

CONSTRUCTION SELECTION AND RELEASE RISKS

Selection Matrix and Release Risks

No construction route is universally superior. Release depends on the specified design and its verified control points.

CONSTRUCTION	MAIN ADVANTAGE	MAIN INSPECTION POINT	MAIN RISK
Welded HWDP	Flexible tube / tool-joint combinations and replaceable component routes.	Weld alignment; PWHT control; HAZ hardness; tube and tool-joint traceability.	Misalignment, incomplete PWHT control, excessive HAZ hardness or broken heat identity.
Integral HWDP	No tube-to-tool-joint friction weld; one-piece load path.	Bar cleanliness; full-length NDT; bore concentricity; bore match point; heat treatment.	Internal bar discontinuity, off-center bore, match-point step or geometry drift.
Spiral profile on welded HWDP	Lower continuous contact area while retaining welded assembly flexibility.	Spiral-profile dimensions; residual wall / section; weld controls; hardbanding locations.	Profile outside tolerance, reduced section, wear concentration, or weld-release gaps.
Spiral profile on integral HWDP	One-piece construction combined with a machined external contact-management profile.	Bar NDT; bore concentricity; spiral geometry; tool-joint and body traceability.	Bore/profile eccentricity, bar quality, dimensional mismatch or incomplete trace records.



ENGINEERING DECISION | Select construction by load path, drilling program, inspection capability, repair philosophy and documented release evidence.
Spiral HWDP is not a separate alloy, grade or guarantee against sticking.