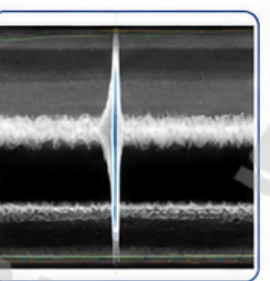
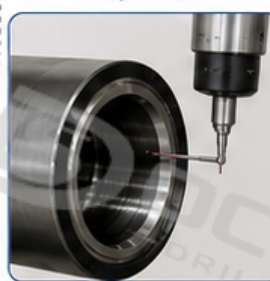




Drill Pipe Manufacturing and Inspection Control Reference

Page 1 of 6

1	2	3	4	5	6	7
Pipe Body	Upset Transition	Weld End	Friction-Weld Zone	Tool Joint	Pin / Box Connection	Shoulder
						
5 1/2" 19.50# P110 PSL 2						
Automated Body Inspection	Special End / Transition Inspection	Special End Inspection	Weld-Zone Inspection	Dimensional & Hardness Checks	Thread Gauging	Shoulder Profile / Sealing Surface Inspection
						

 Automated body inspection and special end / transition inspection require different coverage strategies.

MANUFACTURING / INSPECTION EQUIPMENT (Representative)

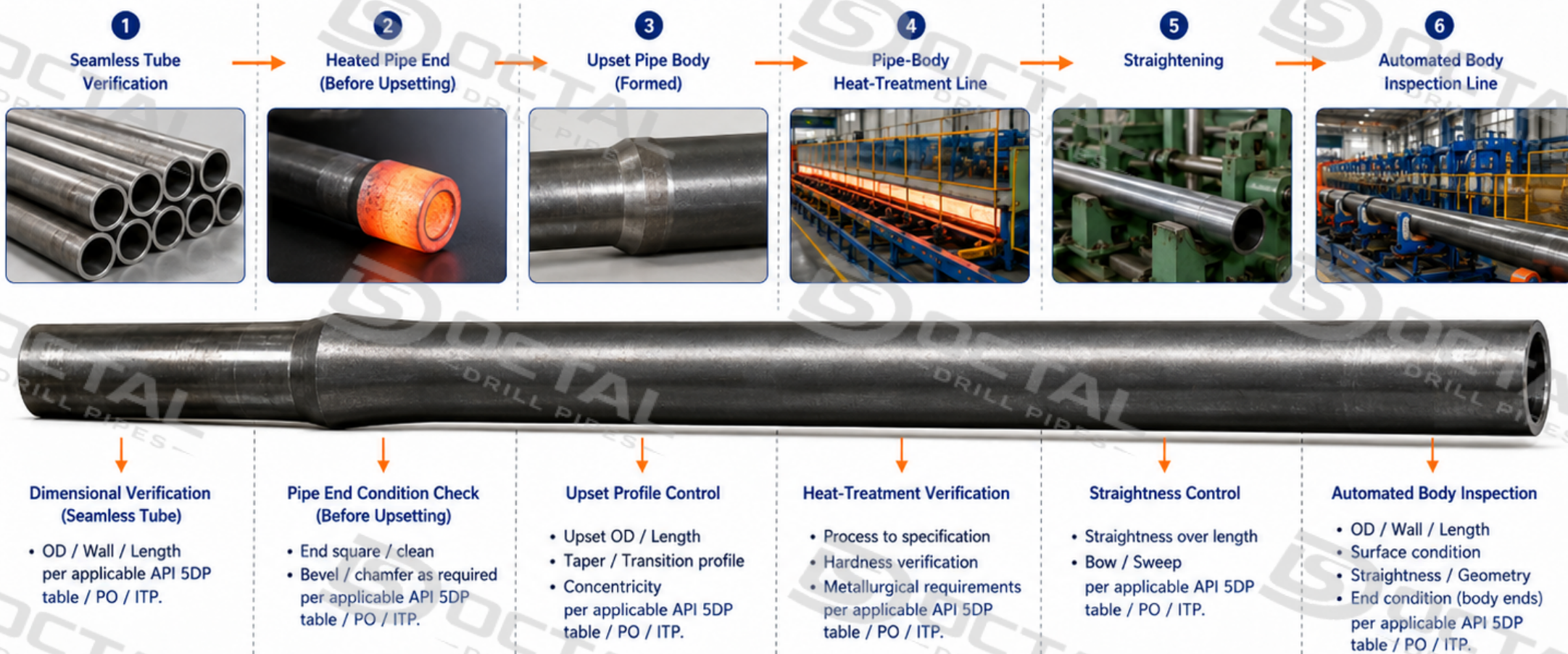
				
Automated Body Inspection Line	Ultrasonic Probe (UT)	Friction-Weld Zone (Close View)	Hardness Tester	Thread Gauge (Go / No-Go)



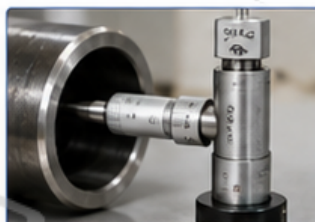
per applicable API 5DP table / PO / ITP.



Pipe Body Manufacturing Route and Automated Body Inspection



 Automated body inspection uses a different coverage strategy from special end / transition inspection.



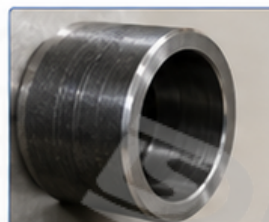
OD Measurement



Wall Thickness Measurement



Straightness Measurement



End Condition Verification



Surface Condition Inspection



Automated Inspection Line



per applicable
API 5DP table /
PO / ITP.



Upset Transition and Weld End Inspection Control

Transition Geometry

Smooth taper profile and blend.
No steps, flats or sharp transitions.

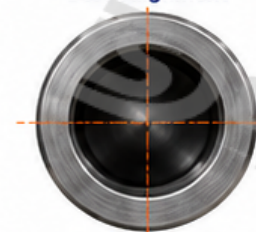
Wall Transition

Uniform wall thickness through the upset. No abrupt changes.

Weld-End Preparation

Square, clean and burr-free face.
Proper bevel / finish per applicable API 5DP table / PO / ITP.

Bore Alignment



Bore concentric to OD.
No offset or misalignment.
Verify ID to OD alignment per applicable API 5DP table / PO / ITP.

1 Special End Ultrasonic Inspection

Targeted UT coverage of the upset transition and weld end to detect internal discontinuities. Different coverage strategy than automated body inspection.



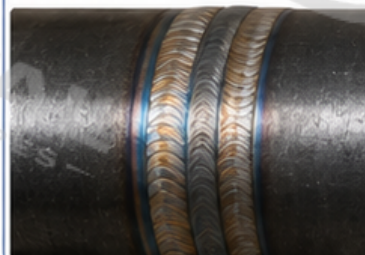
2 Dimensional / Profile Check

Verify taper geometry, wall transition and end face condition.
per applicable API 5DP table / PO / ITP.



3 Visual Surface Check

Inspect transition and weld end surfaces for cracks, laps, undercut, porosity, spatter, dents and other defects.



4 Bore / OD Alignment Verification

Verify concentricity and straightness of bore to OD at the weld end.
per applicable API 5DP table / PO / ITP.



Special end / transition inspection uses a different coverage strategy than automated body inspection.

Targeted methods are required to ensure integrity of the upset transition and weld end.



All requirements per applicable API 5DP table / PO / ITP.

UPSET TRANSITION & WELD END FORMATION PROCESS (Representative)



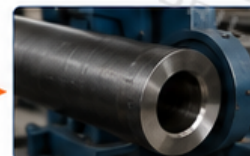
Upset Heating
Induction heats pipe end.



Upset Forming
Axial pressure forms the upset (taper).



Transition Sizing
Sizes OD and verifies transition profile.



Weld End Prep
Facing and beveling to achieve required end preparation.



Pre-Inspection
Visual and dimensional checks prior to NDT.



Tool Joint Manufacturing and Connection Control

1

Alloy Steel
Tool-Joint Blank / Forging



2

Heat Treatment



3

OD / ID
Machining



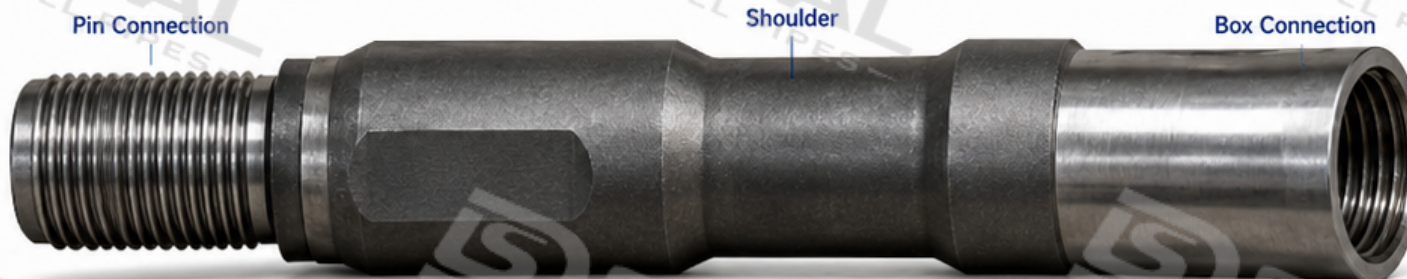
4

Pin / Box Thread
Machining



5

Final Connection
Gauging



per applicable API 5DP
table / PO / ITP.

Key Inspection and Control Points

Heat-Treatment
Verification



Tool-joint hardness
per applicable API 5DP
table / PO / ITP.

OD / ID Machining
Control



Dimensional checks
per applicable API 5DP
table / PO / ITP.

Thread Profile
Control



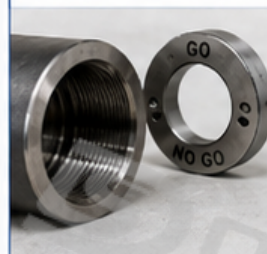
Thread profile and pitch
per applicable API 5DP
table / PO / ITP.

Pin Connection
Gauging



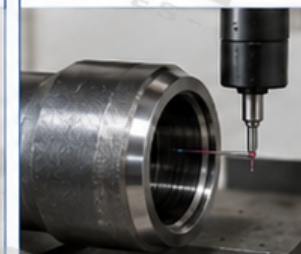
Pin thread gauging
(Go / No-Go)
per applicable API 5DP
table / PO / ITP.

Box Connection
Gauging



Box thread gauging
(Go / No-Go)
per applicable API 5DP
table / PO / ITP.

Shoulder Profile /
Sealing-Surface Inspection



Shoulder profile and sealing
surface inspection
per applicable API 5DP
table / PO / ITP.

Tool-Joint Hardness /
Dimensional Checks



Final hardness and
dimensional checks
per applicable API 5DP
table / PO / ITP.



All inspections shall be performed per applicable API 5DP table / PO / ITP.



Friction Welding and Weld-Zone Control

1. Components Prepared

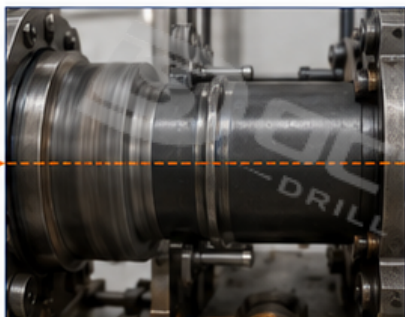
Upset pipe-body weld end
+ tool-joint weld end



Alignment of OD and bore

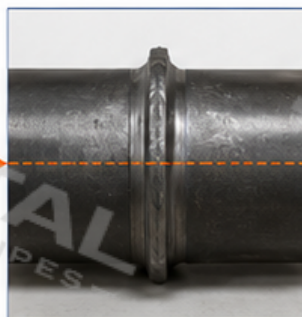
2. Rotary / Inertia Friction Welding

Rotating one part against the other
under axial force



3. Weld Interface Formed

Frictional heat softens material
to form the weld



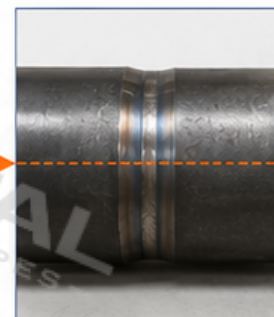
4. Weld Flash (Normal)

Plasticized material is expelled
around the circumference



5. Flash Removal

Flash is machined off
to restore profile



6. Post-Weld Heat Treatment

Stress relief to meet
API 5DP requirements



Friction welding is a solid-state joining process.



Weld flash is normal plastically expelled material and is later removed; it is not a weld defect.



All friction weld and heat treatment requirements per applicable API 5DP table / PO / ITP.

Weld-Zone Inspection and Verification

1. Weld-Zone Ultrasonic Inspection (UT)

Detect internal discontinuities in and adjacent to the weld zone.



UT coverage per applicable API 5DP table / PO / ITP.

2. Dimensional Alignment Verification

Confirm OD alignment, weld imbalance and taper.



Acceptance criteria per applicable API 5DP table / PO / ITP.

3. Hardness Verification

Verify weld-zone hardness meets API 5DP limits.



Testing per applicable API 5DP table / PO / ITP.



API 5DP Hardness Requirements

- Grades E / X / G / S: maximum 37 HRC or equivalent.
- Grade V: maximum 40 HRC or equivalent.
- SS grades: separate hardness requirements.



All acceptance criteria per applicable API 5DP table / PO / ITP.



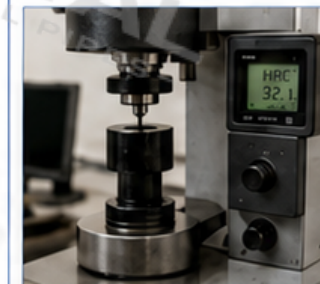
Note: All requirements are per applicable API 5DP table / PO / ITP.



Mechanical Verification, Impact Testing and Release Control



HARDNESS VERIFICATION



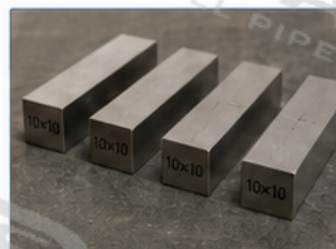
- Body, weld zone and transition hardness verified per PO / ITP.
- Records retained with inspection dossier.

ULTRASONIC VERIFICATION (UT)



- Body and critical-zone examination per PO / ITP.
- Indications evaluated and recorded. Acceptance per applicable criteria.

CHARPY SPECIMENS (FULL-SIZE 10×10 mm)



- Full-size 10×10 mm specimens prepared from body material.
- Orientation and identification per PO / ITP.

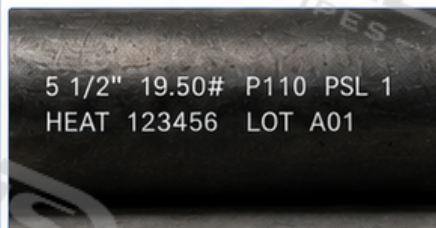
IMPACT TESTING – CHARPY (FULL-SIZE 10×10 mm)



- ✓ PSL-1 drill pipe bodies, Grades X / G / S / V, full-size 10×10 mm specimens: test temperature 21°C ±3°C; minimum average absorbed energy 54 J; minimum individual specimen 47 J.

i Lot definition, acceptance grouping and additional requirements are per applicable API SDP table / PO / ITP.

TRACEABILITY – HEAT / LOT MARKING



- Heat and lot permanently marked on each pipe.
- Traceable to melt, heat treatment and all inspection records.

INSPECTION REPORTS



- Dimensional, NDT, mechanical and inspection results compiled.
- Records retained per PO / ITP.

RELEASE DOCUMENTATION



- Final inspection certificate issued.
- Product released in accordance with applicable PO / ITP.

RELEASE CONTROL – VERIFICATION CHAIN

Heat / Lot



Heat Treatment



Friction Welding Record



NDT (UT)



Connection Inspection



Marking



**RELEASED
READY FOR
SHIPMENT**