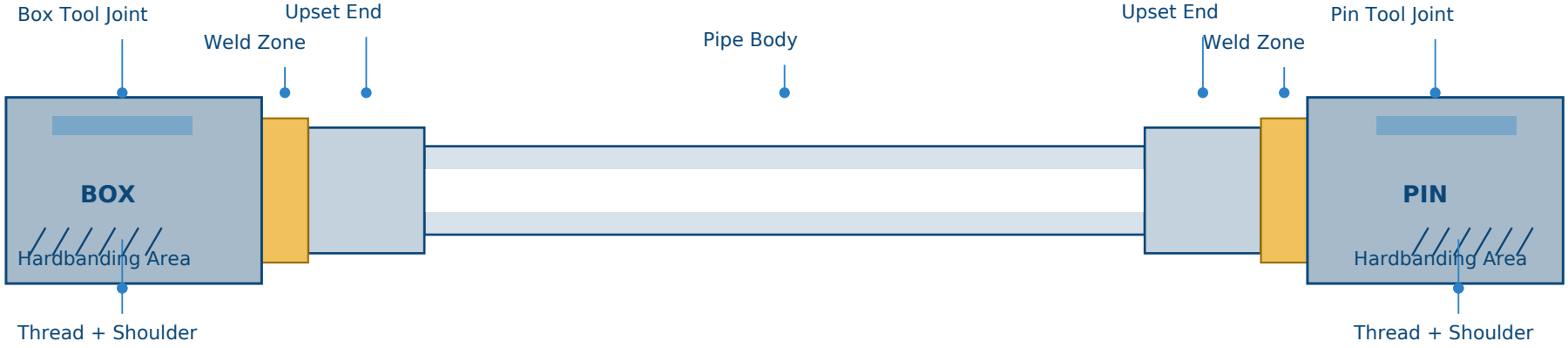
API 5DP Drill Pipe Structure and Connection Guide

API 5DP drill pipe is a steel drill pipe system built around the pipe body, upset pipe-body ends, weld-on tool joints and rotary shouldered connections. The mechanical grade defines pipe-body strength, but field performance depends on how the grade, upset geometry, weld zone, tool joint and connection work together.

Technical basis: API 5DP / ISO 11961 specifies steel drill pipe with upset pipe-body ends and weld-on tool joints for drilling and production operations; API Spec 7-2 / ISO 10424-2 is commonly used for rotary shouldered connection requirements.

1. Drill Pipe Structure Anatomy



Simplified anatomy: exact dimensions, connection form and hardbanding depend on drill pipe size, weight and specification.

2. Pipe Body and Tool Joint Functions

The pipe body and tool joint do different work in the drill string. The pipe body provides the long, relatively flexible section that carries axial tension, rotary torque, internal pressure and bending. The tool joint is shorter and heavier; it provides the threaded connection, shoulder contact and local wear resistance near the connection.

Structure Area	Main Function	Technical Meaning
Pipe body	Carries tension, torque, internal pressure and bending load.	Grade, OD, wall thickness and straightness control the main pipe-body performance.
Upset end	Thickened transition zone between pipe body and tool joint.	Transfers load into the tool joint and reduces abrupt stress concentration.
Weld zone	Joins the tool joint to the upset pipe body.	Requires profile, hardness and NDT control because fatigue may start at sharp transitions.
Tool joint	Provides the pin/box thread and local wear resistance.	Controls make-up torque, shoulder contact, thread durability and OD/ID compatibility.
Thread + shoulder	Transfers torque and axial load through the rotary shouldered connection.	Thread form, shoulder face and gauging condition directly affect connection reliability.

Field meaning: a pipe body may meet E75, X95, G105 or S135 strength requirements, but the full drill pipe still depends on the upset transition, weld zone, tool joint, connection geometry and inspection condition.

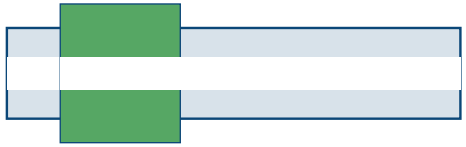
3. IU / EU / IEU Upset Types

Upset geometry changes the end-section wall thickness before the tool joint is welded. It affects local strength, ID clearance, OD clearance and stress transition. Exact dimensions depend on drill pipe size, weight and applicable standard tables.

IU - Internal Upset

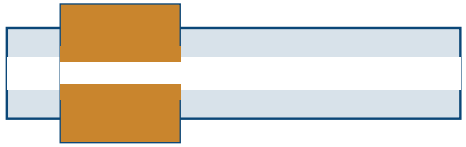
End wall thickens inward; ID reduces near the end.

EU - External Upset



End wall thickens outward; OD increases near the end.

IEU - Internal + External Upset



End wall thickens both inward and outward.

Upset Type	Geometry Meaning	Engineering Effect
IU - Internal Upset	Wall thickens mainly inward; OD remains close to pipe-body OD while ID reduces near the end.	Useful where external clearance is important, but local bore reduction must be considered.
EU - External Upset	Wall thickens mainly outward; ID is less affected while OD increases near the end.	Reinforces the end section while retaining more internal flow area, but increases local OD.
IEU - Internal-External Upset	Wall thickens both inward and outward.	Provides a strong transition section; both OD and ID effects must be checked with tool joint design.

4. NC / IF / FH / REG Connection Notes

NC, IF, FH and REG are common API rotary shouldered connection families. Each affects torque transfer, internal flow path, shoulder contact, thread compatibility and inspection method. Exact dimensions and interchangeability must be checked by the applicable connection specification and gauge practice.

Connection Family	General Meaning	Typical Technical Note
NC - Numbered Connection	Modern API numbered rotary shouldered connection family used widely across drill pipe and drilling tools.	Often used for balanced strength, standardized identification and interchangeability.
IF - Internal Flush	Traditional family intended to keep a comparatively smooth internal flow path.	Flow-bore and compatibility can be useful, but torque and size must still be verified.
FH - Full Hole	Traditional full-hole family with larger flow-bore orientation than some older connection forms.	Can support fluid-flow needs in some assemblies; fatigue and torque limits depend on exact size.
REG - Regular	Traditional regular connection family widely used on drilling tools, subs and BHA-related components.	Robust connection form, but internal diameter and compatibility may not suit every drill-pipe body and hydraulic requirement.

Technical note: connection names should not be treated as interchangeable. Thread form, shoulder geometry, tool joint OD/ID, make-up torque basis and gauge control should match the drilling condition.

5. Weld Zone and Thread Inspection Points

Inspection Point	What to Review	Why It Matters
Weld-zone profile	Transition shape, smoothness, misalignment and absence of sharp section changes.	Sharp transitions can increase fatigue stress under rotation and bending.
Weld-zone hardness	Hardness control according to API 5DP and the confirmed inspection scope.	API 5DP Addendum 1 highlights weld-zone hardness control, including 37 HRC for Grades E, X, G and S under the stated provisions.
NDT coverage	Inspection of weld zone, upset area and tool joint as required by the applicable scope.	Indications near transitions may become crack-initiation points in cyclic drilling service.
Thread form and gauging	Thread profile, taper, lead, crest/root condition and gauge result.	Incorrect geometry affects make-up behavior, load transfer and connection interchangeability.
Shoulder / seal face	Shoulder flatness, damage, galling, washout and contact condition.	Shoulder integrity is essential for torque transfer and connection stability.
Tool joint OD / ID	Wear, re-cut history, hardbanding status and internal clearance.	Dimensional changes can affect torsion ratio, hydraulic passage and downhole compatibility.

6. Why Grade and Connection Must Be Checked Together

Drill pipe grade defines pipe-body strength, but the connection controls how that strength is transferred through the drill string. A high-strength pipe body does not remove the need to verify tool-joint torque capacity, shoulder condition, thread integrity, weld-zone quality and fatigue exposure. In long horizontal sections, high dogleg intervals and high-torque rotary drilling, the connection can become the limiting element before the pipe body reaches its yield capacity.

If Only the Grade Is Checked	Technical Risk	What Must Be Checked Together
Pipe body meets E75/X95/G105/S135 strength	Connection may not have enough torque margin.	Connection family, tool-joint dimensions, make-up torque basis and shoulder condition.
S135 used for high load	Fatigue may still initiate at thread roots, shoulder damage, hardbanding edge or weld transition.	Dogleg severity, cyclic bending, thread inspection and weld-zone hardness/NDT.
Tool joint re-cut or worn	OD/ID changes may reduce torsion-strength ratio and change hydraulic compatibility.	Tool joint OD/ID, re-cut history, hardbanding condition and connection gauging.
Severe environment present	Corrosion pits, H2S/CO2 exposure or mud chemistry can reduce fatigue life.	Material review, hardness control, NDT scope and service-environment limits.

Quick technical summary

- Pipe body grade answers the strength question; connection type answers the torque-transfer and interchangeability question.
- IU, EU and IEU upset styles change the end geometry and must be considered with ID, OD, weld-zone profile and tool-joint design.
- NC, IF, FH and REG are connection families, not interchangeable words. Gauge practice, size, torque limit and field compatibility matter.
- Weld-zone and thread inspection are part of drill-string reliability, especially for G105 and S135 in high-load or high-cycle service.

Reference note: This PDF is a technical guide for structure and connection understanding. Final field use should follow the applicable edition of API 5DP / ISO 11961, API Spec 7-2 / ISO 10424-2 and the confirmed drilling design basis.