ENGINEERING REFERENCE

API Spec 5DP Drill Pipe Engineering Reference Manual

API Specification 5DP — identical adoption of ISO 11961:2008. Integrated mechanical, dimensional and operational data for seamless drill pipe with friction-welded tool joints.

STANDARD BASIS
API Spec 5DP (1st Ed., 2009), an identical adoption of ISO 11961:2008

PRODUCT SCOPE
Seamless drill pipe, 2 3/8 in to 6 5/8 in, grades E-75 through S-135

STATUS OF DATA
Items marked † are practice, calculated or manufacturer data, not standard requirements

01 Scope & Structural Architecture

API Specification 5DP covers seamless steel drill pipe with upset pipe-body ends and friction-welded rotary tool joints. The first edition of API Spec 5DP (2009) is an identical adoption of ISO 11961:2008, so the two designations carry the same requirements. Drill pipe is the mechanical link in the drill string: it transmits torsional torque from the top drive, carries axial load and weight on bit, and conveys drilling fluid to the bit.

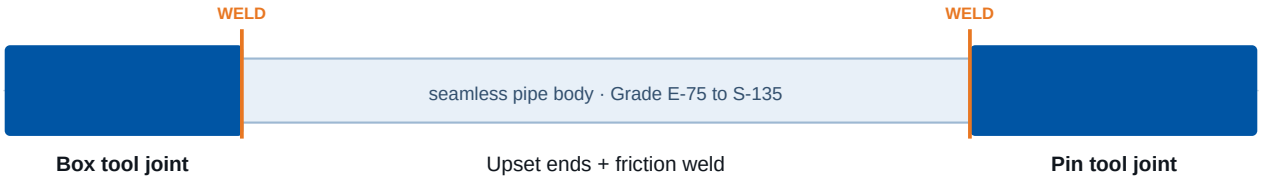
02 Material Metallurgy & Mechanical Properties

The standard covers **Group 1** (Grade E-75) for shallow and medium-depth service, and **Group 3** high-strength grades X-95, G-105 and S-135 for deep, high-torque and extended-reach drilling. Pipe bodies are supplied quenched and tempered, and each grade is subject to the chemistry limits of the standard (for the common grades, phosphorus and sulphur are each limited to 0.030%).

Steel grade	Group	Min yield (psi / MPa)	Max yield (psi / MPa)	Min tensile (psi / MPa)
E-75	Group 1	75,000 / 517	105,000 / 724	100,000 / 689
X-95	Group 3	95,000 / 655	125,000 / 862	105,000 / 724
G-105	Group 3	105,000 / 724	135,000 / 931	115,000 / 793
S-135	Group 3	135,000 / 931	165,000 / 1,138	145,000 / 1,000

† Yield and tensile values are the grade limits of the standard. Elongation is not a fixed percentage: the minimum is calculated from the test-piece cross-section and the specified tensile strength, so it varies with size and wall thickness. Impact testing applies at PSL-2 and PSL-3 and is specified in Annex A.

03 Friction-Welded Assembly & End Upsets



Friction-welded assembly. HAZ = heat-affected zone on each side of the weld.

UPSET TYPES AT THE PIPE ENDS

- **IU (internal upset):** wall thickened on the inside; the outside diameter stays uniform.
- **EU (external upset):** wall thickened on the outside; the inside diameter stays uniform.
- **IEU (internal–external):** transition on both surfaces; the usual choice where fatigue life is critical.

LENGTH RANGES (API SPEC 5DP)

- **Range 1 (R1):** 18.0 – 22.0 ft (5.49 – 6.71 m)
- **Range 2 (R2):** 27.0 – 30.0 ft (8.23 – 9.14 m), the standard range for most strings.
- **Range 3 (R3):** 38.0 – 45.0 ft (11.58 – 13.72 m), used for deepwater and extended-reach wells.

04 Dimensional Data & Operating Capacities

Tube dimensions follow the standard. Tool joint connections, tool-joint dimensions and torque values are shown for reference only; they depend on the connection the purchaser specifies.

4.1 Tube and tool joint dimensions

Nom. size	Weight (lb/ft)	Tube OD (in)	Wall (in)	Tube ID (in)	Upset	Tool joint connection†	TJ OD × ID (in)†
2 3/8"	6.65	2.375	0.280	1.815	EU	NC26 (2 3/8" IF)	3.375 × 1.750
2 7/8"	10.40	2.875	0.362	2.151	EU/IEU	NC31 (2 7/8" IF)	4.125 × 2.125
3 1/2"	13.30	3.500	0.368	2.764	EU/IEU	NC38 (3 1/2" IF)	4.750 × 2.438
3 1/2"	15.50	3.500	0.449	2.602	IEU	NC38 / NC40	5.000 × 2.438
4"	14.00	4.000	0.330	3.340	IU/IEU	NC40 (4" IF)	5.250 × 2.688
4"	15.70	4.000	0.368	3.264	IEU	NC40 (4" IF)	5.250 × 2.688
4 1/2"	16.60	4.500	0.337	3.826	IEU	NC46 (4" FH)	6.000 × 3.250
4 1/2"	20.00	4.500	0.430	3.640	IEU	NC50 (4 1/2" IF)	6.375 × 3.250
5"	19.50	5.000	0.362	4.276	IEU	NC50 (4 1/2" IF)	6.625 × 3.500
5"	25.60	5.000	0.500	4.000	IEU	NC50 / 5 1/2" FH	7.000 × 3.250
5 1/2"	21.90	5.500	0.361	4.778	IEU	5 1/2" FH	7.000 × 4.000
5 1/2"	24.70	5.500	0.415	4.670	IEU	5 1/2" FH	7.250 × 4.000
6 5/8"	25.20	6.625	0.330	5.965	IEU	6 5/8" FH	8.000 × 5.000
6 5/8"	27.70	6.625	0.362	5.901	IEU	6 5/8" FH	8.250 × 4.250

† Tool joint connections and tool-joint OD / ID are the sizes normally fitted to each pipe size; they are not fixed by the standard.

04 Dimensional Data & Operating Capacities (cont.)

4.2 Pipe body capacity and make-up torque

Nom. size	Weight (lb/ft)	Pipe body yield E-75 (lbs)†	Pipe body yield S-135 (lbs)†	Indicative make-up torque (ft-lbs)†
2 3/8"	6.65	138,000	248,000	5,300
2 7/8"	10.40	214,000	385,000	9,100
3 1/2"	13.30	271,000	488,000	14,300
3 1/2"	15.50	323,000	581,000	19,200
4"	14.00	285,000	513,000	19,200
4"	15.70	315,000	567,000	19,200
4 1/2"	16.60	331,000	595,000	25,900
4 1/2"	20.00	412,000	741,000	30,800
5"	19.50	395,600	712,000	38,300
5"	25.60	530,000	954,000	43,500
5 1/2"	21.90	437,000	787,000	43,500
5 1/2"	24.70	497,000	895,000	51,600
6 5/8"	25.20	489,000	880,000	58,900
6 5/8"	27.70	534,000	961,000	58,900

† Pipe body yield is calculated from nominal wall and grade, excludes tool joint and wear derating, and is indicative only. Make-up torque varies with thread compound, surface condition and connection type; take the value from the connection manufacturer or API RP 7G for the specific assembly.

05 Used Pipe & Double-Shoulder Connections

USED DRILL PIPE (API RP 7G-2)

- API RP 7G-2 covers the inspection and classification of used drill stem elements, including drill pipe and tool joints.
- Used pipe is classified from measured wall thickness, dimensional checks and inspection results, and its ratings are reduced accordingly.
- Class limits, inspection methods and acceptance criteria must be taken from the current edition of API RP 7G-2; they are not reproduced here.

DOUBLE-SHOULDER CONNECTIONS†

- A secondary internal shoulder on the pin shares the make-up load, so torque is carried on two shoulders instead of one.
- Manufacturers typically quote 30–50% higher torsional capacity than an equivalent API single-shoulder connection; the gain depends on connection type and size.
- The larger bore reduces hydraulic pressure loss, and the connection is used where high torque or slim-hole clearance governs, such as extended reach and deepwater wells.

† Double-shoulder connections are proprietary products. API Spec 5DP does not define their torque ratings; the percentage above is a manufacturer figure.

06 Product Specification Levels & Sour Service

PRODUCT SPECIFICATION LEVELS (PSL)

- **PSL-1:** the base requirements of the standard, applicable to every order.
- **PSL-2 and PSL-3:** additional requirements set out in Annex A of API Spec 5DP / ISO 11961; PSL-3 is the most demanding level.
- In practice the higher levels add impact testing and more extensive inspection; the exact scope depends on grade and size.
- State the PSL explicitly on the order. The Annex A criteria of the purchased edition govern acceptance.

SOUR SERVICE (NACE MR0175 / ISO 15156)

- Applies where H_2S is present; the governing risk is sulfide stress cracking, not general corrosion.
- ISO 15156-2 limits the hardness and strength of carbon steels used in sour service.
- High-strength grades such as S-135 (135 ksi / 931 MPa) fall outside those limits and are not used in sour service without specific qualification.
- Material selection and hardness verification remain the purchaser's responsibility.

Note: C-95 is an API 5CT casing and tubing grade, not a drill pipe grade under API Spec 5DP. The PSL descriptions above are summaries; the standard text governs.

07 Hydraulics & Field Handling

- **Pressure loss.** In turbulent flow, pressure drop varies inversely with the fifth power of inside diameter ($\Delta P \propto 1/ID^5$) at a given flow rate. On that basis, moving from a 4 1/2 in, 16.60 lb/ft string (ID 3.826 in) to a 5 in, 19.50 lb/ft string (ID 4.276 in) cuts calculated friction pressure by about 40% at the same flow rate, which lowers equivalent circulating density (ECD).
- **Rig handling.** Inspect threads and shoulders for galling before every trip and apply thread dope evenly. Monitor hardbanding thickness and rotate slip setting positions to limit pipe crushing.

† The 40% figure is a calculated comparison for the two sizes named, assuming equal flow and a fully turbulent regime; it is not a standard value.

08 Selection Guidance & Procurement Checklist

DRILL STRING SELECTION (GUIDANCE)†

- **Shallow wells:** Grade E-75, 3 1/2 in or 4 1/2 in, NC38 / NC46, PSL-1.
- **Deep conventional wells:** Grade G-105 or S-135, 5 in IEU, NC50, PSL-2.
- **ERD and deepwater:** Grade S-135, 5 in or 5 1/2 in double shoulder, PSL-3.
- **Sour wells:** restricted-yield, hardness-controlled material compliant with ISO 15156, PSL-3.

PROCUREMENT CHECKLIST

- State the following on the requisition:
- **1.** Quantity in joints or footage, and length range (R1 / R2 / R3).
- **2.** OD, nominal weight, grade and upset type (IU / EU / IEU).
- **3.** Tool joint connection, OD / ID and shoulder type.
- **4.** Hardbanding, internal coating and PSL level.

† Selection guidance is engineering practice, not a requirement of API Spec 5DP. Final design should follow API RP 7G and the approved well plan.

SCOPE AND VERIFICATION NOTES

This manual summarises API Specification 5DP (1st Edition, 2009), an identical adoption of ISO 11961:2008, together with API RP 7G and API RP 7G-2. Statements marked † are industry practice, typical values, calculated examples or manufacturer data; they are not requirements of the standard. Where a value governs an order, the current edition of the purchased standard prevails. Standard designations referred to: API Spec 5DP, ISO 11961:2008, API RP 7G, API RP 7G-2, NACE MR0175 / ISO 15156.