

HWDP Function and Inspection Data Sheet

Heavy Weight Drill Pipe | API Spec 7-1 Reference | Function, Dimensional Controls, Inspection and Release Records

| Technical Position | Data-Based Summary |
|--------------------|---|
| Primary function | Transition component between flexible drill pipe and rigid drill collars; reduces abrupt stiffness change and helps control fatigue concentration. |
| Standard boundary | HWDP is treated under API Spec 7-1 / ISO 10424-1 rotary drill stem elements, not as normal API 5DP drill pipe. |
| Typical location | Above drill collars / within the bottom-hole assembly transition section; used in directional, high-deviation and extended-reach profiles where stiffness and load transfer are critical. |
| Main release logic | Verify function-critical geometry, connection, bore/drift, alignment, NDT scope, hardness/mechanical records, traceability and marking before shipment or field acceptance. |

| Key Item | Reference Data / Control Point |
|-----------------------------|--|
| Nominal length reference | 31 ft +/- 6 in shown in API 7-1 HWDP dimensional figure; many commercial data sheets also use 31 ft nominal length for per-joint weight. |
| Tool joint alignment | Maximum angular misalignment: 0.010 in/in for tube OD 4 in and smaller; 0.008 in/in for larger sizes. Maximum parallel misalignment: 0.125 in. |
| Bore drift | Welded and integral HWDP bores: minimum 10 ft long drift mandrel; diameter not less than the listed minimum drift diameter. |
| Weld zone hardness | Welded HWDP post-weld heat treatment and HAZ hardness control: surface hardness less than 37 HRC. |
| Tool joint material test | Tensile test: 1 specimen per heat per heat treatment lot. Impact test: 1 set of 3 specimens per heat per heat treatment lot. |
| Thread / shoulder treatment | Gall-resistant treatment of zinc or manganese phosphate applied to threads and sealing shoulders after completion of gauging. |

Reference note: This sheet is a technical reference for website readers and project discussion. Final product acceptance shall follow the latest applicable standard, project ITP, connection OEM procedure and agreed purchase requirements.

1. Functional Role in the Drill String

HWDP is selected for load transition, not merely for higher weight. Its position above the drill collar section helps distribute bending stress, reduce sudden stiffness change and protect connection areas from repeated load concentration. In high-deviation or horizontal wells, torque, drag, side force and cyclic bending act together, making this transition role more important than simple weight comparison.

| Function | What It Controls | Why It Matters in Field Operation |
|------------------------|---|--|
| Stiffness transition | Change from flexible drill pipe to rigid drill collar section | Reduces abrupt load transfer and fatigue concentration near the transition zone. |
| Intermediate weight | Adds weight and stiffness without full drill collar rigidity | Useful where added mass is needed but excessive collar stiffness may increase drag or sticking. |
| Fatigue management | Bending stress around connection / transition areas | Helps reduce cyclic stress in dogleg, high-deviation and build sections. |
| Directional stability | Toolface / BHA response through directional sections | Supports smoother force transfer while retaining more flexibility than drill collars. |
| Wear / contact control | Borehole contact at center upset / spiral areas | Spiral or wear-pad designs may reduce contact area and assist cuttings movement in demanding profiles. |

2. Common Configuration Range

| Category | Typical Options / Notes |
|------------------------|--|
| Construction | Welded HWDP or integral HWDP. 2-7/8 in HWDP is commonly listed as integral-only in some manufacturer data. |
| Body type | Slick / smooth HWDP; spiral / tri-spiral HWDP; other proprietary spiral-weight designs. |
| Common API connections | NC38, NC40, NC46, NC50, 5-1/2 FH, 6-5/8 FH. Alternative connections shall follow manufacturer dimensional, marking and gauging requirements. |
| Common sizes | API dimensional tables include 3-1/2 in, 4 in, 4-1/2 in, 5 in, 5-1/2 in and 6-5/8 in HWDP. Some manufacturer product lines also include 2-7/8 in sizes. |
| Service caution | API text notes that specified HWDP materials are generally not regarded as suitable for sour service or highly corrosive drilling conditions unless engineered and agreed. |

Selected Weight References - Standard HWDP

| Manufacturer Weight Reference | Connection | Tool Joint OD x ID | Weight, lb/ft | Weight, lb/jt |
|-------------------------------|------------|--------------------|---------------|---------------|
| 2-7/8 Standard | NC26 | 3-3/8 x 1-1/2 | 17.26 | 535 |
| 3-1/2 Standard | NC38 | 4-3/4 x 2-1/16 | 25.65 | 795 |
| 4 Standard | NC40 | 5-1/4 x 2-9/16 | 29.92 | 928 |
| 4-1/2 Standard | NC46 | 6-1/4 x 2-3/4 | 41.45 | 1,285 |
| 5 Standard | NC50 | 6-5/8 x 3 | 50.38 | 1,562 |
| 6-5/8 Standard | 6-5/8 FH | 8 x 4-1/2 | 71.43 | 2,214 |

Note: Weight values are manufacturer product references based on 31 ft nominal length and should not be treated as API design ratings.

3. API 7-1 Dimensional Reference - Common HWDP Sizes

The table below condenses API 7-1 Table 27 data into a usable quick-reference format. All dimensions are inches. Tube OD and tool joint OD tolerances are listed separately in the control table that follows.

| Tube OD | Tube ID Options | Tool Joint OD | Tool Joint ID | Connection | Max Elevator Upset Dia. | Center Upset Dia. | Min Drift Dia. |
|---------|-------------------------|-----------------------|-----------------|------------|-------------------------|-------------------|------------------------|
| 3-1/2 | 2-1/4 or 2-1/16 | 4-3/4 (opt. 4-7/8, 5) | 2-1/4 or 2-1/16 | NC38 | 3-7/8 | 4 | 2 or 1-13/16 |
| 4 | 2-1/2 or 2-9/16 | 5-1/4 | 2-1/2 or 2-9/16 | NC40 | 4-3/16 | 4-1/2 | 2-1/4 or 2-5/16 |
| 4-1/2 | 2-11/16, 2-3/4, 2-13/16 | 6-1/4 | Same as tube ID | NC46 | 4-11/16 | 5 | 2-7/16, 2-1/2, 2-9/16 |
| 5 | 3 | 6-5/8 | 3 | NC50 | 5-1/8 | 5-1/2 | 2-3/4 |
| 5-1/2 | 3-1/4, 3-3/8, 3-7/8, 4 | 7 (opt. 7-1/4, 7-1/2) | Same as tube ID | 5-1/2 FH | 5-11/16 | 6 | 3, 3-1/8, 3-5/8, 3-3/4 |
| 6-5/8 | 4, 4-1/2, 5 | 8 (opt. 8-1/4, 8-1/2) | Same as tube ID | 6-5/8 FH | 6-15/16 | 7-1/8 | 3-3/4, 4-1/4, 4-3/4 |

| Dimensional Control | API 7-1 Data Point / Acceptance Meaning |
|---------------------------------|--|
| Tube OD tolerance | +1/16, -1/32 in for listed size. |
| Tool joint OD tolerance | +1/16, -1/32 in for listed tool joint OD. Optional ODs shown in parenthesis require agreement. |
| Tool joint ID tolerance | +1/8, -0 in. |
| Center upset diameter tolerance | +1/16, -1/32 in. |
| Tube ID rule | Maximum tube ID is 1/8 in larger than nominal; minimum tube ID is controlled by drift requirement. |
| Drift diameter basis | Minimum drift diameter is based on ID tolerances of heavy-wall pierced tube used for the center section. |

Release meaning: dimensional review should connect tube OD/ID, tool joint OD/ID, connection type, center upset diameter, drift result and marking. A mismatch in connection, drift or center upset data can affect handling, makeup and BHA compatibility.



4. Function-Critical Inspection Controls

HWDP inspection should focus on the features that protect the transition zone: alignment, bore clearance, surface condition, connection quality, thread/root fatigue controls and weld-zone hardness for welded products.

| Inspection Item | Control Data / Requirement | Why It Matters |
|---------------------------------|--|--|
| Tool joint alignment | Angular misalignment max: 0.010 in/in for 4 in tube OD and smaller; 0.008 in/in for larger sizes. Parallel misalignment max: 0.125 in. | Misalignment increases bending stress and connection loading at the transition zone. |
| Bore / drift | Welded and integral HWDP bores gauged with minimum 10 ft long drift mandrel; diameter not less than minimum drift value. | Confirms bore continuity and reduces risk of internal restriction. |
| Integral tube / all tool joints | Each bar or tube used to manufacture HWDP tool joints or integral HWDP examined for surface and internal defects. | Prevents hidden material defects from entering the high-stress connection system. |
| Welded tube - normalized | Visual inspection of OD and ID. | Confirms basic OD/ID surface condition on normalized material. |
| Welded tube - Q&T; | Surface and internal defect examination required. | Quench and tempered material requires stronger defect control before assembly. |
| Defect disposition | Defects found in drifting or inspection removed within allowable tolerances. | Controls repair while keeping dimensions and wall integrity within limits. |
| Connection stress relief | Optional when specified; recommended where fatigue failures at high-stress points are a problem. | Stress relief contours at pin shoulder / box thread base can reduce fatigue failures. |
| Cold working of thread roots | Optional when specified; gauging to API Spec 7 required before cold working; marked with circle enclosing CW after cold working. | Cold working improves connection fatigue performance while maintaining interchangeability logic. |
| Thread / shoulder treatment | Zinc or manganese phosphate gall-resistant treatment applied after completion of all gauging. | Reduces galling risk during makeup and breakout. |

Allowable Surface Imperfection Removal - Center Upset

| Center Upset Diameter Dcu | Maximum Stock Removal from Surface, in |
|-------------------------------|--|
| Over 2-1/2 to 3-1/2 inclusive | 0.072 |
| Over 3-1/2 to 4-1/2 inclusive | 0.090 |
| Over 4-1/2 to 5-1/2 inclusive | 0.110 |
| Over 5-1/2 to 6-1/2 inclusive | 0.125 |
| Over 6-1/2 | 0.155 |

Additional note: external surface imperfections in machined areas of the tube OD may be blended if the depth is less than 1/16 in.

5. Mechanical, Hardness, Impact and Weld-Zone Data

The following values summarize API 7-1 HWDP tool joint and tube control points most useful for inspection review and release documentation. They should be read together with the project specification and latest applicable standard.

| Part / Test | API 7-1 Data Point |
|--------------------------------------|---|
| Tool joint tensile verification | 1 tensile specimen per heat per heat treatment lot; ISO 6892 or ASTM A370, 0.2% offset method. |
| Tool joint OD 3-1/8 through 6-7/8 in | Min yield 110,000 psi; min tensile 140,000 psi; min elongation 13%; min Brinell hardness 285 BHN. |
| Tool joint OD over 6-7/8 in | Min yield 100,000 psi; min tensile 135,000 psi; min elongation 13%; min Brinell hardness 285 BHN. |
| Tool joint hardness test | Each bar or tube used for tool joints; OD hardness test by Brinell, Rockwell C acceptable alternative; ISO 6506-1 or ASTM A370. |
| Impact test temperature | Charpy V-notch impact tests at 70 deg F +/- 5 deg F; lower-temperature tests acceptable if criteria are met. |
| Impact specimen frequency | 1 set of 3 specimens per heat per heat treatment lot. |
| Impact acceptance | Average of three specimens \geq 40 ft-lbs; no single value $<$ 35 ft-lbs. |
| Sub-size Charpy factors | 10 x 10 mm = 1.00; 10 x 7.5 mm = 0.833; 10 x 5 mm = 0.667; specimens below 5 mm not permitted. |
| Welded HWDP tube material | Normalized, normalized and tempered, or quench and tempered seamless alloy steel. |
| Welded HWDP tube mechanical minimums | Tensile strength 95,000 psi; yield strength 55,000 psi; elongation 18%. |
| Integral HWDP tube | Material shall meet tool joint requirements. |
| Weld design | Weld strength must exceed tube section strength; weld shall not be located in the radius between tube upset and tool joint taper. |
| Weld procedure / PWHT | Written welding procedure required; post-weld heat treatment to ensure hardness $<$ 37 HRC and minimum weld yield strength. |
| Weld-zone hardness | Each weld zone hardness tested in HAZ to show surface hardness $<$ 37 HRC. |

Inspection meaning: For welded HWDP, dimensional checks alone are not enough. Release review should include weld-zone hardness, material heat identity, mechanical test linkage, connection treatment, drift status and traceability records.

6. Inspection Data Sheet for Release Review

This checklist converts the function and standard data into practical release questions for HWDP inspection records. It is intended for use below the blog section where HWDP function and inspection controls are discussed.

| Release Checkpoint | Data / Record to Verify | Hold Point if Missing or Conflicting |
|------------------------------|---|---|
| Specification identity | Size, construction type, body type, connection, nominal length, tool joint OD/ID, center upset and drift requirement. | Connection or dimensional data differs from specification / BHA requirement. |
| Dimensional inspection | Tube OD/ID, tool joint OD/ID, max elevator upset, center upset Dcu, length, straightness and drift. | OD/ID or drift does not match listed configuration or agreed drawing. |
| Alignment | Angular and parallel misalignment results or inspection record. | Angular result exceeds 0.010 in/in (≤ 4 in OD) or 0.008 in/in (> 4 in OD), or parallel exceeds 0.125 in. |
| Surface / upset area | Center upset surface condition, blended repair depth, OD/ID visual records. | Grinding / blending depth exceeds allowable surface removal or repair note is missing. |
| Connection inspection | Thread, shoulder, seal surface, gauge basis, gall-resistant treatment and protector condition. | Connection damage, no treatment record, inconsistent gauge basis or missing protector. |
| Stress relief / cold working | Boreback / relief groove when specified; cold-work marking CW after gauging when applicable. | Specified fatigue-control features absent or not traceable. |
| NDT / material inspection | Surface and internal defect examination according to construction and heat treatment route. | No NDT record for required integral / tool joint / Q&T; tube scope. |
| Mechanical tests | Tensile, hardness and impact records by heat and heat treatment lot. | No heat / lot linkage or values do not meet minimum requirements. |
| Weld-zone controls | Written welding procedure, PWHT, destructive qualification and HAZ hardness < 37 HRC for welded HWDP. | Weld-zone hardness, PWHT or procedure qualification not documented. |
| Traceability and marking | Heat identity, chemical analysis, specified mechanical tests, API SPEC 7-1 / ISO 10424-1 marking and traceability ID. | Marking placed in high-stress area, missing traceability ID, or records cannot link pipe body and tool joints. |

Recommended Release Document Package

| Recommended Document Package | Purpose |
|-------------------------------------|---|
| MTC / material certificate | Links heat number, chemistry and mechanical properties. |
| Dimensional inspection report | Confirms OD/ID, upsets, tool joint dimensions, length and drift. |
| NDT report | Confirms required surface / internal defect examination scope. |
| Hardness and impact records | Supports tool joint, weld-zone and heat-treatment acceptance. |
| Connection inspection record | Confirms thread, shoulder, gauging, treatment and protector status. |
| Traceability / marking photo record | Links visible marking to API SPEC 7-1 / heat / lot / shipment identity. |

Reference basis: API Spec 7-1 / ISO 10424-1 HWDP clauses and published manufacturer data. Data in this sheet should be verified against the latest controlled standard, the project ITP and connection OEM requirements before final technical release.