

Specification for Rotary Drill Stem Elements

ANSI/API SPECIFICATION 7-1
FIRST EDITION, MARCH 2006

EFFECTIVE DATE: SEPTEMBER 2006
ADDENDUM 1: JANUARY 2007

CONTAINS API MONOGRAM ANNEX AS PART OF US
NATIONAL ADOPTION.

ISO 10424-1:2004 (Identical), Petroleum and natural gas industries—Rotary drilling equipment—Part 1: Rotary drill stem elements



Addendum 1 to Specification for Rotary Drill Stem Elements

Add the following new clause 10. Renumber the current clause 10 Nondestructive examination of bars and tubes and sub clauses as clause 11.

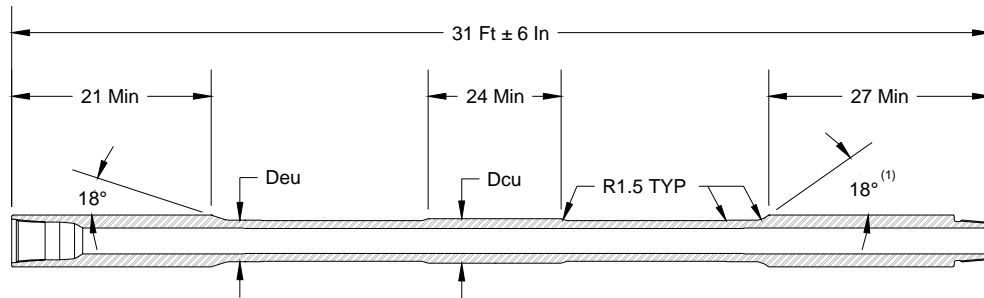
10 Heavy Weight Drill Pipe (HWDP)

10.1 General

This standard covers the manufacturing specifications of heavy weight drill pipe that is most commonly utilized in bottom-hole assemblies. This product should not be confused with heavy wall (or heavy weight) drill pipe manufactured to meet API Spec 5D. It should be understood that the materials specified herein are generally not regarded as suitable for sour service or other highly corrosive drilling conditions, and the User is advised to take this into account when initiating purchase agreements for heavy weight drill pipe if such drilling conditions are anticipated.

10.1.1 Sizes

Heavy weight drill pipe (HWDP) shall be furnished in the sizes and dimensions shown in Table 27 and as illustrated in Figure 11.



- 1 35 degree taper on the pin end at the manufacturers option.
- 2 All dimensions are in inches, except as noted.
- 3 The center upset shall be located approximately mid length of the tube.

Note – The above dimensions apply to both integral and welded Heavy Weight Drill Pipe.

Figure 11 — Dimensions of Heavy Weight Drill Pipe

10.1.2 Outside diameter tolerances

The tube and tool joint outside and inside diameter dimensions and tolerances shall comply with those specified in Table 27.

10.1.3 Tool joint alignment

The maximum angular misalignment between the tube and tool joint shall be 0.010 in/in for 4 in tube OD and smaller, and 0.008 in/in for larger sizes. The maximum parallel misalignment shall be 0.125 in. The misalignment measurements shall be taken at the mid-point of tool joint outside diameter.

10.1.4 Bores

All welded and integral HWDP bores shall be gauged with a drift mandrel 10 ft long minimum. The drift mandrel minimum diameter shall not be less than the Min Drift Diameter shown in Table 27. If Integral product is drilled from each end the match point shall be located under the center upset.

All dimensions are in inches

Size	Tube OD (+1/16, -1/32)	Tube ID ¹	Tool Joint OD (+1/16, -1/32) ²	Tool Joint ID (+1/8, -0)	Connection	Max Elevator Upset Dia	Center Upset Dia. (+1/16, -1/32)	Min. Drift Dia. ³
						D _{eu}	D _{cu}	
3 1/2	3 1/2	2 1/4	4 3/4 (4 7/8, 5)	2 1/4	NC 38	3 7/8	4	2
		2 1/16		2 1/16				1 13/16
4	4	2 1/2	5 1/4	2 1/2	NC 40	4 3/16	4 1/2	2 1/4
		2 9/16		2 9/16				2 5/16
4 1/2	4 1/2	2 11/16	6 1/4	2 11/16	NC 46	4 11/16	5	2 7/16
		2 3/4		2 3/4				2 1/2
		2 13/16		2 13/16				2 9/16
5	5	3	6 5/8	3	NC 50	5 1/8	5 1/2	2 3/4
5 1/2	5 1/2	3 1/4	7 (7 1/4, 7 1/2)	3 1/4	5 1/2 FH	5 11/16	6	3
		3 3/8		3 3/8				3 1/8
		3 7/8		3 7/8				3 5/8 3/4
		4		4				3 3/4
6 5/8	6 5/8	4	8 (8 1/4, 8 1/2)	4	6 5/8 FH	6 15/16	7 1/8	3 3/4
		4 1/2		4 1/2				4 1/4
		5		5				4 3/4

1 Maximum tube ID is 1/8 larger than nominal. Minimum tube ID is controlled by the drift requirement.
2 Optional Tool Joint OD's shown in parenthesis, to be agreed between purchaser and manufacturer.
3 Drift Diameter is based on ID tolerances of heavy wall pierced tube used for the center section.

Table 27 — Dimensions of Heavy Weight Drill Pipe

10.1.5 Material inspection requirements

10.1.5.1 Integral HWDP tube, and all tool joints

Each bar or tube used to manufacture HWDP tool joints or integral HWDP shall be examined for both surface and internal defects in accordance with Clause 11 of ISO 10424-1/API Spec 7-1.

10.1.5.2 Welded HWDP tube

Tubes manufactured from normalized material shall receive a visual inspection of the OD and ID. Tubes manufactured from quench and tempered material shall be examined for both surface and internal defects in accordance with Clause 11 of ISO 10424-1/API Spec 7-1.

10.1.5.3 Disposition of defects

All defects discovered in drifting or inspection shall be removed, within allowable tolerances.

10.1.6 External surface condition

The external surface on the center upset shall be hot rolled mill finished or better. Hot rolled mill finish imperfections may be removed by grinding. If imperfections are removed, the depth of removal shall comply with Table 28 and grinds shall be contoured with the surface of the upset.

External surface imperfections in machined areas of the tube OD may be blended to remove them if the depth is less than 1/16".

Diameter tolerances shall not be applied to localized areas of imperfection removal.

1	2
Center upset diameter (D_{cu})	Maximum stock removal from surface
Over 2 ½ to 3 ½ inclusive	0.072
Over 3 ½ to 4 ½ inclusive	0.090
Over 4 ½ to 5 ½ inclusive	0.110
Over 5 ½ to 6 ½ inclusive	0.125
Over 6 ½	0.155

Table 28 — Allowable Surface Imperfection Removal

10.1.7 Connections

10.1.7.1 Size and type

Heavy weight drill pipe shall be furnished with box up and pin down connections listed in Table 27. The connections shall conform to the dimensional and gauging requirements of API Spec 7.

NOTE Alternative connections not listed in Table 1 are not covered by this standard. When alternative connections are specified in the purchase agreement by the user, they should be specified to conform to the mechanical properties, dimensions, marking and gauging requirements specified by the manufacturer of the alternative connection.

10.1.7.2 Connection stress relief features

Stress relief features are optional. When specified in the purchase agreement, stress relief features complying with the dimensions specified in API Spec 7 shall be provided.

The surfaces of stress relief features shall be free of stress risers such as tool marks and steel stencil impressions. Laboratory fatigue tests and tests under actual service conditions have demonstrated the beneficial effects of stress relief contours at the pin shoulder and at the base of the box thread. It is recommended that, where fatigue failures at points of high stress are a problem, stress relief features be provided.

The boreback design is the recommended relief feature for box connections. However, the box relief groove design has been shown to also provide beneficial effects. It may be used as an alternate to the boreback design.

Stress relief features will cause a slight reduction in the tensile strength of the pin and the section modulus of the connection. However, under most conditions this reduction in cross-sectional area is more than offset by the reduction in fatigue failures. If unusually high tensile loads are expected, calculations of the effect should be made.

10.1.7.3 Cold working of thread roots

When specified in the purchase agreement, cold working of thread roots shall be provided. Method of cold working is optional with the manufacturer.

As with stress relief features, laboratory fatigue tests and tests under actual service conditions have demonstrated the beneficial effects of cold working the thread roots of rotary shouldered connections. It is recommended that, where fatigue failures at points of high stress are a problem, cold working be provided.

If threads are cold worked, they shall be gauged to API Spec 7 requirements before cold working.

Gauge standoff will change after cold working of threads, and may result in connections that do not fall within the specified ISO gauge standoff if gauged after cold working. This will not affect the interchangeability of connections and will improve connection performance. It is therefore permissible for a connection to be marked as complying with the requirements of API Spec 7 if it meets the standoff requirements before cold working. In such event, the connection shall also be stamped with a circle

enclosing “CW” to indicate cold working after gauging. The mark shall be located on the connection as follows:

- a) pin connection — at the small end of the pin.
- b) box connection — in box counterbore.

10.1.8 Gall-resistant treatment of threads and sealing shoulders

A gall-resistant treatment of zinc or manganese phosphate shall be applied to the threads and sealing shoulders of all end connections of heavy weight drill pipe. Application of the treatment shall be after completion of all gauging. The treatment type shall be at the discretion of the manufacturer.

10.2 Mechanical properties

10.2.1 Tool joints

10.2.1.1 Tensile requirements

The tensile properties of the material used to manufacture HWDP tool joints, shall comply with the requirements of Table 29 .

These properties shall be verified by performing a tensile test on one specimen per heat per heat treatment lot.

Tensile properties shall be determined by tests on cylindrical specimens conforming to the requirements of ISO 6892 or ASTM A 370, 0.2 % offset method.

10.2.1.2 The tensile specimen may be taken from either end of the bar or tube. The specimen shall be machined so that the center point of the gauge area is located a minimum of 100 mm (4 in) from the end of the bar or tube. The tensile specimen shall be oriented in the longitudinal direction with the center line of the specimen shall be taken from material at or below the gage point diameter of the connection. Hardness requirements.

A hardness test shall be performed on each bar or tube used to manufacture tool joints. The hardness test shall be on the outside diameter of the bar or tube using Brinell hardness (Rockwell C acceptable alternative) test methods in compliance with ISO 6506-1 or ASTM A 370 requirements. The hardness shall conform to the requirements of Table 29.

1	2	3	4	5
Tool joint OD range	Minimum yield strength	Minimum tensile strength	Minimum elongation, with gauge length four times diameter	Minimum Brinell hardness
in	psi	psi	%	BHN
3 1/8 through 6 7/8	110 000	140 000	13	285
over 6 7/8	100 000	135 000	13	285

Table 29 — Mechanical Properties for Tool Joints

10.2.1.3 Impact strength requirements

10.2.1.3.1 General

Charpy V-notch impact tests shall be conducted on specimens conforming to the requirements of ISO 148 or ASTM A 370 and ASTM E 23 and shall be conducted at a temperature of 70 °F ± 5 °F. Tests conducted at lower temperatures that meet the requirements stated in 10.2.1.3.4 are acceptable.

10.2.1.3.2 Specimens

One set of 3 specimens per heat per heat treat lot shall be tested.

The impact specimens shall be taken from material at or below the gage point diameter of the connection. The specimens shall be longitudinally oriented and radially notched.

10.2.1.3.3 Specimen size

Full size (10 mm × 10 mm) shall be used except where there is insufficient material, in which case the next smaller standard sub-size specimen obtainable shall be used.

If it is necessary to use sub-size test specimens, the acceptance criteria shall be multiplied by the appropriate adjustment factor listed in Table 30. Sub-size test specimens less than 5 mm are not permitted.

Specimen dimensions mm × mm	Adjustment factor
10 × 10	1.00
10 × 7.5	0.833
10 × 5	0.667

Table 30 — Adjustment Factors for Impact Specimens

10.2.1.3.4 Acceptance criteria

The average of the three specimens shall be 40 ft-lbs or greater with no single value less than 35 ft-lbs.

10.2.2 Tubes

10.2.2.1 Welded HWDP tube

Tubes shall be manufactured from normalized, normalized and tempered, or quench and tempered seamless alloy steel, meeting the following mechanical property requirements:

Min. Tensile Strength (psi)	95,000
Min. Yield Strength (psi)	55,000
Min. Elongation (%)	18

10.2.2.2 Integral HWDP tube

The material for integral heavy weight drill pipe tubes shall meet the requirements of 10.2.1 (Tool joints) of this specification.

10.3 Assembly

The design of the tool joint to the tube weld shall be such that the weld is not located in the radius between the tube upset and tool joint taper. The design of the weld shall ensure that the strength of the weld (cross sectional area of the weld times the minimum yield strength of the weld) exceeds the strength of the tube section (minimum cross sectional area of the tube times the minimum yield strength of the tube).

The welding shall be performed in accordance with a written procedure that specifies the essential and non-essential welding variables. The welding procedure shall include a post-weld heat treatment to ensure that the hardness is less than 37 HRC and that the minimum weld yield strength is satisfied. The welding procedure shall be qualified by destructive testing to demonstrate that the minimum yield strength and hardness requirements of the weld is satisfied. The welding machine operators shall be qualified by documenting completion of a weld that satisfies these requirements.

Each weld zone shall be hardness tested in the heat affected zone to demonstrate the surface hardness of the weld zone is less than 37 HRC. The hardness testing method is optional with the manufacturer.

10.4 Traceability

The heavy weight drill pipe manufacturer shall establish and follow procedures for maintaining heat identity. The methods of maintaining identity shall be at the option of the manufacturer. These procedures shall provide means for tracing the tool joints and pipe body to the relevant heat, chemical analysis report, and specified mechanical test results. Lot identity shall be maintained until all required lot tests are performed and conformance with specified requirements has been shown.

10.5 Marking

Heavy weight drill pipe conforming to this standard shall be steel stencil stamped on the taper on the pin end and/or on a tool joint OD or center upset with the manufacturer's name or mark, API SPEC 7-1, and traceability identification. If a slot is used on the center upset, the depth shall not be below tube OD. Stamping shall not be done in highly stressed areas such as the radius between the tube and tool joint taper, weld line, or the tube OD.

The example below illustrates these marking requirements:

EXAMPLE

A B Co (or mark)	API SPEC 7-1	Traceability Identification
------------------	--------------	--------------------------------

The following is an errata item effective immediately.

Annex B, Add the following B.1.1:

E.1.1 A license shall mark either API Spec 7-1 or ISO 10424-1, or both.

Additional copies are available through IHS

Phone Orders: 1-800-854-7179 (Toll-free in the U.S. and Canada)
303-397-7956 (Local and International)
Fax Orders: 303-397-2740
Online Orders: global.ihs.com

Information about API Publications, Programs and Services
is available on the web at www.api.org



1220 L Street, NW
Washington, DC 20005-4070
USA

202.682.8000

Product No. XXXXXX