

4145H DRILL COLLAR MATERIAL, HEAT TREATMENT AND HARDNESS REVIEW GUIDE

API 7-1 reference review for material identity, quench-and-temper control and release evidence

4145H modified drill collars are heavy-wall, high-strength components used in the Bottom Hole Assembly (BHA) near the bit to provide weight on bit, stabilize the drill string and transmit torque. Because they operate under extreme cyclic loading, compressive stress and abrasion, material identity, heat treatment consistency and hardness review are critical release points that directly impact performance, fatigue life and field reliability.



PRODUCT

API 7-1
Drill Collar



MATERIAL

AISI 4145H
Modified alloy steel
or approved
equivalent



HEAT TREATMENT

Quenched
and tempered



SERVICE POSITION

Bottom Hole
Assembly



ENGINEERING NOTE



This guide focuses on the key release criteria for 4145H drill collars in accordance with API 7-1, including material identity verification, quench-and-temper (Q&T) process control and hardness evidence prior to shipment release.

02 MATERIAL IDENTITY REVIEW

Material identity verification ensures the drill collar body conforms to the required specification before further processing or assembly. Review and document the criteria below using objective evidence from the manufacturer's test certification and physical markings.

Review Item	What to Confirm	Why It Matters
 Material Grade	Verify the grade is 4145H MOD as specified on the purchase order and MTC.	Ensures the material meets the required strength, toughness, and hardenability for drill collar service.
 Heat Number	Confirm the heat number on the MTC matches the marking on the drill collar body.	Ensures full material traceability from the steel mill to the final component.
 Chemical Composition	Verify chemical composition meets API 7-1 requirements for 4145H MOD.	Confirms the alloy meets specification limits that control hardenability and mechanical performance.
 Mechanical Properties	Confirm the mechanical properties meet API 7-1 requirements for 4145H MOD.	Ensures the material will perform as required under high stress and cyclic loading conditions.
 Surface Condition	Inspect the surface for defects such as cracks, seams, laps, or inclusions.	Surface defects can compromise fatigue life and lead to premature failure.



TECHNICAL NOTE



Verify all material identity data against the approved purchase order and the requirements of API 7-1.

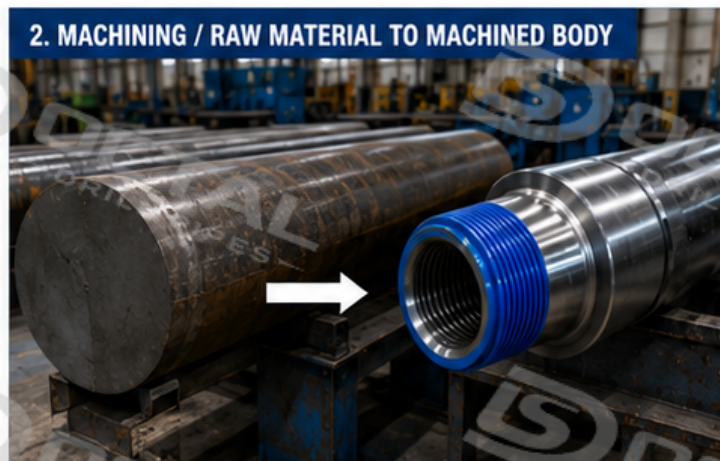
Confirm that the material grade, heat number, chemical composition, mechanical properties, and surface condition are supported by the manufacturer's Mill Test Certificate (MTC) and physical markings on the drill collar body.

Specific numerical values are not shown in this guide unless provided by the manufacturer.

1. PRODUCT MARKING (TYPICAL)



2. MACHINING / RAW MATERIAL TO MACHINED BODY



3. MILL TEST CERTIFICATE (MTC)



03 HEAT TREATMENT CONTROL

Controlled quench-and-temper heat treatment is the primary method for achieving a balanced microstructure in 4145H drill collars. Precise control of austenitizing, quenching severity, and tempering ensures the material develops uniform hardness and toughness through the heavy wall section. This balance stabilizes strength and impact resistance under extreme cyclic loading, reduces the risk of brittle failure, and delivers consistent hardness response for reliable Bottom Hole Assembly (BHA) performance.



04 HARDNESS REVIEW

Hardness testing confirms that the drill collar material has responded correctly to quench-and-temper heat treatment, achieving the specified balance of strength and toughness. Consistent hardness across the body and shoulder area helps ensure predictable behavior under cyclic loading, resisting bending, torsion, and impact in downhole service.

Reviewing hardness evidence also helps manage cracking sensitivity and wear performance. Over-hard material can be brittle and prone to stress corrosion or fatigue cracking, while low or uneven hardness can reduce yield strength and accelerates wear on bearing surfaces and connections. Verifying hardness within the approved range protects connection make-up integrity, extending service life and reducing unplanned downtime.



Hardness Review Point	Inspection Meaning	Risk Controlled
 Representative hardness values	Multiple hardness checks taken on body and shoulder confirm quench-and-temper response is consistent.	Ensures overall uniformity and reliable mechanical performance.
 Over-hard condition	Hardness above the approved range indicates excessive hardness and reduced toughness.	Controls risk of brittleness, stress corrosion cracking, and fatigue under cyclic loading.
 Low or uneven hardness	Hardness below range or with high variation indicates insufficient or non-uniform heat treatment.	Prevents reduced strength, poor wear resistance, and unpredictable field performance.
 Record matching	Hardness results must be traceable to the specific drill collar via heat number/LOT and serial/markings.	Ensures traceability, protects product identity, and validates compliance to specification.

 **ENGINEERING INTERPRETATION NOTE**

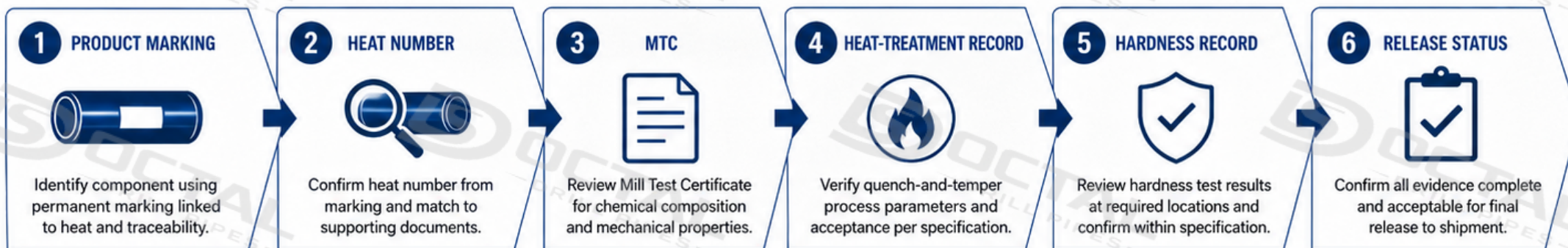


Exact hardness values are not displayed when individual measurements are not provided. The hardness review confirms that all results are within the approved specification range for the material and product condition. This verification must be supported by calibrated testing, appropriate locations (body and shoulder), and documented results that are linked to the drill collar's unique product identity (heat number/LOT and serial/markings). Only hardness results within range and fully traceable to the product should be accepted for release.

05 RELEASE EVIDENCE

DOCUMENTATION FLOW AND EVIDENCE REQUIREMENTS

Consistent collection and verification of release evidence ensures that every 4145H drill collar meets material, heat treatment and hardness requirements prior to shipment.



EVIDENCE ITEM	RELEASE PURPOSE	WHY IT MATTERS
Product Marking	Links the physical part to its heat and documents.	Ensures traceability from steel melt to finished component.
Heat Number	Confirms the steel heat used in manufacturing.	Prevents mix-ups and ensures correct document package is applied.
MTC	Verifies material chemistry and mechanical properties.	Confirms the steel meets the required API 7-1 and 4145H specification.
Heat-Treatment Record	Confirms quench-and-temper process and acceptance.	Ensures proper properties and performance for service.
Hardness Record	Verifies hardness testing at required locations.	Confirms component strength and resistance to wear and fatigue.
Release Status	Documents final review and approval for shipment.	Provides assurance that all release criteria have been met.



ENGINEERING NOTE

Hardness review should be treated as a release item, not as a simple certificate line.