

Material Grade: **4145mod (30-36HRc)**  
 Material Condition(s): **Untreated / Annealed / Quench and tempered (optionally also Stress Relieved)**  
 Surface Finish: **As rolled / As forged / Bright turned**

Associated Standard: **ASTM A29**  
**ASTM A322**

Description:

This Chromium-Molybdenum through hardening steel is typically used for downhole applications. Similar to 4140 except with a higher carbon level resulting in greater strength, hardenability and ruling sections making this grade more suitable for application with larger section size and higher strength requirements. In the 'as-quenched' state, hardness's of 55-62HRc are achievable. This grade demonstrates good forgeability but must be controlled through cooling due to its susceptibility to cracking. Care should also be taken when quenching, ensuring control over the quench medium, for the same reasons. Impact toughness is reduced due to the increased carbon content. Weldability is also poor and is often carried out by more sophisticated methods such as plasma arc or electron beam.

Typical applications: **Drill collars, drill bits, crossover subs, tool joints**

**1. STEELMAKING**

Method/ Refining: **Electric Arc Furnace / Basic Oxygen Furnace followed by VDG**  
 Grain Size: **5-8**  
 Min. reduction ratio: **4:1 min (typically 3:1 on sections > 300mm)**

	<u>C</u>	<u>Si</u>	<u>Mn</u>	<u>S</u>	<u>P</u>	<u>Cr</u>	<u>Ni</u>	<u>Mo*</u>	<u>V</u>	<u>Al</u>	<u>Cu</u>	<u>Sn</u>
Min	0.43	0.20	0.85			0.90		0.25		0.010		
Max	0.49	0.30	1.10	0.020	0.015	1.20	0.25	0.35	0.05	0.035	0.25	0.035

\* Mo content is often modified to 0.30-0.35 to ensure greater hardenability

**2. TYPICAL MECHANICAL PROPERTIES**

Test type			Tensile and hardness test (at room temperature)					Impact test (KV)		
			Yield (Re)	0.2 % proof	UTS (Rm)	Elong (A)	R of A (Z)	Hardness	RT	-46°C
Variation	Sample dia	Unit	<i>KSI</i>	<i>KSI</i>	<i>KSI</i>	%	%	<i>HRc (HB)</i>	J	J
4145 + QT	150mm	Min		130	145	15	40	30 (286)	54	27
		Max			160			36 (336)		
4145 + QT	230mm	Min		120	140	14.5	40	30 (286)	54	27
		Max			160			36 (336)		
4145 + QT	320mm	Min		110	130	13	35	30 (286)	54	
		Max						36 (336)		

**3. INSPECTION**

NDT procedure: **ASTM A388/A388M**  
 Acceptance Standard **API 6A PSL Level 3 & API 7-1**