



EH9

9% Chromium Sucker Rod & Coupling
for Corrosive & Deviated Applications

EH9

Chromium Sucker Rod

After years of research and development, engineers at Exceed have found a special Chromium Alloy Steel and developed EH9 steel grade. This new product not only can withstand extreme corrosion, it also delivers ultra-high tensile and fatigue performance, making it the rod of choice for the toughest wells.

EH9	VS	Other Approaches
* Stop corrosion at surface		* Rely on chemical treatment
* Superior cycle life performance		* Frequent rod failure / work-overs
* Long operating life		* Interrupted production operation
* Reduce downtime, improve production		* Surface protection susceptible to scrape and scratch
* Base material is anti-corrosion		

Inside EH9's special alloy, abundant (~10%) Chromium atoms diffuse much faster than that in conventional Carbon alloys. In corrosive environments, a chromium-rich passivation layer forms on the grain boundary, effectively stopping the corrosion process at the material surface while protecting the integrity of the micro-structure inside.

Significantly reducing Carbon content (<0.03%) also eliminates the carbon-chromium compound precipitation along grain boundaries. This also improves the material's abrasion performance; not only protecting itself, but all other material it comes in contact with.

Small amounts of Mo, Ni, Al added to the material act as an anodic process blocker; while Cr, Cu, Si, Mn and other rare earth metals promote a cathodic process and surface activity. As a result, these further improve its corrosion performance against acidic mediums including CO₂, H₂S and HCl and electrochemical corrosion.

Lab Test Result

Test Condition	Corrosion Rate
H ₂ S - 0.1 Mpa	≤0.04mm/yr
CO ₂ - 2.0 Mpa	≤0.06mm/yr
Brine - 120,000ppm (Ca ²⁺ , Cl ⁻ , Mg ²⁺ , SO ₄ ²⁻ , HCO ₃ ⁻ , Na ⁺)	≤0.03mm/yr

Mechanical Properties

Tensile Strength		Yield	Fatigue Strength			Elongation	Reduction
Ksi	Mpa	Ksi	Mpa	σ0.1 MPa	cycles	2", %	%
140-170*	965-1172	≥115	≥793	540	≥1x10 ⁶	≥10	≥45

Chemical Composition

C	Mn	Cr	Ni	Si	Mo	Nb	Cu	P	S	Al
0.035 Max	0.60-1.00	9.0- 11.0	0.40-0.80	0.05 Max	0.20-0.35	0.03-0.05	0.30-0.50	0.02 Max	0.005 Max	0.006 Max

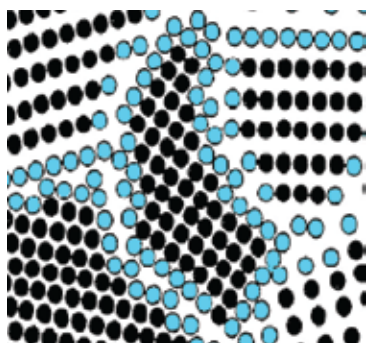


Figure 1. Chromium-rich passivation layer form on grain boundaries

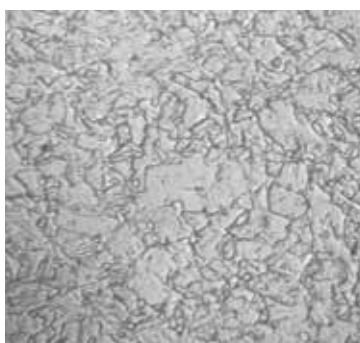


Figure 2. EH9 - Grain Structure (400X)



Figure 3. EH9 rod shows no visible corrosion after 280 days of operation



Figure 3. EH9 coupling (after 280 days) vs. T coupling (after 180 days)

EH9 Coupling

Severe Deviation Mitigation

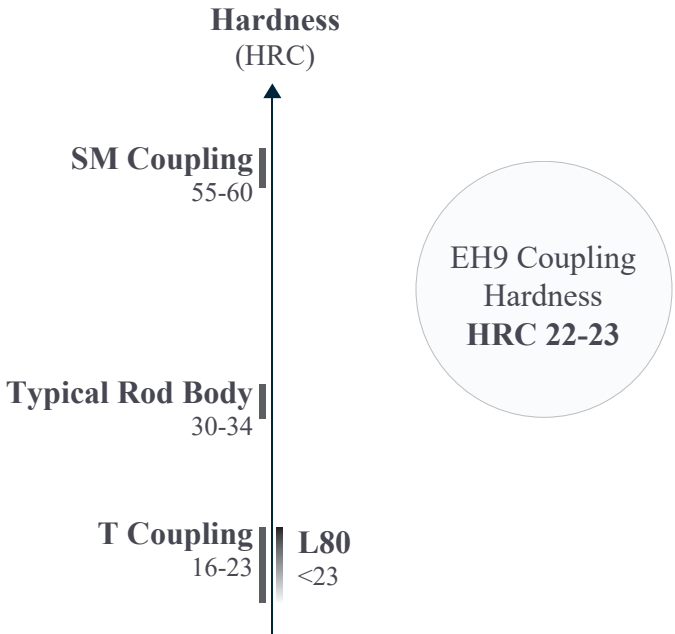
Traditional T and SM couplings both have limitations operating in severely deviated well sections, especially when corrosion is present. SM couplings can better resist corrosion and does not wear easily; however, its higher surface hardness often cause excessive tubing wear. The T coupling is softer and does not cause tubing wear, but under the combined effect of corrosion and abrasion, it does not last long before it has to be replaced. As a result, the operator has to choose between frequent work-over jobs to replace T coupling, or dealing with tubing leaks. Neither is desirable.

EH9 Coupling's material is a special steel that contains 9%-11% and no carbon. It resists common corrosive agents including H₂S, CO₂ and bacteria. EH9 outperforms SM couplings even in the harshest environment. At the same time, EH9 maintains the same hardness level as T grade coupling, 56-62 HRA (16-23 HRC), and reduces tubing wear risks even in the severely deviated wells with significant amount of side loading.

Dimension, tensile strength, torque performance and other properties of EH9 coupling comply to API11-B specifications.

The copper plated threads and side surfaces ensure easy and reliable makeup and reduced risk of galling. Regular torque cards provided by rod manufacturer should be used to make-up with EH9 coupling. No special procedure is required.

T Coupling	SM Coupling
<ul style="list-style-type: none"> * Softer * Doesn't wear tubing * Susceptible to corrosion * Wears off quickly 	<ul style="list-style-type: none"> * Harder * Wears off tubing * Resist to corrosion * Wears away slower
↓	↓
<ul style="list-style-type: none"> * Less expensive but frequent rod walkovers 	<ul style="list-style-type: none"> * Less frequent but more expensive tubing jobs



Mechanical Properties

Tensile Strength		Reduction	
ksi	2", %	%	(HRA)
95-120	>16	>50	56-62

Corrosion Factor for T coupling

When Tubing and T coupling rub against each other, the protective corrosion scale is removed in the process, resulting in accelerated corrosion wear, hence shorter run time for T coupling.



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