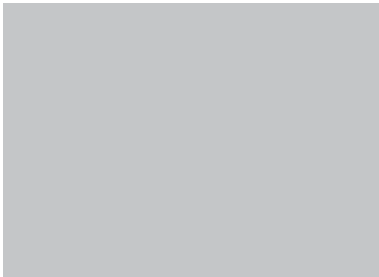


EndurAlloy™
Abrasion and Corrosion Resistant Solutions

Applications
and Benefits



The EndurAlloy™ surface is comprised of one atom of boron and one atom of iron, which combine to create a molecule of iron boride. EndurAlloy™ provides excellent corrosion resistance because it is inert and non-reactive to most of the corrosive elements found in oil and gas production.

EndurAlloy™

EndurAlloy™ Tubing offers a unique combination of corrosion, abrasion and erosion resistance that can reduce or eliminate tubing failures for oil and gas production.

EndurAlloy™ is an alloyed surface created by diffusing boron into the substrate of carbon steel approximately .015". The alloyed surface is very hard, up to 90 Rockwell C, and offers superior protection against rod wear, erosion caused by sandy fluids, and other factors that cause premature tubing failure.

While full strings of EndurAlloy™ Tubing are used in extremely corrosive environments, the most common applications are one to five joints above the pump and five to twenty joints around deviations where both wear and corrosion are present. Customers generally receive between three and ten times the run-time of bare steel tubing. EndurAlloy™ Tubing costs more than bare steel tubing but there is a quick return on this investment through increased revenue on stream and reduced costs related to fewer workovers and well servicing requirements.

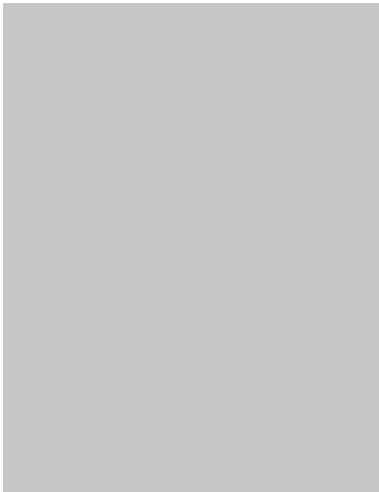
More than 50,000 joints of EndurAlloy™ Tubing have been put into service in the North American oil and gas industry in a variety of challenging downhole environments.

Technical Benefits

- High corrosion-resistance to H₂S, CO₂, chlorides, produced water
- Wire-lining, swabbing, pulling the pump and other down-hole operations will not damage the alloyed surface and create holidays in the surface, where corrosive elements can attack
- No corrosion caused by dissimilar metals
- No loss of inside diameter, as with coated tubing
- Withstands high H₂S concentrations, unlike some coated tubing
- Base tubing is standard J55 joint, so no special handling required for ID-treated product
- Available in 2-3/8", 2-7/8", 3.5" and up to 5.5"

Corrosion Applications

- Highly corrosive production environments: H₂S, CO₂, chlorides, produced water
- Environments with high wear and corrosion
- Water source wells
- Acid gas injection wells



Test Data

Pressurized Atlas Cell Test (NACE TM0174-91)

Test objective:

Determine effects of simulated oil field service on the EndurAlloy™ (boronized) Tubing utilizing produced fluids and gas mixtures EndurAlloy™ would be exposed to in field service conditions. A boronized sample was exposed to an environment consisting of 70 degrees C, 3.4 MPa/500 psi, 7% H₂S, 80% CO₂, 12% CH₄, produced crude and produced water. The test was conducted for 120 days, with 14 and 64 day interim ratings. The report concluded that “the coating provided excellent protection to both the weld and the edges of the welded piece of steel. No corrosion was noted, indicating complete coverage of the irregular shapes and sharp edges. No evidence of coating deterioration or corrosion of the substrate was detectable at any of the rating intervals.”

Evaluation of Inorganic Chemical Vapour

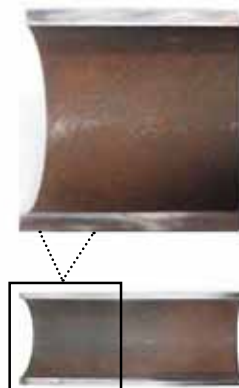
Deposition Coatings in an Autoclave Test (NACE 0174-95-01T)

Test objective:

Determine effects of simulated oil field service on the EndurAlloy™ (boronized) Tubing utilizing produced fluids and gas mixtures EndurAlloy™ would be exposed to in field service conditions. A boronized sample was exposed to an environment consisting of 70 degrees C, 3.4 MPa/500 psi, 7% H₂S, 80% CO₂, 12% CH₄, produced crude and produced water. The test was conducted for 120 days, with 14 and 64 day interim ratings. The report concluded that “the coating provided excellent protection to both the weld and the edges of the welded piece of steel. No corrosion was noted, indicating complete coverage of the irregular shapes and sharp edges. No evidence of coating deterioration or corrosion of the substrate was detectable at any of the rating intervals.”

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Customer Example: West Texas Well

The section of EndurAlloy™ Tubing pictured above was removed from a corrosive well (H₂S and bacteria) near Midland, Texas. The customer was getting two to three months from the joint above a rod pump. They installed one joint of EndurAlloy™ Tubing in April 2004. Six months later the tubing was pulled to replace the pump and the joint of EndurAlloy™ Tubing was removed for inspection. Even though it had already lasted three times the run-life of the bare steel tubing it replaced, the EndurAlloy™ joint showed no visible signs of corrosion or wear.