

Protecting Electrodes from Moisture — Information

Drive Off Moisture and Get Better Welds

Beware of electrode coatings with more than .20% moisture. Welding releases hydrogen, hydrogen promotes cracking...

Welding electrode coatings, especially low hydrogen electrodes, readily attract moisture in the coating. This moisture is a major cause of weld cracking and porosity. While plain water itself wouldn't damage the weld, the heat and arc break down water into its basic elements, hydrogen and oxygen. These elements in or near the molten weld are defect carriers that pose a significant threat to the quality of the weld. In addition to water, there are other hydrogen contamination sources such as oil and grease, dirt, and coatings.

Atomic hydrogen produced from the moisture at the arc diffuses in the weld, goes into solution and settles in the atomic structural voids. If the metal cools rapidly enough, not all the hydrogen is absorbed. Some migrates to the heat-affected zone of the parent metal, some forms gas pockets or evaporates, and some helps form other undesirable impurities in the weld.

Steel's ability to absorb hydrogen increases with temperature. Molten steel absorbs more than .0024% hydrogen, and at 2,600°F, when the steel is austenitic, the hydrogen solubility is about .0001%. When the metallurgical structure is ferrite at 1,600°F, the solubility of hydrogen falls to about .00025%, and at a normal 70°F,

.0002%. Because weld deposit hydrogen content from standard electrodes runs from .0001 to .002%, there is a significant risk of generating sufficient levels of hydrogen to supersaturate the molten weld from the core wire alone. The operator must reduce the available hydrogen in the coating for quality welds..

When steel is heated above its critical temperature (the point of temperature where there is a transformation from one metallurgical phase to another phase) and fully austenitic is cooled slowly it converts to a hard brittle martensitic structure. Cooled rapidly enough the austenite will not transform into martensite. The retained austenite now changes very slowly to martensite at temperatures from 400°F to room temperature. During the delayed transformation, the metal microcracks and fissures. If other stresses are present, cracking becomes aggravated and is easily detected. The defect may appear in the weld, at the weld interface, or in the parent metal, depending on how the hydrogen moves or where it becomes trapped.

Besides eliminating stress raisers, other precautions include reducing the retained austenite through carbon control, cold-working, and holding the heat treating temperatures to close limits. Other defects, such as porosity, inclusions, and notches should be eliminated. They exacerbate hydrogen effects. It is not known for sure whether hydrogen causes porosity, but it does influence the amount of porosity in the weld.

Preventing hydrogen embrittlement is critical. Detecting a defect is difficult and frequently found only after the weld is put into service. Like cancer it grows and worsens with time. High strength steels, depending on high carbon content or low martensitic transformation properties, demand close watch.

PHOENIX®

What Happens to Electrodes* Under Normal Shop Exposure Conditions?

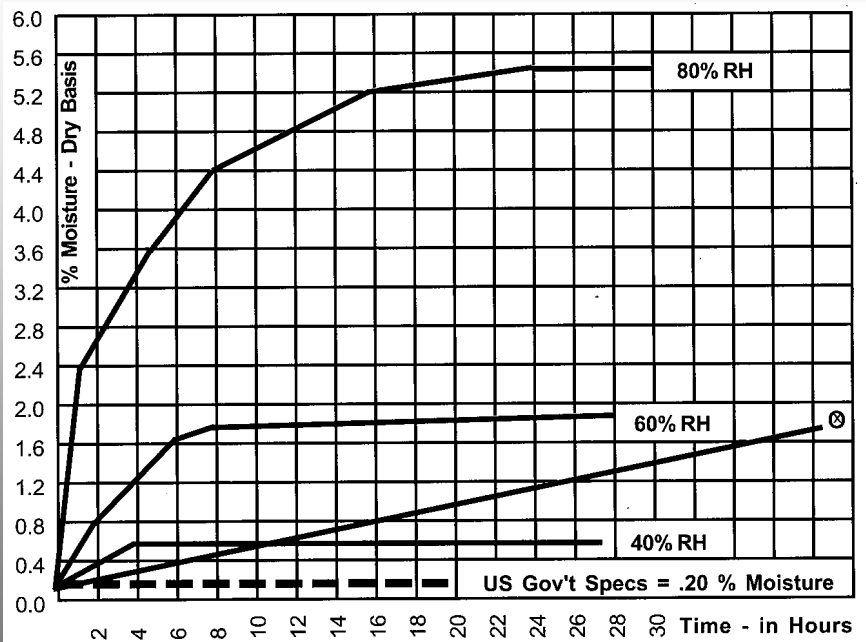
Within two hours at 80% relative humidity, rods may contain up to 13 times the allowable moisture content for U.S. Government & Nuclear Specifications. Within 24 hours, the rods may test up to 26 times the 0.2% allowed. Phoenix DryRod Ovens hold electrodes well within specifications limits.

Dry Flux, Too ... Flux used for submerged arc welding is another source for hydrogen. It is a good idea to put flux in a holding oven for storage. Treat flux the same as electrode coatings, especially if high strength steel is to be welded.

* Including, to a lesser extent, "moisture resistant" electrodes.

Moisture Absorption of Low Hydrogen Type Electrode Coatings

80°F (26.6°C) dry bulb temp, 80%, 60% and 40% relative humidity



E7018 MR Electrode (moisture resistant") @ 90°F (32.2C), 90% RH