

## Should I replace my 18Mn-5Cr type retaining rings with 18Mn-18Cr retaining rings?

By: Dr. Donald R. McCann, Ph.D. Metallurgy



There are several problems with 18Mn-5Cr type rings: low stress corrosion resistance and low fracture toughness. Due to their chemical composition, they are susceptible to intergranular stress corrosion cracking in the presence of moisture and contaminants typically found in industrial environments. The high percentage of grain boundary chromium carbides in older rings can lead to stress corrosion cracks and brittle fracture. These rings were manufactured some 30 years ago when manufacturing techniques and chemical compositions were not what they are today. The 18Mn-18Cr rings manufactured today have superior corrosion resistance and toughness at a higher

tensile strength. They are immune to stress corrosion cracking in the presence of moisture and most industrial environments.

About thirty-two 18Mn-5Cr type rings have failed in service, and many rings have been retired due to severe cracking. Although the failure rate is low, when failure does occur, it is catastrophic. When a burst occurs the resultant chunks of debris can cause major damage to the stator and rotor. All major OEM's have experienced retaining ring failures that resulted in wrecks with subsequent long repair times and high costs. Some owners elect to keep their 18Mn-5Cr type retaining rings because they feel they can monitor the rings and manage their exposure to moisture. From experience, we have seen that, in fact, moisture exposure cannot be controlled reliably. In addition, the cost of properly inspecting the rings on a regular basis makes replacement a better alternative. Even with inspection at regular intervals, cracks are unpredictable and can grow rapidly under moisture conditions. A retaining ring failure at a power plant in 1990 occurred just 19 months after a complete inspection with the rings off the rotor. The stress corrosion crack that caused the wreck was less than ½ inch deep when the ring burst. Subsequently, it was determined that the hydrogen dryer was not operating properly. If you have 18Mn-5Cr type rings, you should visually inspect all retaining ring external surfaces for cracks. If cracks are found, replace the rings. Also look for water stains, rust, pitting, and fretting debris (dry red powder). If found, eddy current inspect external surfaces, and ultrasonic inspect internal surfaces. If indications are found, the rings should be removed for 100% inspection by eddy current in order to determine the type and size of flaws. If cracks are found, the rings should be replaced. In our opinion, the retaining rings that are at greatest risk are on peaking machines. The very nature of the use pattern of the peaking machines (off line for long periods) makes them especially vulnerable to moisture problems—the biggest contributor to cracks. Although the nominal stress on smaller rings is low, stress concentrators, such as fillets, can initiate stress corrosion cracks if moisture is present. If you are unsure as to whether you have 18Mn-

5Cr type rings, we have a Texas Nuclear Technologies model 9277 Metallurgist™ and are able to determine the material composition. However, for small units, it is best to ship the entire generator rotor to us for a total evaluation. We have the engineering and metallurgical staff to address testing and problems that may arise. We have an eddy current instrument to inspect all ring surfaces if the rings are removed from the rotor. This is the preferred method of inspection. However, automated ultrasonic inspection can be conducted if the rings are not removed from the rotor. If you have specific questions about retaining rings, contact Dr. McCann at

[dmccann@regencoservices.com](mailto:dmccann@regencoservices.com)

**Don't let this happen to you!**