

# **Avoidance of Hydrogen Embrittlement of Steel**

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**AVOIDANCE OF HYDROGEN EMBRITTLEMENT OF STEEL****1. SCOPE:**

This standard outlines the conditions that enhance the risk of hydrogen embrittlement of steel and define the relief procedures required to minimize the risk of hydrogen embrittlement. It is intended to control the process.

1.1 Hydrogen embrittlement of steel, which can cause brittle fractures under stress, occurs as a result of the absorption of hydrogen during cleaning, phosphate coating and plating processes. The susceptibility to hydrogen embrittlement increases with increasing stress (internal or externally applied stress) and increasing material strength.

1.2 Hardness readings in this specification are in Vickers scale. SAE J417 should be referred to for conversion to other scales.

**NOTE 1:**

All references to temperatures relate to part core temperature and not the indicated oven air temperature. Statistical data of verifications in temperature at the center of the oven load and oven temperature shall be established to develop the oven profile. The temperature of parts in a batch type of baking furnace shall be monitored with a thermocouple placed in the middle of the load. For continuous bake ovens a temperature trace through the oven must be run with a calibrated thermocouple in the lowest temperature position, at least once a year.

**2. REFERENCES:****2.1 SAE Publications:**

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J417 - Hardness Tests and Hardness Number Conversions.

**3. REQUIREMENTS:**

The parts shall be processed in accordance with this specification as applicable to minimize the risk of hydrogen embrittlement. Specific applications or customer requirements may require processing that goes beyond the requirements of this specification.

**3.1 Cleaning Prior to Heat Treatment:**

All parts to be heat treated to a specified hardness (core or surface) greater than 353 HV must be cleaned prior to heat treatment to remove phosphate associated lubricant residues and detrimental contaminants from the surface.

**NOTE 2:**

The formation of a delta ferrite layer caused by the penetration of phosphorus during the hardening process enhances the possibility of embrittlement.