



Title: EXHAUST VALVE GUIDE INSTALLATION

Issued: 06/27/02

Revision: 1 (08/20/02)

Technical Portions are FAA DER Approved.

1.0 SUBJECT: Installation of Niresist (Nickel Cast Iron) valve guides in aircraft piston engine cylinders.

2.0 DISCUSSION: Exhaust valve guides made from high nickel cast iron has become the standard of the industry because of the high temperature characteristics of this alloy and the severe operating conditions imposed by aircraft piston engines. The standard (Niresist) alloy used for valve guides has approximately 3% carbon, 1.5% silicon, 20% nickel and between 2 and 6% chrome depending on the casting technique. These parts are provided to the industry by most FAA Production Approval Holders in the metallurgical condition with flake graphite contained in an “Austenite” matrix. Nickel is added to provide the high temperature operating properties desired, and chromium is added to enhance the high temperature wear properties.

The austenitic metallurgical phase of the valve guide coupled with the optimum alloying elements produce the best wear characteristics of any alloy that has been tested. However, we are aware that the metallurgical phase of the alloy can be changed to a condition called “Martensite” through supercooling to temperatures below -70°C (-94°F). The martensitic structure has two significant differences from the original austenitic structure that can be evaluated through simple tests:

- a. The alloy becomes magnetic
- b. The alloy will expand (grow) approximately 4% by volume

There are other significant differences, but these can only be determined in the laboratory. We are aware that some cylinder shops use liquid nitrogen to cool the valve guides to ease the installation, liquid nitrogen is much colder than -70°C (-94°F). ECi has not tested Niresist valve guides that have been converted to a martensitic structure. Accordingly, we have no operating or wear data to confirm that this condition is acceptable from an airworthiness status. Obviously the growth can change the interference fits, and the I.D. of pre-reamed guides may not stay in tolerance.

3.0 INSTALLATION GUIDANCE: The installation practice at ECi is to heat the cylinder head to a temperature that will allow installation of the valve seat and valve guide without supercooling the valve guide below -70°C (-94°F). This results in the valve guide remaining austenitic, and is the configuration that ECi has approved through testing to FAR Part 33.49.