

Environmental Embrittlement Studies

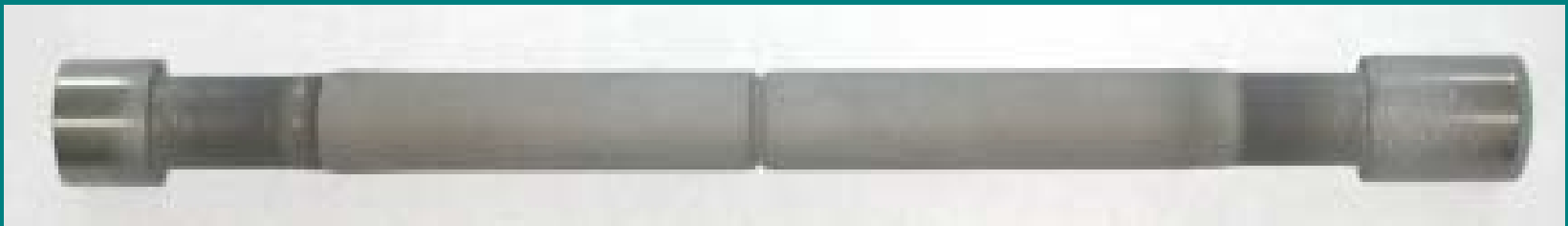
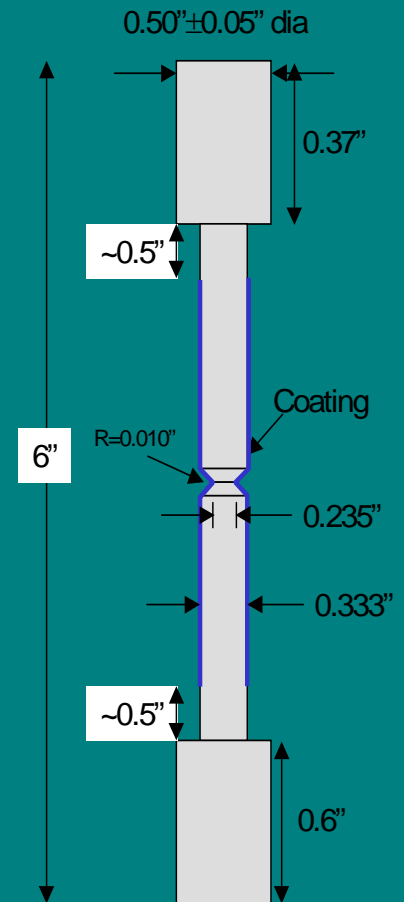
- *Studies to determine if there is environmental embrittlement of Actuator JTP materials due to galvanic couple between base material and HVOF coating*

<u><i>Material</i></u>	<u><i>Heat Treat (tens. strength)</i></u>
<i>4340</i>	<i>180-200 ksi</i>
<i>PH15-5</i>	<i>155 ksi (condition 1025)</i>
<i>Ti-6Al-4V</i>	<i>130 ksi (annealed)</i>

- *Following coatings evaluated:*
 - Electrolytic hard chrome (EHC)*
 - HVOF WC/10Co4Cr*
 - HVOF Cr₃C₂/20(80Ni-20Cr)*
 - Tribaloy 400*

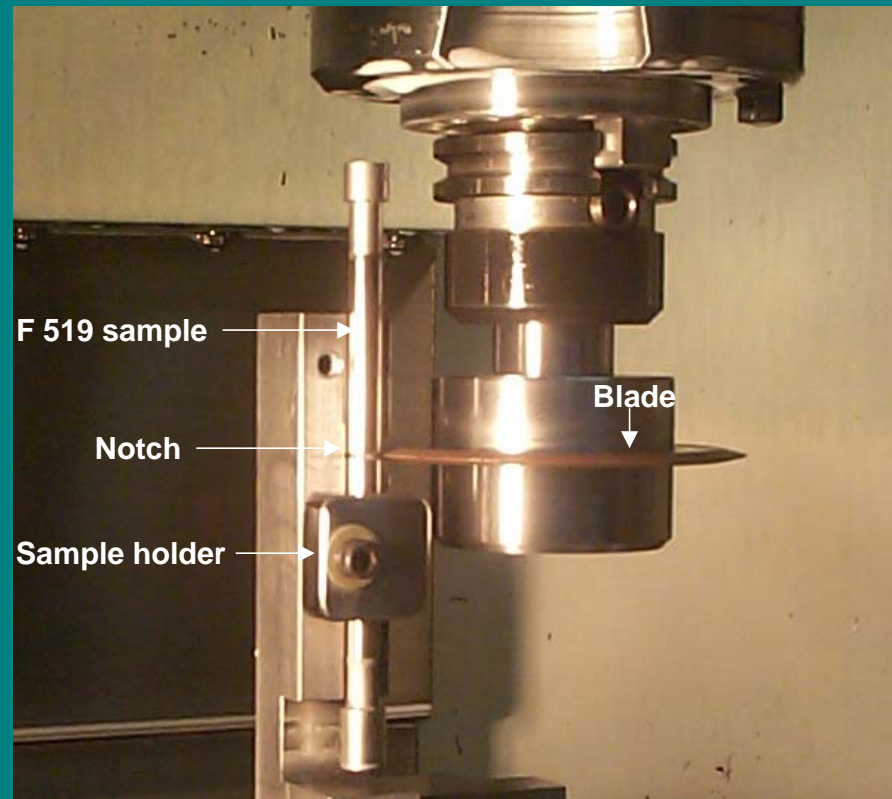
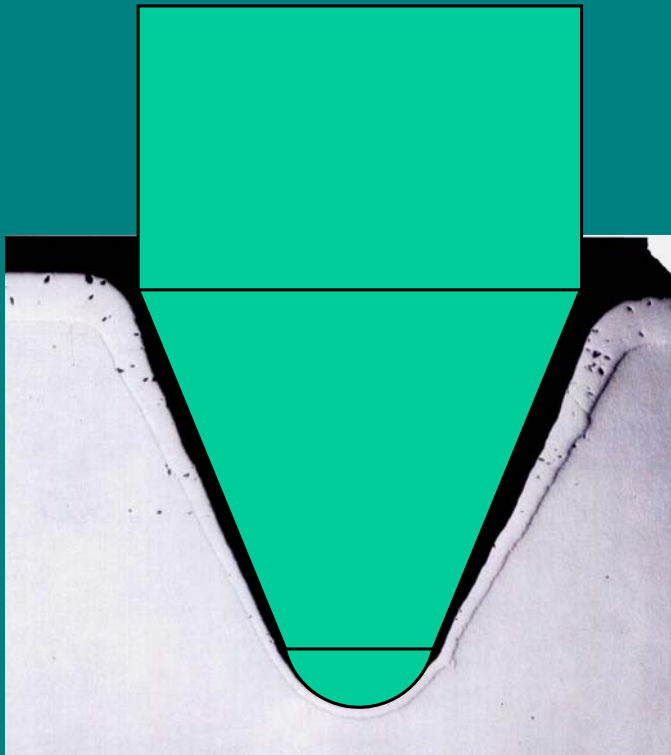
Coating Application to Specimens

- Specimens were notched Type 1a.2 round bars as defined in ASTM F519-97
- Specimens were not shot peened
- Grit blasting performed (54-60 mesh aluminum oxide for HVOF and #13 glass bead for EHC)
- 0.003"-thick coatings applied into notch and approximately 2 inches either side of notch



Cutting Through Coating at Base of Notch

Coating removed from base of notch with a diamond cutting wheel with a 45 degree angle and 0.010" radius



Environmental Embrittlement Testing

- *Specimens were immersed in either de-ionized water or a 5% NaCl solution and subjected to 200-hour sustained tensile load of 45% of the notch fracture strength*

Hydrogen embrittlement test matrix. 45% NTS load.

	4340*		Ti6Al4V		15-5 PH	
Test environ.	DI H ₂ O	5% NaCl	DI H ₂ O	5% NaCl	DI H ₂ O	5% NaCl
EHC	3	3	3	3	3	3
WC-CoCr	3	3	3	3	3	3
T400	3	3	3	3	3	3
Cr ₃ C ₂ -NiCr	3	3	3	3	3	3
Total	12	12	12	12	12	12

*Use 180-200ksi 4340 steel rather than standard F-519 280 ksi specimens

Environmental Embrittlement Testing

Results:

***No specimens fractured during 200-hour
immersion***