



Helicopter Dynamic Components JTP

HCAT Program Review
Park City, UT
July 2004

Current status

- ❑ **Stakeholder meeting held March 17, 18**
- ❑ **JTP completed and published to web site for review and correction**
- ❑ **Bruce visited UTRC to review fretting fatigue tests**
- ❑ **How is this JTP different from other JTPs?**
 - **Fretting fatigue**
 - **Helicopters are giant fretting fatigue machines**
 - **Crevice corrosion**
 - **Instead of B117**
 - **Use of carburized 9310**

Substrates

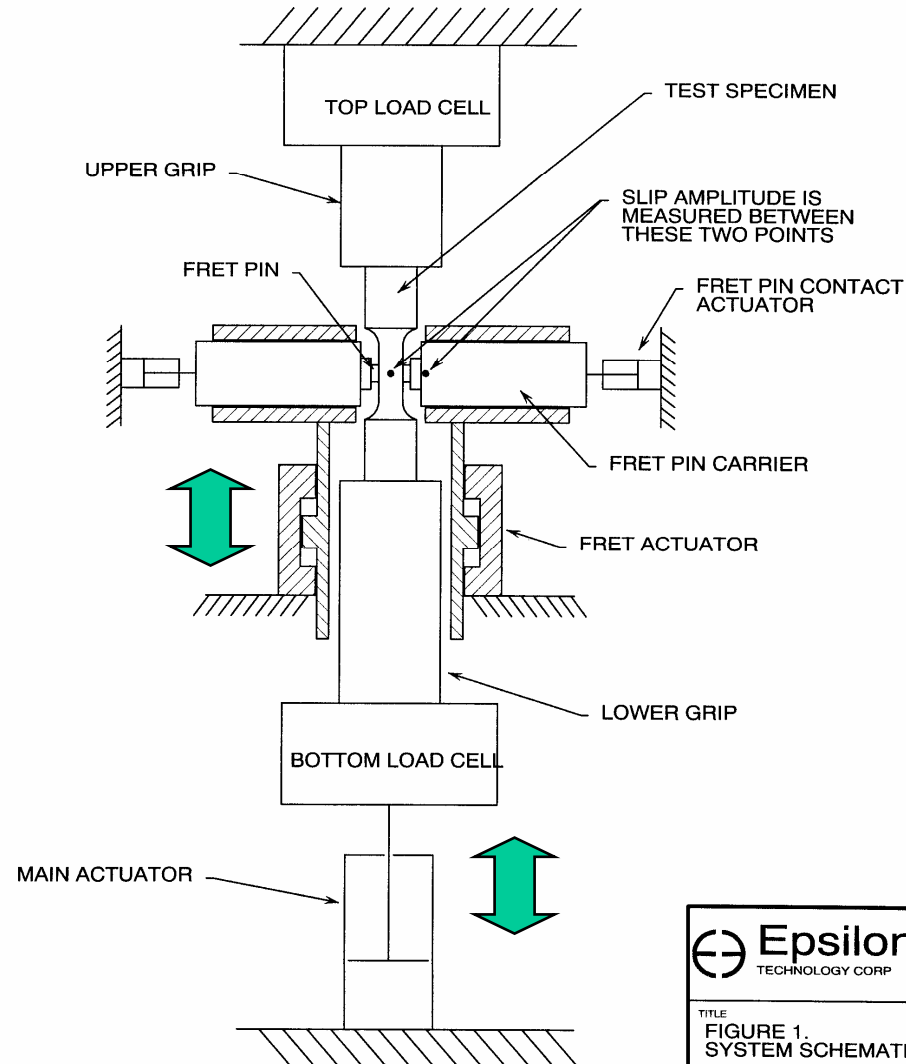
Material	Heat Treat (tens. strength)	Shot Peen
4340	150-170 ksi	8-10A, S110, wrought steel
PH13-8Mo	M1050 heat treat	8-10A, S110, wrought steel
9310 carburized	HRc 34-42 core, 59-62, 0.030" deep case	8-10A, S110, wrought steel
7075 Al	T73	??

Coatings

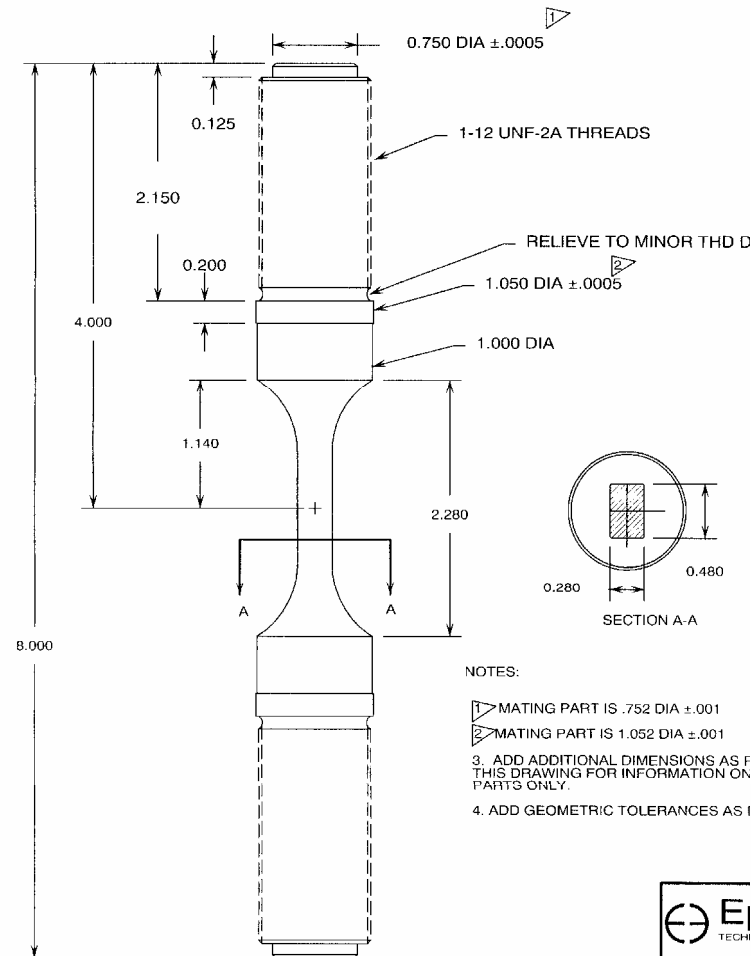
- ❑ **WC-17Co**
- ❑ **WC-10Co-4Cr**
- ❑ **Tribaloy 400 (T-400)**
- ❑ **WC-17Co + T400 bond layer (for 7075 Al only)**
 - **Because pre-HCAT data showed <EHC fatigue for WC on Al**
 - **Too high modulus?**

Fatigue, Fretting Fatigue

- ❑ **Fatigue**
 - **Smooth bar, $R=0.1$**
- ❑ **Fretting fatigue**
 - **Primary fatigue testing, not included in any previous JTP**
 - **Rectangular cross section**
 - **Use cyclic stress that gives 10^5 cycles for EHC standard fatigue**
 - **Adjust fretting load and amplitude to give $\sim 10^4$ cycles for EHC**
 - **Test all under these conditions**



Fretting fatigue specimen



**0.280x0.480
cross section**

Fretting matrix

Coating	Thick-ness (mil)	Surface finish (μ'')	# of specimens PH13-8Mo	# of specimens 9310 carb	# of specimens 7075 Al	# of specimens 4340
EHC	10-12	4-6 ground	3	3	3	3
WC-Co	10-12	4-6 ground	3	3	3	3
WC-CoCr	10-12	4-6 ground	3	3	3	3
T400	10-12	4-6 ground	3	3	3	3
T-400 + WC-Co	7-9/3-4	4-6 ground			3*	
EHC	10-12	1-2 super	3	3	3	3
WC-Co	10-12	1-2 super	3	3	3	3
WC-CoCr	10-12	1-2 super	3	3	3	3
T400	10-12	1-2 super	3	3	3	3
T-400 + WC-Co	7-9/3-4	1-2 super			3*	
Total			24	24	30	24
Grand total						102
<i>*Note: to be run only if fatigue tested in Section 3.</i>						

Crevice corrosion

- ❑ **Testing to be done by Sikorsky using set-up that they have found to be a good test**
 - **Use fluids that represent real life crevices**
 - **Information to be supplied**
- ❑ **Open Circuit Potential to be measured between saturated calomel electrode (5% NaCl) for each substrate and each coating material**
 - **Tests to be done by ARL (potentiostatic)**

Fluid immersion

- ❑ **MIL-PRF-83282 (hydraulic)**
- ❑ **Skydrol AS1241 Type 4**
- ❑ **Fluorescent penetrant**
- ❑ **Propylene glycol**
- ❑ **Nital**
- ❑ **Ammonium persulfate**
- ❑ **MIL-C-87937 (cleaner)**
- ❑ **Oakite 90**
- ❑ **Proceco alkaline soap**
- ❑ **60% bleach (sodium hypochlorite) (foot & mouth)**
- ❑ **Cee-Bee J-84A (cleaner)**
- ❑ **Turco 4181**
- ❑ **JP5 Fuel**
- ❑ **Cd plating solution**
- ❑ **Cd stripping solution**
- ❑ **Grease (e.g. MIL-G-4343C)**

Environmental embrittlement – ASTM F519

	4340	PH13-8Mo	9310	9310 carb.
Test environ.	5% NaCl	5% NaCl	5% NaCl	5% NaCl
EHC	3	3	3	3
WC-Co	3	3	3	3
WC-CoCr	3	3	3	3
T400	3	3	3	3
Total	12	12	12	12

To be done

- ❑ **Input from all stakeholders to finalize JTP**
- ❑ **Begin testing**