



# Project Results

HVOF WC/Co Replacement of  
Chrome – Bench Tests  
Bell Helicopter Textron

# Project Goals

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- **Qualify HVOF Coated Components**
  - HVOF W/C Co in lieu of chrome plate
- **Drive System Test**
  - Bench test of rotor brake disc adapter flange
- **Rotor System Test**
  - Tail Rotor Control rod test, comparison HVOF WC/Co vs chromium plate

# Drive System Components, Chrome Plated on UH-1 and AH-1 Helicopters

Component	Used On	Coating Thickness	Contacting Surface
205-040-303-001, Rotor Brake Disc Adapter Flange	UH-1N, -1H	0.0005" – 0.0006"	Oil Seal, 450071-H
209-040-177-101, Rotor Brake Disc Adapter Flange	AH-1W, -1T	0.0005" – 0.0006"	Oil Seal, 450071-H
212-040-156-001, -101, Tail Rotor Drive Quill Spacer	UH-1, AH-1	0.001 - 0.003"	Oil Seal, 451858-H60
204-040-313-101, Tail Rotor Drive Quill Spacer	UH-1H	0.001 - 0.003"	Oil Seal, 451858-H60

–205-040-303-001. Test on this xmsn rotor brake disc adapter flange which has the highest seal lip sliding velocity of the 4 transmission components and will qualify all 4 components.



# Drive System Test

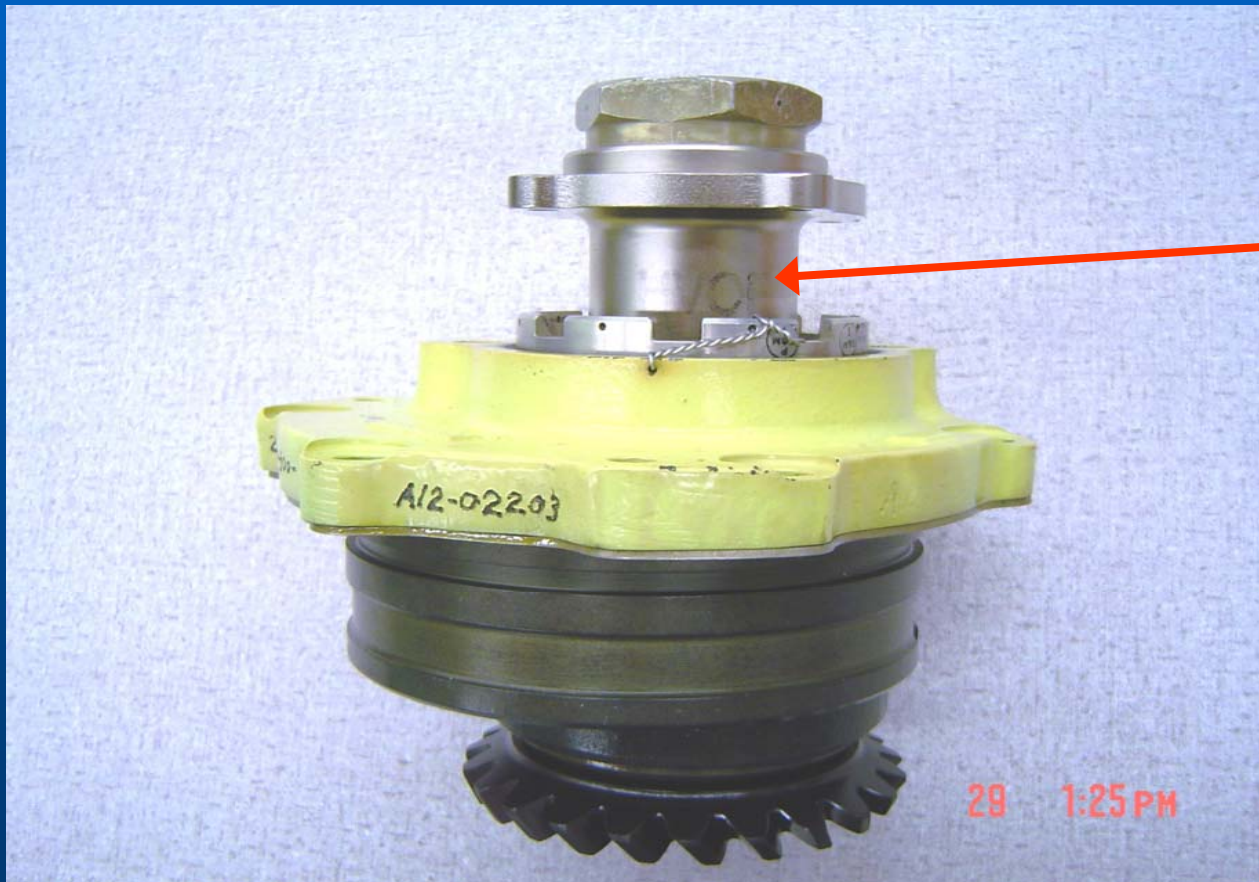
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- 100 hour bench test on the 205-040-303-001 rotor brake disc adapter flange.
- 50 rotor brake applications from 50% rpm in order to subject part to thermal cycling affects.
- Test to demonstrate that HVOF coating does not affect the sealing at the seal lip/flange interface and does not increase the seal lip wear rate.

# Drive System Test Discussion

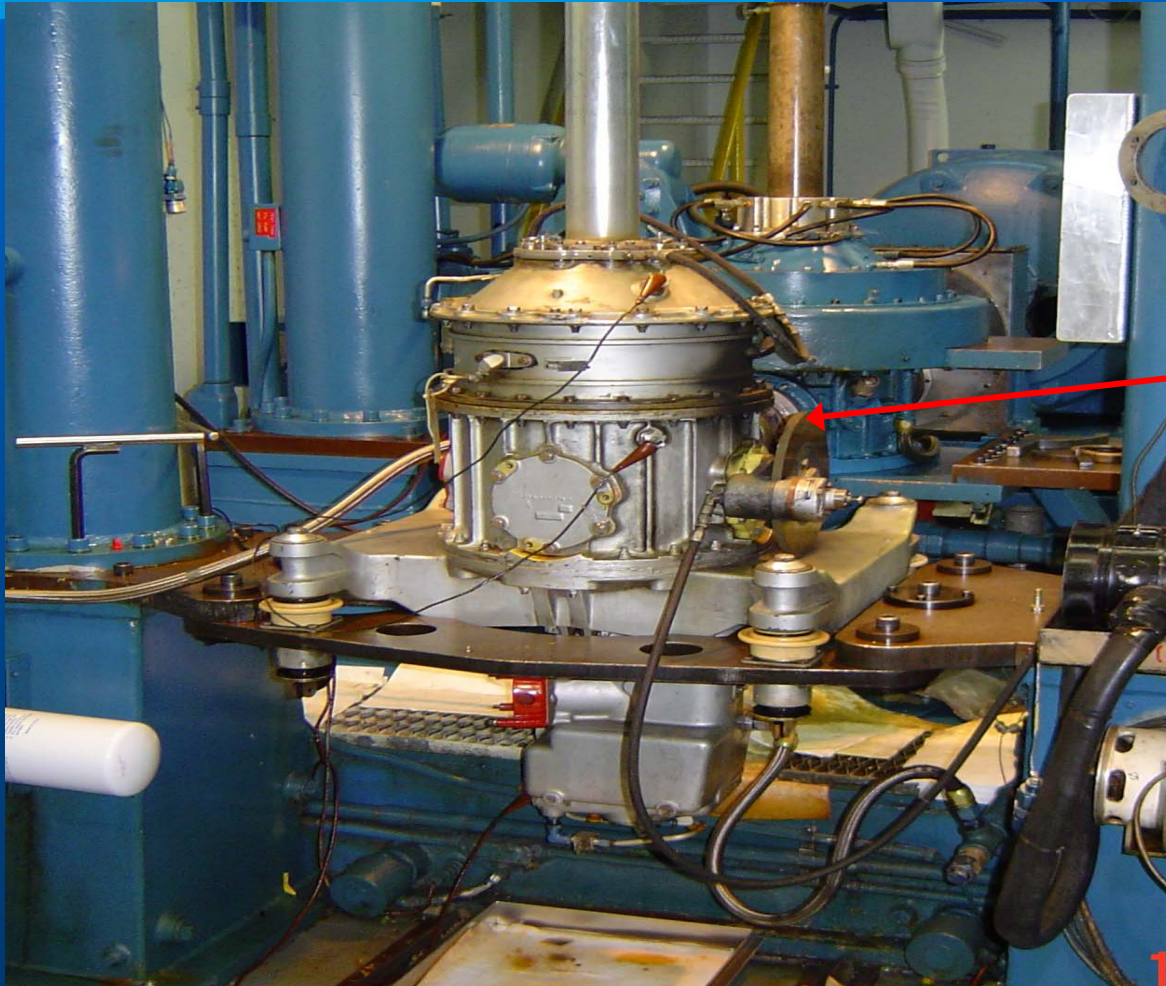
- Due to time limitations only seal riding surface was HVOF WC/Co Coated. E-nickel plated over non-functional surfaces.
- Diameter A of flange adapter allowed to be little larger to allow for thicker WC/Co coating of 0.002” compared to 0.0005-0.0006” call-out for chrome plating. 100 hr test proved out larger diameter.

# Rotor Brake Disc Flange Adapter in Brake Disc Quill Assembly



Flange  
Adapter

# Rotor Brake Disk Quill Assy Installed in XMSN and in Test Stand



Rotor  
Brake  
Disc Quill  
Assy

# Drive System Test Results

- The 100 hour drive system test included 2 rotor brake stops every 2 hours for a total of 100 brake stops. Temperature during the brake stops reached above 270 °F but below 330 °F as indicated by temperature indicating Templates. This temperature change indicated successful thermal cycling of the component
- After disassembly and inspection, no damage to or leakage from the oil seal was detected

# Drive System Test Results

- The HVOF tungsten carbide coated diameter of the rotor brake disc adapter flange on which the oil seal rides was in good condition after the test run with no evidence of a wear step with only a faint trace of the path of the oil seal lip. A post plate dimensional check also showed no evidence of appreciable wear of the tungsten carbide surface as the dimension of diameter 'A' measure 1.8780 inch which is the same as the pre-test measurement.
- The test was successful in qualifying the HVOF applied tungsten carbide coating, when applied per BPS 4463, as a replacement for chromium plate for all components listed in Table 1

# AH-1 and UH-1, Rotor System Chrome Plated Components (Table II)

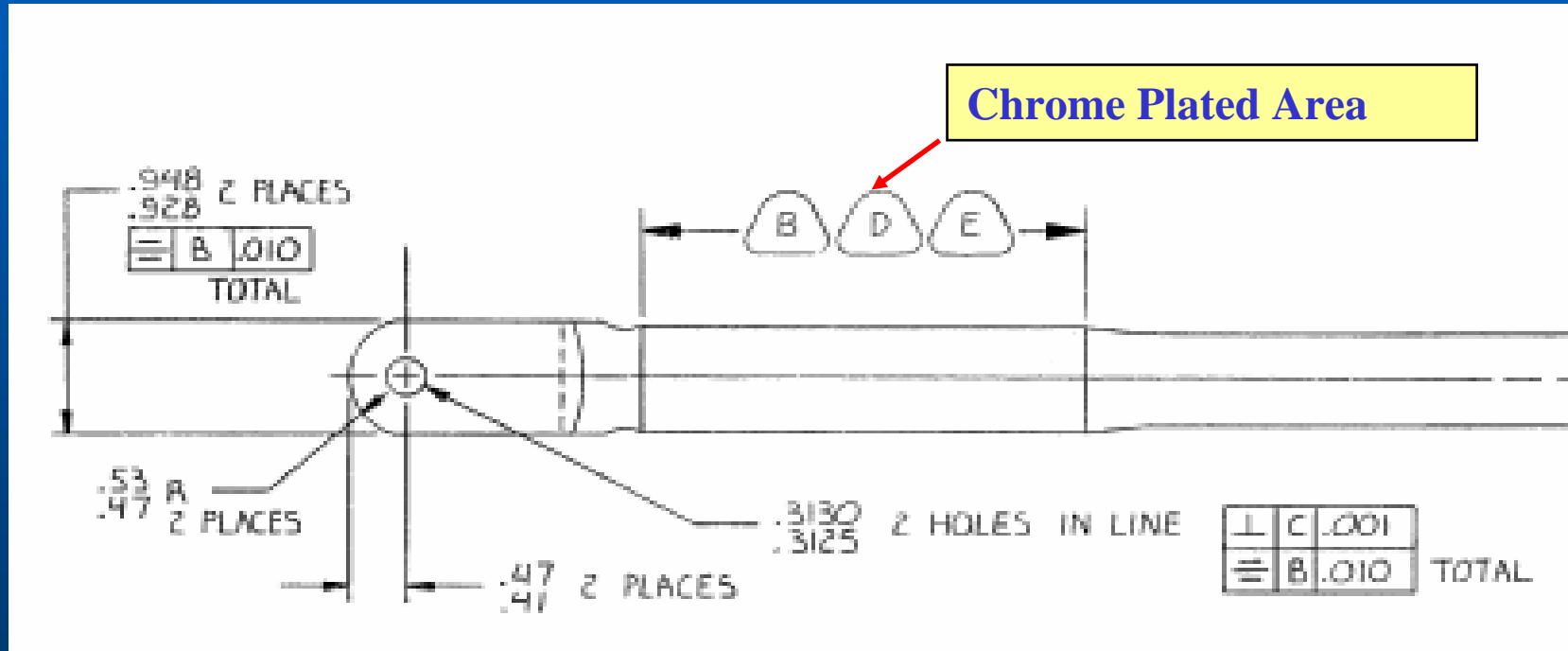
Component	Used on	Thickness of Coating	Contacting Surface
214-010-411-003 SLEEVE - Collective, Scissors and Sleeve, Main Rotor Controls**	AH-1T	.002 after finish grind	
214-010-716-001 CONTROL ROD - Tail Rotor	AH-1T	.002 after finish grind	Nylatron GS / 214-010-723 and Seal
214-010-855-105 CONTROL ROD - Tail Rotor	AH-1W	.002 after finish grind	Nylatron GS / 214-010-723 and Seal

\*\*The 214-010-411-113 is HVOF WC coated and is used on the AH-1W. No further Qualification needed.

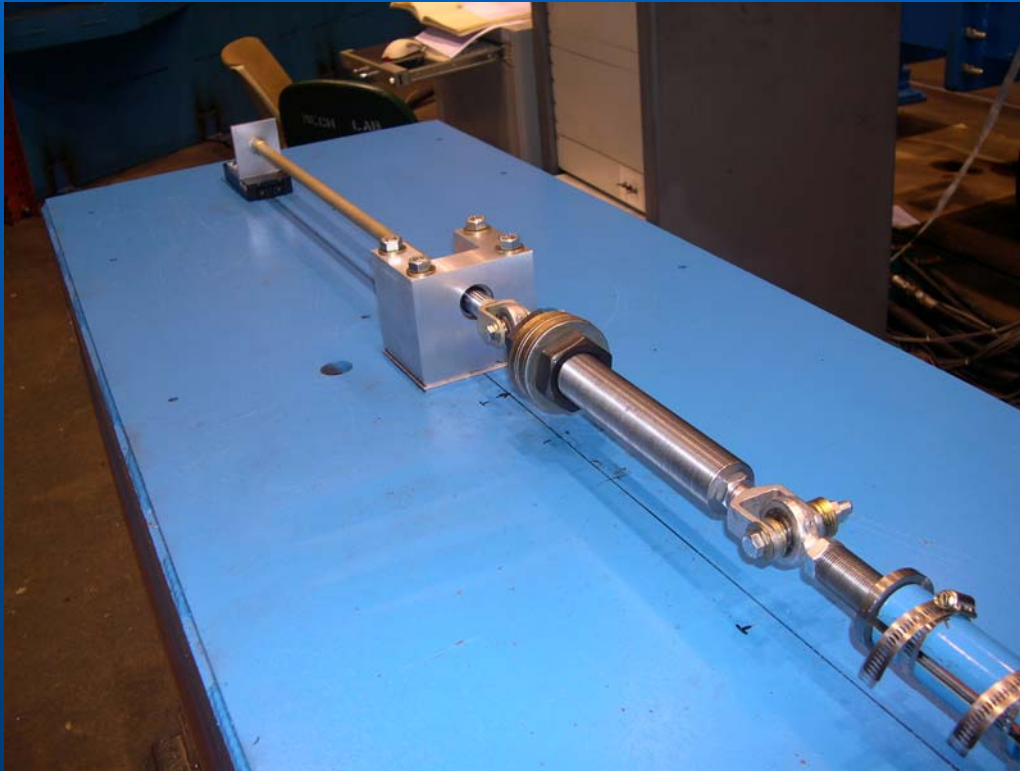
# Rotor System Test

- **Test on tail rotor control rod, 214-010-855-115**
  - **Comparative test between HVOF coated and chromium plated tube**
  - **50,000 cycles @ full stroke, 0.5 –1.0 Hz.**
  - **Disassemble & inspect after 50,000 cycles. Record wear and condition.**
  - **Re-assemble, apply Arizona road dust and run additional 5,000 cycles. Record wear and condition.**

# 214-010-855, Control Rod – Tail Rotor, AH-1W



# Tail Rotor Control Rod in Test Apparatus



# HVOF Coated Area of Tail Rotor Control Rod in Test Apparatus



# HVOF Coated Area with Arizona Road Dust Applied



# Rotor System Test Results

- There was no indication of wear or damage to the HVOF coated area of the modified rod tested or on the chromium plated area of the baseline rod.
- In the comparison test between the HVOF tungsten carbide coated rod and the chromium plated baseline rod the performance was the same and no differences were noted as evidenced by visual and microscopic inspection of the coated surface.

# Rotor System Test Conclusion

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- **The HVOF tungsten carbide, when applied per BPS 4463, is a qualified replacement coating for chromium plate for all the components listed in Table II.**