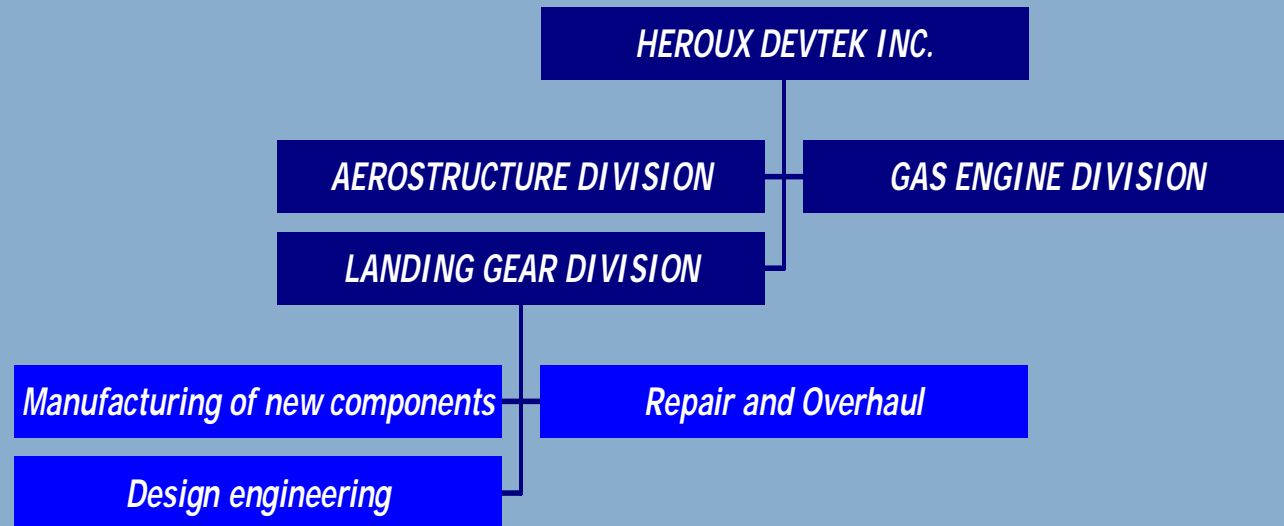


HVOF qualification and implementation in landing gear manufacturing

Presented by Marc-André Lefebvre
M&P engineer

HÉROUX DEVTEK INC.



HÉROUX DEVTEK

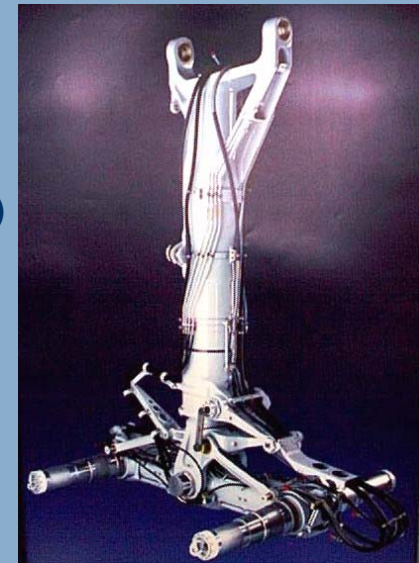
→ Landing Gear Division

→ 3 plants near Montréal

- Manufacturing new components (B777, F-16)
- Repair and overhaul (C-130, KC-135R)
- Design engineering unit (40 engineers, RQ-4B, X-45, JSF)

→ 1 plant in Kitchener

- Manufacturing new components



- Machining (HSS, stainless steel, Al & Ti alloys)
- Plating (nickel, chrome, cad, Ti-cad, anodizing, passivation)
- Painting
- Assembling

Héroux Devtek studies in HCAT program

Canadian – HCAT member

- Producibility testing with WC-Co-Cr powder
 - Fluid compatibility
 - Stripping solutions
 - Surface finishing
 - Non-destructive testing
- Héroux Devtek HVOF qualification

Héroux Devtek studies in HCAT program

- **Producibility testing**

- **Fluid compatibility**

- **Immersion tests**

- **Hydrogen embrittlement tests**

- **Microscopic observations**

- **Organic compounds**

- » **Degreasers, solvents, hydraulic fluids, greases**

- » **Grinding coolant fluids, corrosive preventive products**

- **Aqueous solutions**

- » **Nital etch solution, plating solutions**

- **Stripping solutions**

- **Electrochemical tests**

Héroux Devtek studies in HCAT program

- **Producibility testing**

- **Surface finishing**

- Grinding parameters
 - Superfinishing parameters
 - Surface profile characterization

- **Non-destructive testing**

- **To determine acceptable:**

- NDT methods (Visual, FPI, Barkhausen noise inspection)
 - NDT acceptance criteria (Pit, crack, abusive grinding)

Héroux Devtek studies in HCAT program

–HVOF qualification results

- Héroux Devtek Process Specification

- HPS230: Grinding and inspection of WC-Co-Cr HVOF coating

- HPS235: Stripping of WC-Co-Cr HVOF coating

–HVOF implementation

- Héroux Devtek Design Requirements

- Drawing notes

- Final HVOF thickness

- Surface finish requirements

- Areas to be coated

- »Wear

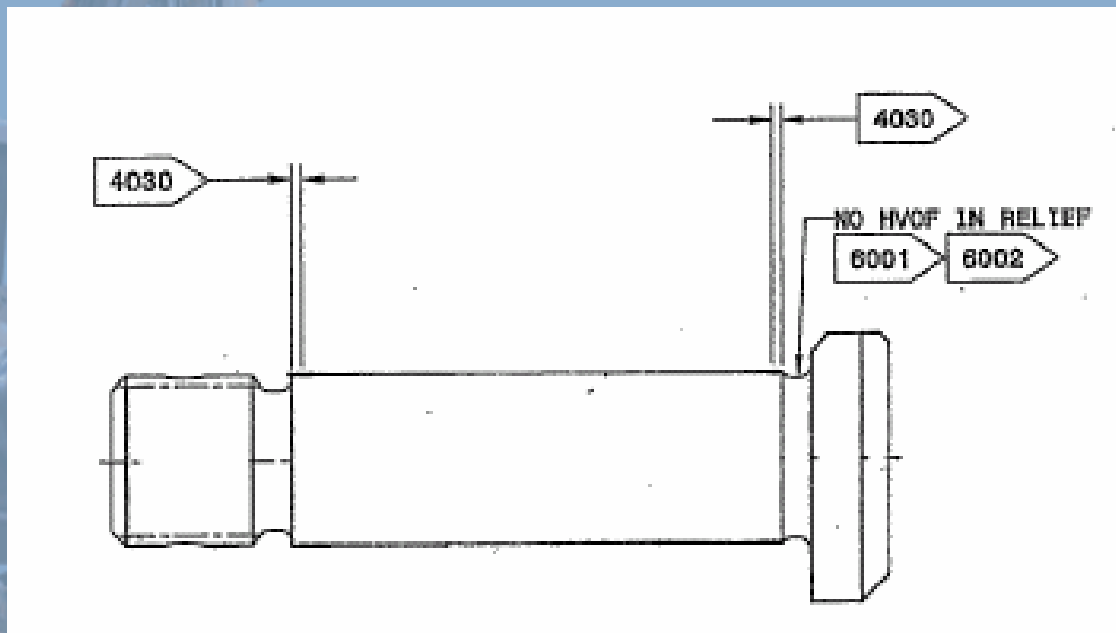
- »Sealed surfaces

HVOF implementation in manufacturing

- X-45C landing gear design
 - Application of HVOF WC-Co-Cr coating
 - Examples of design drawing notes
 - FL4026: Apply HVOF coating per AMS 2447 using AMS 2447-9 coating
 - FL4030: HVOF coating runout per HPS 230
 - FL4031: Grind and inspect HVOF coating per HPS 230
 - FL4032: HVOF coating overspray per HPS 230

HVOF implementation in manufacturing

- X-45C landing gear design
 - OD: 0.3035/0.3049 before coating, Ra<63
 - OD: 0.3109/0.3115 after coating, Ra<8



HVOF implementation in manufacturing

- X-45C landing gear design
 - Surface parameters achieved by superfinishing

SURFACE PARAMETERS PER HPS-230 AFTER HVOF APPLIED COATING:

Ra = < 5 μ in
Rpk = \leq 2 μ in MAXIMUM
tp (Mr) = \geq 60% @ 4 μ in DEPTH
= \geq 85% @ 8 μ in DEPTH
Rsk = -0.1 to -3

HVOF implementation in manufacturing

- For each P/N, required qualification for:
 - HVOF application technique
 - HVOF grinding and superfinishing technique
 - HVOF inspection technique

HVOF implementation in manufacturing

- For each P/N:
 - HVOF application technique
 - Cleaning
 - Masking
 - Control process qualification tests
 - Application parameters

HVOF implementation in manufacturing

- For each P/N:
 - HVOF grinding technique
 - Wheel trueing and dressing methods
 - Grinding wheel characteristics
 - Grinding parameters
 - Grinding equipment
 - HVOF superfinishing technique
 - Superfinishing equipment
 - Superfinishing parameters

HVOF implementation in manufacturing

- For each P/N:
 - HVOF inspection technique
 - Cleaning
 - Methods used
 - Visual 100%
 - FPI 100%
 - BNI Sampling for grinding technique qualification
 - Acceptance criteria
 - Final inspection (thickness, surface finish)

HVOF implementation in manufacturing

- Up to now:

- Non-Conformance Report

- Inadequate final HVOF thickness

- Stripping and reprocessing sequence

- Inadequate surface finish

- Grinding adjustment

- Calibration of the surface finish tester

- More inspection time needed for surface finish check

- No evidence of abusive grinding

HVOF implementation in manufacturing

- QUESTIONS?