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MESSIER-DOWTY, PRODUCTION FACILITIES

- **Bidos, France**
  - Manufacturing centre for shock strut / shock absorber
  - HVOF requirements on pistons for various programs
  - M-D currently considering to invest into HVOF technology

- **Gloucester, United Kingdom**
  - Manufacturing centre for axles / truck beam (bogie beam)
  - HVOF requirements on axles for various programs

- **Toronto, Canada**
  - Manufacturing centre for business, regional and military programs
  - Assembly line for the B787 program
  - HVOF requirements on a wide range of components
  - One HVOF booth

- **Montreal, Canada**
  - Manufacturing centre for cylinders (main fittings) on Airbus / Boeing commercial program
  - HVOF requirements still in the early phase due to size of the components

- **Suzhou, China**
  - Manufacturing centre for non complex components on various program
  - HVOF investment being considered
MESSIER-DOWTY, HVOF REQUIREMENTS

- **Existing programs**
  - Falcon 7X (Dassault) – Business program
  - A380 Nose Gear- Commercial program
  - A400M Main & Nose Gear – European military program
  - B787 – Commercial program
  - A350 Main Gear – Commercial program

- **Every new program at Messier-Dowty will require HVOF coating as replacement to chrome plating whether it is a European or North American programs**

- **Still some exceptions on large components**
  - Internal small bores (micro gun ???)
  - Internal diameter on cylinders (ID gun ???)
  - Spigot (rotating equipment ???)
  - OEM will require eventually such exceptions to be removed and converted to HVOF
M-D located in 3 distinct geographic areas
- North America
- United Kingdom
- Western Europe

European approach to HVOF technology
- HP technology (kerosene system) superior to LP technology (hydrogen system)
- Market dominated by Praxair JP 5000 / 8000 and/or SM Woka Jet 350 / 400
- Approval process strenuous for potential suppliers

North American approach to HVOF technology
- Participation to HCAT
- LP technology and HP technology are comparable
- Simplification of the approval process for potential suppliers

Approval process has been simplified
MESSIER-DOWTY, APPLICABLE SPECIFICATIONS

- **HVOF THERMAL SPRAY – PCS 2560**
  - Application of tungsten carbide cobalt chromium coatings on metallic parts by High velocity oxygen / fuel (HVOF) process
  - Largely inspired by AMS 2448

- **QUALIFICATION PLAN FOR PCS-2560 SUPPLIERS**
  - Stipulates M-D approval process and commercial requirements

- **HVOF POWDER – PCS 2561**
  - Tungsten Carbide Cobalt Chrome Powder, Agglomerated and Sintered
  - 86 WC – 10Co – 4Cr
  - Largely inspired by AMS 7882

- **GRINDING REQUIREMENTS – PCS 4102**
  - Grinding of HVOF Sprayed Tungsten Carbide Coatings applied to Steel
# MESSIER-DOWTY, HVOF REQUIREMENTS

## FUTURE REQUIREMENTS

<table>
<thead>
<tr>
<th>Sites</th>
<th>Number of parts</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>2008</td>
</tr>
<tr>
<td>Montreal</td>
<td>158</td>
</tr>
<tr>
<td>Bidos</td>
<td>204</td>
</tr>
<tr>
<td>Gloucester</td>
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<tr>
<td>Toronto</td>
<td>330</td>
</tr>
<tr>
<td>Suzhou</td>
<td>1,800</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,442</strong></td>
</tr>
</tbody>
</table>

Montreal: Main Fittings A350 / A380 / B787
Bidos: Sliders A350 / A380 / B787 / F7X / A400M
Gloucester: Pins A350 / B787
Toronto: Main Fittings + Trailing Arm + Piston F7X
Suzhou: Pins B787

Excludes indirect requirements for A400M / A380 / F7X program. Estimated to an additional 5,800 parts in 2010.
MESSIER-DOWTY, QUALITY SYSTEM REQUIREMENTS

- **COMPLIANCE TO PRIDE MANUAL**
  - Process Requirements in Developing Excellence
  - Stipulates Messier-Dowty quality requirements for suppliers

- **AS 9100 APPROVAL REQUIRED TO BECOME M-D SUPPLIER**
  - EN 9100, AS9100 or JISQ9100
  - Prerequisite to become a M-D approved HVOF spray supplier
  - Immediate requirement

- **NADCAP ACCREDITATION**
  - All special processes shall be certified NADCAP by target dates
  - Target data for HVOF: December 31st, 2008
  - Mandatory requirement from Boeing for B787 components
SUPPLIER TO BE RESPONSIBLE FOR THE FOLLOWING ACTIVITY

- HVOF Thermal Spray per PCS-2560
- HVOF Grinding, Super Finishing and Inspection per PCS-4102
- Surface Texture Inspection per PCS-2565
- Magnetic Particle Inspection (MPI – if required) per PCS-3100 (or equivalent)
- Grinding and Super Finish could be sub-contracted by HVOF spray shop
  - Grinding source to be approved by Messier-Dowty
  - HVOF spray shop still commercially responsible for quality of products
- MPI could be sub-contracted to a M-D approved source
HVOF – SUPPLIERS REQUIREMENTS

MESSIER-DOWTY ‘MAKE’ PARTS

• Messier-Dowty ‘MAKE’ parts are parts machined by M-D facilities. These parts are typically very large and heavy and require handling to manipulate

  - M-D BIDOS (France): Sliders or piston (Straight shape or T shape)
  - M-D Gloucester (UK): Axle (long cylindrical component) and truck / bogie beam
  - M-D Montreal (Can): Cylinders or Main Fittings

• M-D outsourcing requirements is only for HVOF spray since M-D already owns grinding equipment

• Even if M-D invest into HVOF technology, outsourcing will still be required
MESSIER-DOWTY ‘BUY’ PARTS

• Messier-Dowty ‘buy’ parts are components machined and assembled by M-D various suppliers

• Most of these suppliers do not have processing capability. Special process shall be conducted through approved M-D suppliers

• Several small suppliers with limited resources to manage sub-tiers.

• M-D would prefer to have ‘one-stop shop’ taking care of all operations:
  - Nital etch, MPI, shot peen, HVOF, grind, inspection, cad plating, paint, etc…

• Bare minimum: HVOF, grind, inspect & NDT
HVOF – SUPPLIERS REQUIREMENTS

QUALIFICATION PROCESS

- Supplier to present a plan with minimum processing services
- Plan to be reviewed by M-D
- M-D lab and QA to audit suppliers to ensure that quality and processing are acceptable
- Design for experiment (DOE) to be completed by suppliers to demonstrate optimization and repetitiveness of spray parameters
- Supplier to procure material and machined to round axial specimens (ASTM-E-466)
- Supplier to spray the test samples
- Supplier to sub-contract samples testing to approved M-D laboratories
- Upon completion of the tests and acceptable results, notification of conditional approval to be sent by M-D
- Corrective actions from previous audits to be closed
- Final approval
HVOF – SUPPLIERS REQUIREMENTS

ADDITIONAL QUALIFICATION PROCESS INFORMATION

- Approval process is material specific
  - Approval process for 300M is valid for low carbon steel and all stainless steel
  - Approval process for titanium
  - Approval process for Custom 465
  - A given supplier could pass its approval for steel substrate but fail for titanium substrate

- First few pieces to be coated and ground by a new supplier will have to be Rollscan
  - Barkhausen Noise Test
  - Activity to be done by supplier at its facility or at M-D facility

- Within 12 months of conditional approval, suppliers will be requested to purchase and install on-line monitoring equipment for thermal spray booths
  - Accura Spray
  - Spray Watch
MESSIER-DOWTY, LESSONS LEARNED

- Capacity available in the marketplace is limited
  - Lots of spray shop in the market
  - Capacity to meet aerospace reqs is more difficult than traditional spray market
  - Developing a good new supplier is a lengthy process

- Never split between spray source and grind source

- Consider spray and grind as two separate markets
  - Capacity problem is probably even more severe for grinding
  - Lots of grinding knowledge in the market for chrome
  - Transition from chrome grinding to HVOF grinding is not easy

- Start your supply chain development very early in the process
  - B787 program highlighted this need due to rapid program in monthly build-up rate

- Dedicate full-time resources to the assignment

- Preference for the one-stop shop concept
MESSIER-DOWTY, CONCLUSION

- Still looking for suppliers willing to embrace the challenge

- M-D business model calls for supply chain to grow
  - US dollar zone
  - Emerging countries (LC) zone

- Areas of development in dollar zone
  - West Coast
  - Mid-West
  - North-East

- Areas of development in LC zone
  - Mexico
  - India
  - China