StandardAero Overview

- $1.8B+ in annual sales
- 3,800+ team members
- Customers in 70+ countries
- We are a leading (#1 or #2 market share in most markets we serve) provider of maintenance, repair and overhaul (MRO) services including:
  - Engine repair and overhaul
  - Component repair and overhaul
  - Avionics upgrades
  - Airframe repair, overhaul and paint
  - Interior completions
  - Engineering services
- Cincinnati facility is the Headquarters for the Components, Heli, & Accessories Sector.

Organized into 5 sectors

Components, Heli & Accessories
- Locations: Cincinnati, Winnipeg, Singapore
- Platforms include CFM56, CF6, F110, GE90, V2500, M250, etc.

Airlines & Fleets
- Location: Winnipeg, Maryville, Tilburg
- Platforms include AE3007, APUs, CF34, CFM56, PT6, PW100

Business Aviation
- Locations: Augusta, Houston, LAX, Springfield
- Platforms include TFE731, Airframe MRO, APUs, TPE331

Associated Air Center
- Location: Dallas
- Platforms include VIP completions & maintenance on ACJ, BBJ, B747, B757, B787

Military
- Locations: San Antonio, Winnipeg, Australia
- Platforms include T56, AE2100, M250, 501K
We specialize in engine component repairs…

• Cincinnati, Ohio (250,000 ft²)
• Approx. 530 employees across 3 shifts
• 5,000 engine part repair capabilities
  • Dedicated OEM repairs
• 70,000 repair capabilities
• 15-21 day Turn Around Time

…with broad capabilities

• Cleaning & inspection
• Eddy current
• Non-destructive testing
• Welding
• EDM & spark erosion
• Machining
• Metal spray
• Cold spray
• Heat treatment
• Balancing
• Composites
• Water jet
• Brazing
# StandardAero Component Services (SACS)

*Example products (not exhaustive)*

<table>
<thead>
<tr>
<th>Fan</th>
<th>Compressor</th>
<th>Combustor</th>
<th>LPT &amp; HPT</th>
<th>Composites/Multiple materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Booster Van Assemblies</td>
<td>Forward Stator Case</td>
<td>CFM Combustor Case</td>
<td>Inter Rotating Seal</td>
<td>Fan Case</td>
</tr>
<tr>
<td>OGVs</td>
<td>Comp Rotor Shaft</td>
<td>LM1600 Combustor Case</td>
<td>LPT Shaft</td>
<td>Spinner Cone</td>
</tr>
<tr>
<td>Fan Shaft</td>
<td>STG 1-2 Rotor Spool</td>
<td>CF34</td>
<td>HPT Shroud Supports</td>
<td>Acoustic Panel</td>
</tr>
<tr>
<td>Fan Case</td>
<td>CDP Seal</td>
<td>STG 4-9 HPC Spool</td>
<td>Turbine Rear Frame</td>
<td>OGV</td>
</tr>
<tr>
<td>Fan Blade Platform</td>
<td>Rear Stator Case</td>
<td>LM2500 Combustor DLE</td>
<td>LPT Disk</td>
<td>Stationary Seal</td>
</tr>
<tr>
<td></td>
<td>STG 4-9 HPC Spool</td>
<td></td>
<td>STG 1 LPT Nozzle Inner Seal</td>
<td>Spanner Nut</td>
</tr>
</tbody>
</table>
StandardAero Component Services (SACS)
Process Capabilities (not exhaustive)

- Cleaning, NDT and Inspection
- Thermal Spray/Cold Spray
- Autoclave
- Welding/Brazing and Heat Treatment
- Painting, Water Jet & Surface Prep
- Manual and CNC Machining
- Balancing
StandardAero Component Services (SACS) Detailed Process Capabilities
StandardAero Component Services (SACS)

Process Capabilities

<table>
<thead>
<tr>
<th>Cleaning, NDT &amp; Inspection</th>
<th>Thermal Spray/Cold Spray</th>
</tr>
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<tbody>
<tr>
<td>• Light, heavy and multi-step alkaline cleaning</td>
<td>• Powder, Wire and HVOF thermal spraying (four robotic booths)</td>
</tr>
<tr>
<td>• Steam cleaning</td>
<td>• Robotic and manual plasma spray</td>
</tr>
<tr>
<td>• Waterjet</td>
<td>• Heat resistant enamel paint</td>
</tr>
<tr>
<td>• Ultrasonic</td>
<td>• Dry film lubricant</td>
</tr>
<tr>
<td>• FPI &amp; MPI</td>
<td>• Metallurgical lab</td>
</tr>
<tr>
<td>• Radiographic (X-ray)</td>
<td></td>
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<tr>
<td>• Eddy Current (hand held &amp; robotic)</td>
<td></td>
</tr>
<tr>
<td>• Coordinate Measuring Machine</td>
<td></td>
</tr>
<tr>
<td>• On machine inspecting using Faro arms</td>
<td></td>
</tr>
<tr>
<td>• Composition analysis</td>
<td></td>
</tr>
</tbody>
</table>


StandardAero Component Services (SACS)

Process Capabilities

Welding/Brazing and Heat Treatment

- GTAW (all materials, including titanium)
- Dabber welding (knife edge seals)
- Electron beam welding
- Spot resistance welding
- Torch brazing
- High temperature furnace brazing
- Inert atmosphere chambers
- Furnace heat treating (local and full)
- Induction heating (braze/heat treat)
- Automated shot/lance peening

Painting, Stripping & Surface Prep

- Surface protection, lubricants, bonding agents
- Wet and dry abrasive blasting
- Glass bead blasting
- Plastic media
- High-pressure water jet stripping

CNC shot peen
StandardAero Component Services (SACS)
Process Capabilities

**Manual and CNC Machining**
- Lathes, mills, VTLs, HBMs, grinders
- Die sink EDM/graphite
- Spark erosion grinding

**Balancing**
- Large and small capabilities

**Composites Autoclave**
- 10’ long x 6’ wide

120” VTL
SACS serves several of the world’s most recognized and discerning organizations
## StandardAero Component Services (SACS)

### Current engine component repair platforms

<table>
<thead>
<tr>
<th>CFMI</th>
<th>GE Aviation</th>
<th>GE – Land &amp; Marine</th>
<th>Honeywell</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CFM56-2A/2B</td>
<td>• CF6-6/50/80C2/80E</td>
<td>• LM1500, LM1600, LM2500, LM5000, LM6000, LMS100</td>
<td>• TFE731</td>
</tr>
<tr>
<td>• CFM56-3</td>
<td>• CF34-3/8C/8E/10E</td>
<td></td>
<td>• TPE331</td>
</tr>
<tr>
<td>• CFM56-5A/5B/5C</td>
<td>• GE90, GE90-100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• CFM56-7B</td>
<td></td>
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</tr>
</tbody>
</table>

### IAE
- V2500-A1/A5/D5

### GE Aviation
- PW2000, PW4000, PW100, PT6

### GE – Land & Marine
- AE2100 & AE1107
- Avon
- M250 & RR300
- RB211 (energy only)
- T56 & 501K

### Honeywell
- TFE731
- TPE331

### Pratt & Whitney
- PW2000, PW4000, PW100, PT6

### Military
- F100
- F108
- F110
- F117
- F404
- J85
- LM2500
- T700
- TF33

Note: list not exhaustive
StandardAero Component Services (SACS)
Core Engine – Fan Repairs

Booster Vane Assemblies

Fan Shaft

Dedicated Fan Case Module Line (Full assembly repair capability)

OGVs

Fan Disk

Fan Blade Platforms
StandardAero Component Services (SACS)
Core Engine – Compressor Repairs

- Forward Stator Case
- Comp Rotor Shaft
- Stg 1-2 Rotor Spool
- CDP Seal
- Rear Stator Case
- STG 4-9 HPC Spool
StandardAero Component Services (SACS)

Core Engine – Combustor Repairs

Dedicated Combustor Repair Line – LM, CFM, CF34, T56

CFM Combustor Case

T56 Combustion Liner

CF34

LM2500 Combustor DLE
StandardAero Component Services (SACS)
Core Engine – High and Low Pressure Turbine Repairs

HPT Rotating Seal  LPT Shaft  HPT Shroud Supports

Turbine Rear Frame  LPT Disk  STG 1 LPT Nozzle Inner Seal
StandardAero Component Services (SACS)
Core Engine – Secondary System Repairs

- A/O Separator Cover
- Center Vent Tube
- Oil Sump Assembly
- No. 5 Bearing Support
- Oil Inlet Cover
- Gears
StandardAero Component Services (SACS) Repair Development

StandardAero invests in developing new repairs, new technology and finding custom solutions for our customers

Cincinnati (SACS) RD CoE

• **Separate & dedicated Repair Development cell** with specialized engineers & experienced operators
• OEM alignment for departure record repairs and repair development. – *GE90-100 capable now*
• 300+ new repairs in 2016
• 45 active repairs, over 300 new repairs in queue
• Active technology roadmap - $3m invested since 2015
• FAA Organizational Designation Authorization capability – allows repairs to be developed in conjunction with OEM partners
• In-house tool design & fabrication
  • AutoCAD/MasterCAM/3D Modeling
Continuous Improvements (CIs)

• Any employee can initiate and lead a CI project
• **Over 1,000 completed CI projects since 2011**
• CIs drive improvements to production processes, safety procedures and customer relationships
• Senior managers participate in **weekly CI walk-aroounds** to review projects
• Example CI tools:
  • Grouping by part family
  • Value stream mapping
  • Kaizen
  • Daily walk arounds
• All managers and engineering personnel trained with Lean Manufacturing and Six Sigma principles
• Internal Lean Manufacturing/Six Sigma training course – over 45 employees have completed certification to date
StandardAero maintains Repair Station Certificates and upholds internationally recognized Quality and Environmental Systems in Cincinnati.

Cincinnati

- Federal Aviation Administration (FAA) Air Agency Certificate and Ops Specs
- European Aviation Safety Agency (EASA) Certificate
- Brazilian Agencia Nacional de Aviação Civil (ANAC) Certificate and Ops Specs
- Civil Aviation Administration of China (CAAC) Certificate
- Civil Aviation Administration of China (CAAC) Maintenance Capability List
- Jordan Civil Aviation Regulatory Commission (CARC) Certificate
- Indonesian Directorate General of Civil Aviation (DGCA) Certificate and Ops Specs
- Thailand Department of Civil Aviation (DCA) Certificate and Ops Specs
StandardAero Component Services (SACS)
Industrial Pretreatment
Facility Discharge Permit

• Facility permitted by Metropolitan Sewer District (MSD) under permit Significant Industrial User (SIU) 3674.

• Daily batch discharge of up to 7,500 gallons beginning at 1:30pm

• Currently, we discharge 7 days a week and average approximately 4,000 gallons per day.

• Permit has been effective since July 1, 2013.
Sources of Industrial Wastewater

• Rinse Waters from Chemical Cleaning
  • Facility has aqueous, caustic, and acidic cleaning
  • Primary rinse occurs over the chemical tanks
  • Secondary rinse is a submersion rinse that is discharged

• Process Wastewater from CNC “WaterJet” Machine
  • High pressure (50,000 psi) coating stripper/cleaner
  • 3 gallons per minute flow during operation
  • Wastewater goes through multi stage filtration prior to discharge.
Facility Pretreatment System

SYSTEM DIAGRAM

SEQUENCE OF OPERATION:
1. OVER NO PILOT PUMP WAS CLOSED TO THE TANK 2.
   A LEVEL ALARM WAS RAISED ALARM AND A LOW
   LEVEL ALARM WAS RAISED ALARM PUMP
   PUMP P-2 CONTROL

PUMP P-2 CONTROL

Chemical Cleaning Rinse

• Change out 1 tank per day

• Generates approx 1,100 gal. per batch.

Process Controls:
  pH and Chromium checks prior to transferring to batch discharge tank
CNC WaterJet Machine

- Multi step filtration prior to transfer to batch discharge tank.
CNC WaterJet Machine Filtration

• Step 1:
  Water separating sump to allow “large” solids to fall out of suspension

• Step 2:
  Filter system consisting of:
  • 2- 5 Micron bag filters
  • 2- 1 Micron bag filters
  • 1- 2.5 Absolute cartridge filter
7,500 Gallon Batch Discharge Tank

• Every batch must log:
  • Date
  • Volume/Flow
  • pH
  • Temperature
  • Stop Time
  • Sampler Sign Off

• Self-Monitoring requirements:
  • 4 days, Semi Annually
    - Metals
    - Oils/Grease
    - Cyanides
    - Total Toxic Organics

• Zero non-compliances in our permit history.
Benefits of Discharge

• Chemical Cleaning Rinse
  • Significant cost savings vs disposal
  • Increased operational efficiency due to the fact that we change the rinse tanks more regularly vs disposal
  • Less down time vs disposal

• CNC WaterJet Machine
  • Significant cost savings due to extended filter life
  • Less down time to change filters; prior to discharge multiple filter changes per day
  • Prior to discharge, component reliability was an issue due to heat generation. Once discharge began, component reliability significantly increased.
QUESTIONS?