Design Partners for the
Global Aerospace & Defense Industry

2015
CIRCOR International Overview

Key Markets

- Oil & Gas
- Natural Gas
- Power Generation

Major Locations

- U.S.A
- Canada
- UK
- Italy
- Germany
- China
- India
- Brazil

Aerospace & Defense

- Commercial Transport
- Business Aviation
- Defense

- U.S.A
- UK
- France
- Morocco
- China
- India
CIRCOR Business Overview

**Business Description:** Design, develop, manufacture and sell flow control and actuation solutions to the Energy (Oil & Gas and Power) and Aerospace markets

2014 Sales: $841 Million
Enterprise Value: ~$1.34 Billion
Employees: ~3,000
HQ: Burlington, MA, USA
NYSE Listed: Ticker: CIR

![Sales by Geography 2014](chart.png)
About CIRCOR Aerospace & Defense

Design, develop and test Fluid Control and Actuation products for commercial and defense markets

Focused on high growth programs and technologies
• Commercial aircraft
• Weapons & Ordnance
• Aftermarket, Maintenance, Repair and Overhaul

Strong, globally recognized brands with differentiated technology
• Aerodyne pneumatic controls
• CIRCOR Bodet sensing & flight controls
• Circle Seal electromechanical valves
• Hale Hamilton air control valves

International footprint for growth and low cost manufacturing
Balanced Business

2013 Aerospace & Defense Sales = $199M

Defense 60%

- Rotary Wing 29%
- Maritime 22%
- Fixed Wing 23%
- UAV 13%
- Missiles 12%

Commercial 40%

- Single Aisle 30%
- Twin Aisle 33%
- Regional Jet 3%
- Civil Transport 7%
- Rotary Wing 10%
- BizJet 12%
- Survival Solutions 4%

Note: Excludes general industrial of $36M
CIRCOR Aerospace & Defense

Sales

Revenue by Segment

Revenue by Region

- US & Canada: 50%
- EMEA: 48%
- Latin America: 1%
- Asia & Pacific: 1%

• Significant opportunity to grow in Asia and South America
Strong Brands with Differentiated Technology

Brands

Aerodyne Controls

Circle Seal Controls

Industria

HALE Hamilton

Motor Technology

Products

Long Range Bizjet Electro-Mechanical Actuation

UAV Nose Wheel Steering Actuation

Submarine Critical Air Control Valves

Narrowbody Tachometers

Widebody Landing Gear Door Actuation
<table>
<thead>
<tr>
<th>Location</th>
<th>Facility Size</th>
<th>Actuation</th>
<th>Fluid Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>115,000 ft²</td>
<td>Door Actuation, Motors</td>
<td>Hydraulic Valves, Pneumatic Valves</td>
</tr>
<tr>
<td>Paris</td>
<td>11,000 ft²</td>
<td>Solenoids, Pressure Switches, Manifolds</td>
<td>Hydraulic Valves, Couplings</td>
</tr>
<tr>
<td>Chemillé</td>
<td>17,000 ft²</td>
<td>Motors, Wheel Speed Transducers</td>
<td>Hydraulic Valves</td>
</tr>
<tr>
<td>Morocco</td>
<td>40,900 ft²</td>
<td>Motor Winding</td>
<td>Component Marching</td>
</tr>
<tr>
<td>New York</td>
<td>31,000 ft²</td>
<td>Switches</td>
<td>Regulators, Power Modules, Centrifuges</td>
</tr>
<tr>
<td>Uxbridge</td>
<td>48,380 ft²</td>
<td></td>
<td>Regulators, Hydraulic Valves, Pneumatic Valves</td>
</tr>
</tbody>
</table>

800 employees worldwide
CIRCOR Aerospace & Defense
Low Cost Manufacturing

**China – Suzhou**
- Machining / Final Assembly / Test
- Local supply chain

**Morocco - Tangier**
- Assembly & Test
- Machining
- Windings

**India – Coimbatore**
(opened 2012)
- Engineering
- Sourcing
- Manufacturing
CIRCOR Aerospace & Defense

Major Programs

Airbus A350 XWB , A320, A330/340, A380
Boeing Next Generation: 737, 747, 767 and 777

Gulfstream 650/Learjet 85/Hawker Beechcraft/Dassault 7X, 2000/ Cessna Citation
BBJ / HondaJet / Embraer Phenom / Bombardier Global Express

T-38 / T-45 / F-15 / F-16 / F-18 / F-22 /F-35
UAVs: Predator / Global Hawk / Fire Scout / A-160 Hummingbird

Weapons Programs: SM3 / AIM-7 & 9X / Hellfire / Longbow /
Sea Sparrow / EKV (Exoatmospheric Kill Vehicle)

Augusta Westland 129 BCH Helicopter
AH-64D
Eurocopter EC-175 (Z-15)
Mitsubishi Regional Jet
C-Series Bombardier Regional Jet

HMS Victorious V-Class SSBN Ballistic Submarine
LCS USS Freedom
CIRCOR Aerospace & Defense Products
Your Component & Sub-System Design Partner for Fluid Control and Actuation

Engineered Products

- Main Landing Gear Door Actuator
- Norm Brake Selector Manifold
- Cold Gas Thruster Regulator
- Built-In Breathing Systems

MRO Repair Station Products

- Hydraulic Stick Pusher
- Check & Relief Valves
- Motor-Operated Valves
- "Geared" Turbofan Fuel Solenoid Valves
CIRCOR Aerospace & Defense
Core Capability

**Fluidic Control**
- Pneumatic, Fuel, Hydraulic
- Commercial Transport, UAV, Missile/Defense
- Sensing & flight control components commercial transport
- Missile/Defense

**Actuation**
- Military, Commercial Transport, Bizjet, Rotorcraft
- Variable electro-mechanical actuation with position feedback

**New Products & Technologies**
- Fit and enhance product portfolio
- Access to new customers and aftermarket
- Unique technologies: enhancements, increase value proposition
Sample Defense Content

- Nose-Wheel Steering Actuator
- Canopy Seal Regulators
  - Fuel Valves
  - Hydraulic Valves
  - Pneumatic Valves
  - Accumulator Pressure Gauges
- Brake Manifolds
- Instrumentation Pressurization Pod
- Helmet Visual Display
- Seat Potentiometer
- Pneumatic Power Module
Sample Commercial Content

- Alt Brake Selector Valve
- Park Brake Selector Valve
- Norm Brake Selector Valve
- Main (Gear) Isolation Valve
- Tachometer
- MLG Door Actuator
- Door Bypass Valve
- Vent Valve
- Pilot Valve
- Brake Pedal Transmitter Unit
- NLG Door Actuator
- Nose (Gear) Isolation Valve
## Actuation: Hydraulic Actuators

<table>
<thead>
<tr>
<th>Technology</th>
<th>First Generation</th>
<th>Current Products</th>
<th>Future Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuator</td>
<td>Build to Print</td>
<td>Design to Spec</td>
<td>Internal mechanical locking (extend and/or retract)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Military, Business Jet to Large Air Transport applications</td>
<td>- 3,000 psig and 5,000 psig operating pressures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rate control and snubbing mechanisms</td>
<td>- Lock Indication (proximity or micro-switch based)</td>
</tr>
</tbody>
</table>

### Current Products
- **F-16 Nose Wheel Steering Actuator**
- **A350 Main Landing Gear Door Actuator**
- **A330 Retract Actuator**
- **A350 Nose Landing Gear Door Actuator**
## Fluid Controls: Manifolds

<table>
<thead>
<tr>
<th>Valve Type</th>
<th>First Generation</th>
<th>Current Products</th>
<th>Future Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manifold Valve Assembly</td>
<td>- 1990’s Ground service manifold,</td>
<td>- 2000’s simple spool valve, pilot plug-in manifold</td>
<td>- Multi component integration, several spool assy with complex component</td>
</tr>
</tbody>
</table>

### Valve Pedigree:

- **A340** Ground service Manifold
- **A350** Alternate Brake Selector Valve
- **AB139** Rotor Brake selector valve
- **A400** Ground service Manifold
## Fluid Controls: Motor Operated Valves

### Valve Pedigree

<table>
<thead>
<tr>
<th>Valve Type</th>
<th>First Generation</th>
<th>Current Products</th>
<th>Future Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Operated Valves</td>
<td>-1970’s: developed valve only w/o actuator.</td>
<td>-Permanent magnet motors for longer life.</td>
<td>-CIRCOR brushless motors.</td>
</tr>
<tr>
<td></td>
<td>-Designed/qualified MOV w/actuator in mid-70’s.</td>
<td>-Weight-saving designs.</td>
<td>-Composite materials.</td>
</tr>
<tr>
<td></td>
<td>-1980’s: qualified “Big-4” Boeing MOV.</td>
<td>-Modular designs.</td>
<td>-Smart Valve Technology; variable open/close, flow control.</td>
</tr>
<tr>
<td></td>
<td>Weight-saving designs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Modular designs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acquired Motor Technology.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Boeing Hydraulic Shutoff Valve B737, 767, 777**
- Standard LRU Actuator used on 4 separate Boeing valves
- Unibody construction w/EMI filter and thermal relief valve

**Parker Hydraulic Shutoff Valve Dassault Falcon 7X**
- Brushless motor, manifold interface, to replace a solenoid operated valve

**Sikorsky Gearbox Shutoff Valve S-92**
- Brushless motor, manifold interface, to replace a solenoid operated valve
# Fluid Controls: Solenoid Valves

## Valve Pedigree

<table>
<thead>
<tr>
<th>Valve Type</th>
<th>First Generation</th>
<th>Current Products</th>
<th>Future Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot Solenoid Valve</td>
<td>- 1970’s - Developed valve from BTP product</td>
<td>- &quot;Mini&quot; solenoid valve</td>
<td>- Permanent magnet latch valve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- &quot;stage noze&quot; pilot valve</td>
<td>- Pick and hold/PWM device for power saving</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Electro-Mechanical Controls: Tachometers

<table>
<thead>
<tr>
<th>Technology</th>
<th>First Generation</th>
<th>Current Products</th>
<th>Future Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable reluctant flux</td>
<td>- 1980's for Airbus Platforms A300, A320, … - Dassault Business Jet Only one customer: Messier-Bugatti</td>
<td>- Business Jet to Large Air Transport applications - Military and civil business - Integration of TPIS function</td>
<td>- Small tachometer for small Business Jet (less than one inch) - Electronic Tachometer (TBC): measurement from 0 rpm, indication of direction</td>
</tr>
</tbody>
</table>

- A320, A330-A340 Tachometer
- F2000 Tachometer
- Rafale Tachometer
- A380 Tachometer
- F7X Tachometer
- ARJ21 Tachometer
Assemblies, Manifolds & Systems

The safe control & reduction of high pressure fluids to lower application pressures used on submarines & surface warships today

- Autocharge Systems: automated cylinder filling
- Hood Inflation Systems
- Built-in Breathing Systems
- Reducing Stations & Manifolds
- Valve Chests & Distribution Manifolds
Portable Charging Units
Ground service equipment serving business aviation, commercial and military aerospace.
Supplying Industry Leaders

- Bombardier
- UTC Aerospace Systems
- Embraer
- Boeing
- Safran (Messier-Bugatti-Dowty)
- Rolls-Royce
- Airbus
- Northrop Grumman
- Honeywell
- Raytheon
- Cessna
- Lockheed Martin
- Gulfstream
- Parker
- Eurocopter
- Meggitt
Quality Attributes

- Quality Control Systems Implemented
  - AS9100C
  - NASA NHB5300.4
  - FAA PMA FAR 21
  - FAA FAR 145 Repair Station
  - EASA 145 Repair Station
  - Calibration ANSI/NCSL Z540-1

- Product Traceability
  - Unique Traceability # of each lot
  - UID Marking
  - Full Documentation System

- Continuous Improvements
  - Cross Functional Teams
  - Kaizen Events / Model Lines
  - Lean Sigma Systems
  - CIRCOR Problem Solving

- Customer Satisfaction
  - Lockheed Martin STAR Supplier
  - Lockheed 100% Delivery & Quality Award
  - Airbus SQIP Gold Award Winner
  - Customer Approved Supplier
  - Government
  - Boeing D6-82479
  - Airbus GRESS
  - Rolls Royce SABRE
  - NASA
  - Lockheed Martin
  - Honeywell Self Reliance
  - Gulfstream
  - Northrop Grumman

- Strategic Supplier Management
  - On time delivery/ Quality monitoring and reporting
Thank You

www.circoraerospace.com