FLOW, LEVEL, TEMPERATURE & PRESSURE SENSORS

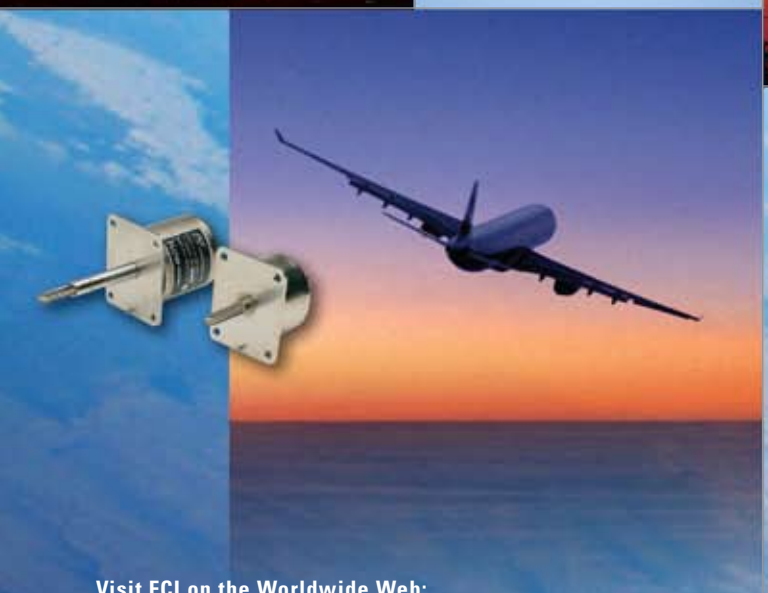
FOR AIRCRAFT APPLICATIONS

PERFORMANCE | RELIABILITY | QUALITY

FCI® AEROSPACE

F C I A E R O S P A C E

FLOW, LEVEL, TEMPERATURE AND PRESSURE SENSORS FOR AIRCRAFT



Visit FCI on the Worldwide Web:
www.fluidcomponents.com

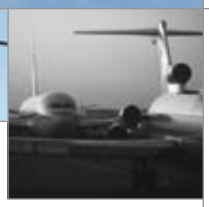
Headquarters: 1755 La Costa Meadows Drive
San Marcos, California 92078 USA
Phone: 760-744-6950* Toll Free: 800-854-1993
Fax: 760-736-6250*

European Office: Persephonestraat 3-01
5047 TT Tilburg, The Netherlands
Phone: 31-13-5159989
Fax: 31-13-5799036

**Please note: FCI area code changes from "760" to "442" effective January 1, 2009*

Doc No. 02MK011531-

AH-64 Apache photo by Matthiknight, Hebrew Wikipedia



- **Flow, level, temperature, and pressure sensors for on-board aircraft installations**
- **Sensor systems to meet a broad range of flight applications**
- **Comprehensive engineering and technical support**
- **AS9100 and ISO-9001:2000 certification**
- **MIL-STD-45662A**
- **ANSI/NCSL Z540**
- **RTC DO-160 and DO-178B**

FCI Aerospace provides flow, level, temperature and pressure measuring solutions for on-board aircraft installations. Recognizing that aircraft and sub-system manufacturers have diverse and technical measurement and sensing requirements, FCI Aerospace is a world leading manufacturer of built-to-specification flow, level, temperature and pressure sensors with designs that meet and exceed specifications for performance, reliability and quality.

Whether fixed wing or rotary aircraft, FCI Aerospace has designed and manufactured qualified, flight-worthy sensor systems to meet a broad range of applications. Manufacturers and sub-system suppliers of commercial, business, defense and military aircraft throughout the world have specified and installed FCI sensors with confidence for more than 20 years.

APPLICATION ASSISTANCE FROM FCI

To learn what solutions FCI Aerospace can provide for your sensor application, simply complete the Application Data Sheet on page 7, or download the interactive PDF from our web site (www.fluidcomponents.com/aerospace). Submit the ADS via fax, mail or email.

Aircraft and System Manufacturers Using FCI Aerospace Products

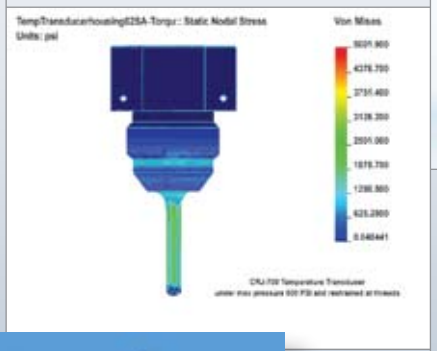
ADAMS RITE AEROSPACE
BELL HELICOPTER
BF GOODRICH
BOEING
BOEING DEFENSE & SPACE
BOEING ROTORCRAFT
BOEING SERVICE COMPANY
BOMBARDIER DEHAVILLAND
BOMBARDIER, CANADAIR
BOMBARDIER/LEARJET
DEHAVILLAND
DEPT OF THE AIR FORCE
DFAS
DOW AEROSPACE
DUCOMMUN TECHNOLOGIES
EMBRAER
FEDERAL AVIATION ADMINISTRATION
FAIRCHILD CONTROLS
FLIGHT STRUCTURES INC
GENERAL DYNAMICS
GLOBAL EXPRESS
HAMILTON SUNDSTRAND
HONEYWELL
HONEYWELL AEROSPACE
HONEYWELL NORMALAIR
L3 COMMUNICATIONS
LIEBHERR AEROSPACE
LOCKHEED MARTIN
MCDONNELL DOUGLAS
NORTHROP GRUMMAN
NORTHROP GRUMMAN SPACE TECHNOLOGIES
PARKER HANNIFIN
RAYTHEON SYSTEMS
RAYTHEON AEROSPACE CO
SIKORSKY AIRCRAFT
SUNDSTRAND AEROSPACE
TECHNOFAN
WHITTAKER CONTROLS INC

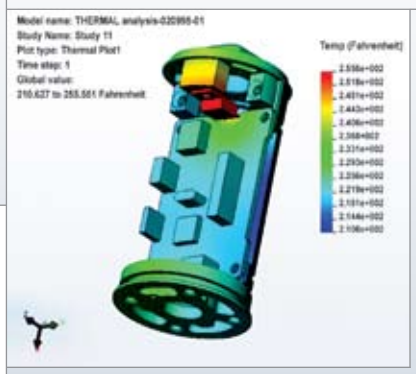
VEHICLE and SHIPBOARD APPLICATIONS

FCI's flow, level, temperature and pressure measuring solutions are also successfully designed for service in military vehicle and shipboard applications. Submit the attached Application Data Sheet (page 7) for product information and solutions.

ENGINEERING and DESIGN TOOLS FOR SUCCESS

In support of customer sensing solutions, FCI provides comprehensive engineering and technical support that meets aircraft manufacturers' highest standards. Documentation, flight test qualifications, fabrication, use of specific ducting or piping to simulate vehicle conditions and installation are all within the scope of any FCI project. Program options include electronics manufacturing compliant with J-STD-001C and software (firmware) validation per DO-178B. FCI also operates a world-class calibration facility on its premises. This facility is utilized for both design development and validation, as well as production. The FCI calibration facility is NIST traceable, and meets MIL-STD-45662A and ANSI/NCSL Z540 requirements.





FCI continuously invests in engineering tools and development systems to bring you the most effective measurement product solutions while minimizing your investment. By applying computer design, modeling and analysis, FCI is able to dramatically reduce development times, provide improved diagnostics and eliminate excessive prototyping, which results in a better product with significant cost savings to you.

Engineering tools utilized by FCI Aerospace in product solution development include:

- 3D Modeling, Design and Drawing Preparation – *SolidWorks*®
- Computational Flow Dynamics (CFD) – *FloWorks*®
- Stress, Temperature and Vibration Analysis – *Cosmos*®
- Statistical Data Reduction – *MathCAD*®
- Electronic Circuit Design – *OrCAD Schematic Capture*®
- Electronic Circuit Analysis – *PSpice*®
- Automated Application Evaluation – *AVAL*

FCI Aerospace is AS9100 and ISO-9001:2000 certified and adheres to the quality system requirements of MIL-I-45208A and 14CFR21.303h as defined in Section Two. The quality programs and processes have been audited and approved by all major aircraft and airframe providers. FCI also holds FAA/PMA approval on its components in service on several aircraft including the RJ200, Dash8-400, MD11, B717, Global Express and others. FCI has participated in the aerospace, defense and space industry's Supplier Excellence Alliance (SEA) supply-chain initiative.

ELECTRONICS

Sensor elements can be specified to interface directly to customer supplied electronics or with FCI electronics.

FCI electronics are combined with sensor elements to create complete flow, level, temperature and pressure switches or transmitters. For switch outputs, FCI can supply up to three solid state switch outputs, or a combination of solid state switches and analog outputs for limit control or alarm applications. For transmitter applications, FCI electronics can provide one or more linearized 4-20 mA, 0-5 Vdc or 0-10 Vdc analog outputs and/or digital bus communication output.

Electronics for either switch or transmitter products may be integrally mounted with the sensor element or remote mounted with an interconnecting cable. Electrical connections are typically made using MIL-STD connectors.

UNIQUE 'FLOW + TEMPERATURE' AND 'LEVEL + TEMPERATURE' SENSING TECHNOLOGY

FCI's thermal dispersion technology excels in applications where both flow and temperature or level and temperature are measured. Because temperature sensing is inherent in FCI's thermal dispersion flow and level measurement technology, a second output of the fluid's temperature is always available. A single sensor provides dual measuring functions. Aircraft manufacturers save weight, save space, and save costs over two or more discreet sensors. You realize reduced qualification installation costs and complexity.

FLOW SENSORS

FCI flow products utilize FCI patented, exclusive thermal dispersion technology. FCI uses a proprietary constant power technique which is effective in flow switch designs. In flow meter type applications, FCI utilizes either of two effective techniques, constant power or constant ΔT, which ever is best suited for the specific application. Further, because FCI thermal dispersion sensors have no moving parts to clog or foul, maintenance costs are virtually eliminated. Flow element designs are available for either flanged or threaded process connections into the aircraft's duct or pipe.

LEVEL and INTERFACE SENSORS

FCI level products utilize FCI exclusive constant power, thermal-dispersion as the sensing technology which yields a highly sensitive and low power element. FCI level sensors have no moving parts to clog or foul, maintenance costs are virtually eliminated. Level element designs are available for either flanged or threaded process connections through the reservoir or gearbox and is equipped with an electrical connector or flying lead to the electronics. FCI has also provided level elements for mounting internally within the reservoir or sump with a flying electrical lead passing through a seal in the wall of the vessel and attaching to remote mounted electronics. Multi-point level sensing element designs are available for up to eight (8) separate elevations in a resevoir.

TEMPERATURE SENSORS

FCI temperature product designs most often utilize precision, platinum RTD (resistance temperature detector) as the sensing technology; however, depending on specific application needs FCI has provided and may recommend designs using thermistors or thermocouple technologies. Element designs are available for either flanged or threaded process connections into the aircraft's duct or pipe.

PRESSURE SENSORS

FCI pressure products are built using piezoresistive sensors in a wheatstone bridge, strain-gage configuration. They can be specified for absolute, gauge or differential pressure measurement. The pressure element is threaded for direct installation into pipes, ducts, tanks, reservoirs, sumps and gearboxes on the aircraft.

AS-FS

AS-FT

AS-LLS

AS-LLE

AS-TS and AS-TT

AS-MLLS

AS-TE

AS-PE, AS-PS and AS-PT

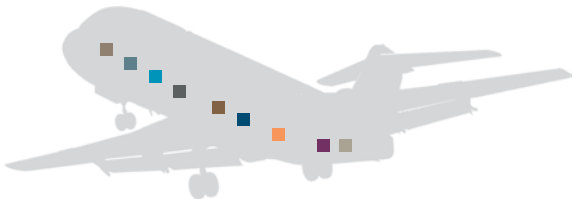
Model Summary

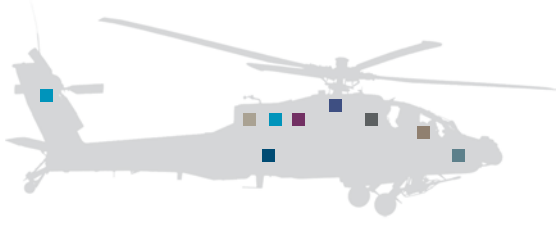
Model Type	Outputs	Application(s)	Flow	Level	Temperature	Pressure
Element Only	Direct, non-linearized from sensor	For direct integration into customer electronics	N/A	AS-LLE	AS-TE	AS-PE
Switch Electronics	Solid state (open collector), digital; single, dual or triple	High and/or low setpoint warning, alarms or on/off control	AS-FS	AS-LLS, AS-MLLS	AS-TS	AS-PS
Transmitter/ Meter Electronics	Linearized and conditioned 0-5 Vdc, 0-10 Vdc or 4-20 mA over specific range	Displaying, reading or recording actual measured value of specified process	AS-FT	AS-LLT	AS-TT	AS-PT

Industry Applications

Air Flow Applications	Flow	Level	Temperature	Pressure
PACK Air – mass flow, temperature, and pressure	■		■	■
Avionics and ECS Low Air Flow Alarms – mass flow and temperature switches and transmitters	■		■	
Cooling Effects Detectors (CED) – dual-function mass flow and temperature switch	■		■	
Bleed Air – high temperature mass flow and pressure switches and transmitters	■		■	■
Cabin Temperature – multiple point temperature and transmitter outputs			■	
Crew Cabin Ventilation – flow and temperature switches and transmitters	■		■	
Water, Waste and Service Cart Systems	**Flow**	**Level**	**Temperature**	**Pressure**
Potable Water – temperature and multi-point liquid level elements with controller electronics		■	■	
Warm Water Wash Reservoirs – temperature and liquid level switches		■	■	
Waste Tank – high alarm liquid level		■		
Toilet Flush Fluid Leak Detection – low flow switch	■			
Service Cart Condensate Overflow Detection – high liquid level alarms		■		
Oil Detection in Engine, Auxiliary Power Unit and Integrated Drive Generator Gearboxes and Reservoirs	**Flow**	**Level**	**Temperature**	**Pressure**
Gearbox Remote Oil Level Sensors (ROLS) – liquid level elements		■		
Oil Temperature Sensors – temperature elements and switches			■	
Oil Reservoir Level Sensors – single/multi-point liquid level switches and continuous liquid level transmitters		■		
Hydraulic Systems	**Flow**	**Level**	**Temperature**	**Pressure**
Hydraulic Oil Sensors – flow, level and pressure transmitters, temperature elements	■	■	■	■
Hydraulic Oil Reservoir Monitor – liquid level and temperature switches and transmitters		■	■	
Fuel Systems	**Flow**	**Level**	**Temperature**	**Pressure**
Engine Control – flow and temperature transmitters	■		■	
Fuel Transfer – flow switches and flow transmitters	■			
Fuel Tank Inerting Sensors – flow, temperature and pressure transmitters	■		■	■
Cooling Systems	**Flow**	**Level**	**Temperature**	**Pressure**
Ethylene Glycol – flow, level, temperature and pressure	■	■	■	■
Poly-Alpha-Olefin (PAO) – flow, level, temperature and pressure	■	■	■	■

Aircraft System Applications





- Environmental Control (ECS), Air Management Systems (AMS) Control and Health Monitoring
- Onboard Inert Gas/Oxygen Generating System (OBIGGS/OBOGS)
- Gearbox Level and Temperature Detection
- Avionics Cooling Systems
- Fuel Tanks and Refueling Systems
- Generators
- Engine Fuel Controls
- Airframe Mounted Pod System (AMADS), ATFUR
- Radar and Electronic Accessory Cooling
- Integrated ECS/NBC System
- Auxiliary Power Unit (APU)
- Turboshaft Engines

1755 La Costa Meadows Drive
San Marcos, California 92078 USA
Phone: 760-744-6950 / 800-854-1993
Fax: 760-736-6250
www.fluidcomponents.com

Application Data Sheet (ADS)

Aerospace & Military Products

Temperature, Flow, Liquid Level & Pressure Sensors

Send completed form: SAVE | EMAIL | Print & FAX

* *Required information*

NOTE: If EMAIL button does not work in your system, please SAVE this form and email to AerospaceADS@fluidcomponents.com with the PDF as an attachment

Customer Information

Date: _____

*** Company Name:** _____

* Address: _____

_____

* City: _____ State: _____ * ZIP/Postal Code: _____

Country: _____ ☐ Commercial ☐ Military

*** Technical Contact:** _____

* Phone: _____ Fax: _____

* Email: _____

Procurement Contact: _____

Phone: _____ Fax: _____

Email: _____

Application Information

Sensor type: ☐ Temperature ☐ Pressure ☐ Flow ☐ Level/Interface ☐ Other: _____

Mounting connection: ☐ Thread ☐ Flange Description _____

Input Power: ☐ 28 Vdc ☐ 110 Vac, 60 cycle ☐ Other: _____

Alarm Output: ☐ Open drain buffer ☐ Analog Output Only ☐ Other: _____

Application Sketch

☐ **Sending sketch via email**

Process Conditions

Primary process media (at sensor location): _____

☐ Gas ☐ Liquid

Temperature - specify units: ☐ °F ☐ °C ☐ Other: _____

Minimum: _____ Nominal: _____ Maximum: _____

Pressure - specify units; ☐ psig ☐ psia ☐ bar(g) ☐ atm ☐ Other: _____

Minimum: _____ Nominal: _____ Maximum: _____

Secondary process media (flow or level): _____

☐ Gas ☐ Liquid

Temperature - specify units: ☐ °F ☐ °C ☐ Other: _____

Minimum: _____ Nominal: _____ Maximum: _____

Pressure - specify units; ☐ psig ☐ psia ☐ bar(g) ☐ atm ☐ Other: _____

Minimum: _____ Nominal: _____ Maximum: _____

Interface description (specify interface state; foam, sediment, slurry): _____

Calibration Conditions *(Customer must specify calibration media)*

Temperature/Pressure Applications

Temperature/Pressure range:

☐ As entered for the primary media in Process Conditions section above

☐ As entered for the secondary media in Process Conditions section above

☐ Other _____

Alarm set point: No. 1 _____
No. 2 _____
No. 3 _____

Analog output signal: ☐ Not required
☐ 0-5 Vdc
☐ 4-20 mA
☐ Other _____

For temperature applications only

Element type: ☐ RTD
☐ Thermistor
☐ Thermocouple

Flow Sensor Applications

Duct inside diameter: _____ ☐ Inch ☐ mm

Pipe orientation: ☐ Horizontal ☐ Vertical

Sensing element mounting: ☐ Side ☐ Top

Flow direction: ☐ Right to left ☐ Left to right
☐ Top to bottom ☐ Bottom to top

Flow rate: Min. _____ Max. _____

Nominal flow rate: _____

Flow units: _____

Alarm set point: No. 1 _____
No. 2 _____
No. 3 _____

Signal output: ☐ 0-5 Vdc ☐ 4-20 mA

Media: ☐ Air ☐ Fuel
☐ Hydraulic fluid ☐ Coolant

Description: _____

_____

Level/Interface Applications

Sensing element mounting: ☐ Side ☐ Top ☐ Bottom

Level or interface rate-of-change (at sensing element): _____

☐ Inch/sec ☐ mm/sec
☐ Inch/hr ☐ mm/hr

Alarm set point elevation distance from mounting connection:
No. 1 _____
No. 2 _____
No. 3 _____
No. 4 _____
No. 5 _____

Analog output signal:

☐ Stepped ☐ Continuous
☐ 0-5 Vdc ☐ 4-20 mA
☐ Not required
☐ Other _____

General Capabilities & Specifications

	Flow	Level	Temperature	Pressure
Fluid Service (Compatibility)	Air, Gas, Liquids	Liquids, Interface	Air, Gas, Liquids	Air, Gas, Liquids
Base Series Model Number				
Element	N/A	AS-LLE	AS-TE	AS-PE
Switch	AS-FS	AS-LLS, AS-MLLS	AS-TS	AS-PS
Transmitter/Meter	AS-FT	AS-LLT	AS-TT	AS-PT
Installation	Insertion or in-line flow body	Insertion	Insertion	Insertion
Accuracy	±2% FS	± 0.25 inch [6.35 mm]	±0.5 °F [± 0.3 °C]	± 1% of reading
Repeatability	±1% FS	± 0.1 inch [2.54 mm]	±0.05% reading	± 0.1% of reading
Element Materials of Construction	300 Series Stainless Steel, Titanium and other materials available; Brazed or all-welded	PVC/Kapton, 300 Series Stainless Steel, Titanium and other materials available; Metals brazed or all-welded	300 Series Stainless Steel, Titanium and other materials available; All welded	300 Series Stainless Steel, Titanium and other materials available; All welded
Process Connections	Flanged or Threaded	Flanged or Threaded	Flanged or Threaded	Flanged or Threaded
Element Operating Temperature	-65 °F to 800 °F [-54 °C to 427 °C]	-65 °F to 800 °F [-54 °C to 427 °C]	-50 °F to 800 °F [-46 °C to 427 °C]	-40 °F to 257 °F [-40 °C to 125 °C]
Element Operating Pressure	to 7500 psig [517 bar g]	to 7500 psig [517 bar g]	to 7500 psig [517 bar(g)]	to 10,000 psig [690 bar(g)]
Element Proof Pressure	to 12,500 psig [861 bar(g)]	to 12,500 psig [861 bar(g)]	to 12,500 psig [861 bar(g)]	to 20,000 psig [1380 bar(g)]
Other	Flow Turndown 5:1 to 100:1			
Integral or Remote Mounting	Yes	Yes	Yes	Yes
Operating Temperature	-40 °F to 257 °F [-40 °C to 125 °C]	-40 °F to 257 °F [-40 °C to 125 °C]	-40 °F to 257 °F [-40 °C to 125 °C]	-40 °F to 257 °F [-40 °C to 125 °C]
Power Input	28 Vdc nominal per MIL-STD -704	28 Vdc nominal per MIL-STD -704	28 Vdc nominal per MIL-STD -704	28 Vdc nominal per MIL-STD -704
Outputs				
Switch Configurations	Op Amp Totem Pole, Open Collector/Drain	Op Amp Totem Pole, Open Collector/Drain	Op Amp Totem Pole, Open Collector/Drain	Op Amp Totem Pole, Open Collector/Drain
Transmitter Configurations	0-5 Vdc, 0-10 Vdc, 4-20 mA and/or digital bus; linearized and conditioned	0-5 Vdc, 0-10 Vdc, 4-20 mA and/or digital bus; linearized and conditioned	0-5 Vdc, 0-10 Vdc, 4-20 mA and/or digital bus; linearized and conditioned	0-5 Vdc, 0-10 Vdc, 4-20 mA and/or digital bus; linearized and conditioned
Housing Materials	Environmentally sealed units – electroless nickel plated aluminum with o-ring seal; Hermetically sealed units 300 series Stainless Steel	Aluminum alloy painted lusterless black per MIL-C-83286; Hermetically sealed units 300 series Stainless Steel	Environmentally sealed units – electroless nickel plated aluminum with O-ring seal; Hermetically sealed units 300 series Stainless Steel	300 series Stainless Steel; Hermetically sealed
Other Features, Options	• Process temperature output • Controller functions (time delays, etc.) • Extended Temperature Service • Extended Pressure Service	• Process temperature output • Controller functions (time delays, etc.) • Extended Temperature Service • Extended Pressure Service		

For ground-based, fuel depot, test stands or plant operations applications, see FCI's industrial product line.

Visit FCI on the Worldwide Web: www.fluidcomponents.com

Headquarters: 1755 La Costa Meadows Drive
San Marcos, California 92078 USA
Phone: 760-744-6950* Toll Free: 800-854-1993
Fax: 760-736-6250*

European Office: Persephonestraat 3-01
5047 TT Tilburg, The Netherlands
Phone: 31-13-5159989
Fax: 31-13-5799036

**Please note: FCI area code changes from "760" to "442" effective January 1, 2009*

0808-2.5K **Doc No. 02MK011531-**