

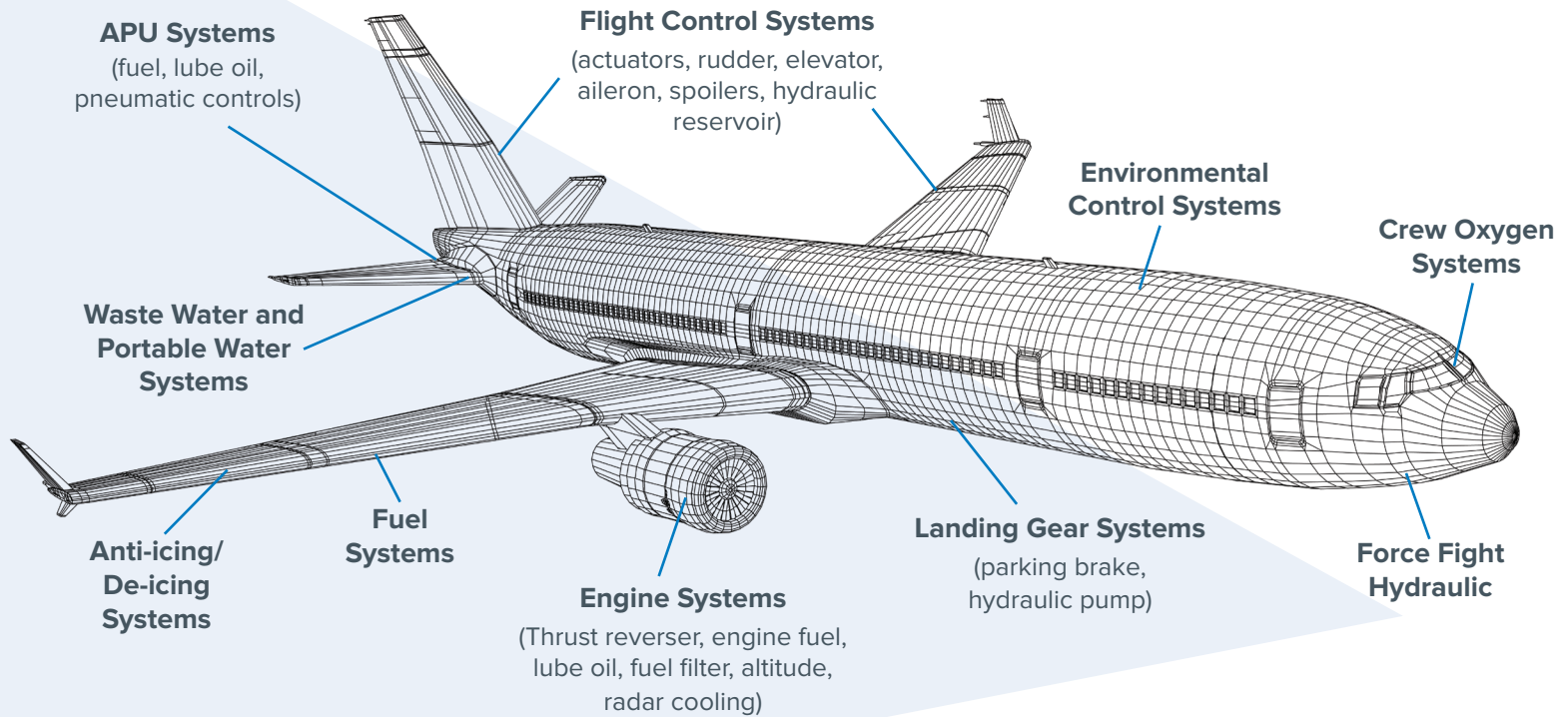
# HydraElectric™



## *Breakthrough Sensing Technology*

Sensors | Switches

Hydra-Electric's sensors and switches have been put to the test across a wide range of critical aircraft systems.



#### FOR A VARIETY OF MEDIA

Oil | Fuel | Hydraulic | Air | Bleedair

## Unparalleled Commercial and Military Program Experience

### Recent examples (partial list):

- Airbus: 320, 320neo, 330, 350, 380
- Boeing: 737, 747, 757, 767, 787
- Bombardier: CRJ, CS 100/300, Global 5000/6000 & 7000/8000
- Embraer: 170, 190, E2, Phenom 300
- General Aviation: Gulfstream G150, G280, G450, G500/600, G550/650; Pilatus PC9, PC 12, PC24
- Military Fixed Wing: P-8, F15, F18, F16, F35, C130, Eurofighter Typhoon, AV-8B Harrier II
- Rotary-Military: Bell Boeing V22; Sikorsky CH-53K, Boeing AH-64
- Rotary-Commercial: AW 149, 169, 189; Bell 407, 429, 430, 525; AS265, EC120, EC135; Sikorsky S-76, S-92, S-97; MD 520, 530, 600
- Engines: Rolls Royce Trent 900, 1100, XWB84K & 97K; GE H70, H75, H80; PWC: PT6, 207, 150; Snecma/Safran LEAP; Williams FJ44

# Sensors

*Hydra-Electric's patent-pending sensors excel where older technologies fail.*

## Our aerospace designs

- Extend service life
- Deliver high accuracy
- Eliminate pressure spike damage
- Stay protected from electrical transients
- Remain safe at millions of pressure cycles
- Resist electro-magnetic HIRF interference

## Types of Sensors

### PRESSURE

*Gage  
Absolute  
Differential*

### TEMPERATURE

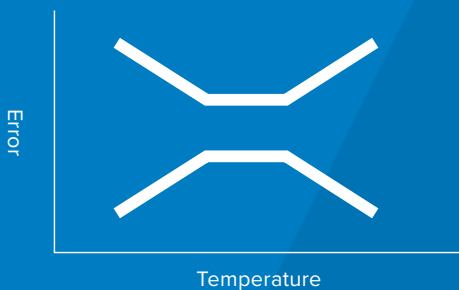
### MULTI-FUNCTION



## Achieve Linear Accuracy

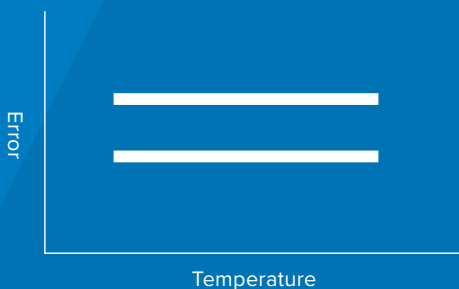
Achieve linear accuracy over a wider temperature range...and better manage your error budget.

### Error band with other sensors



No need to compromise on the zero and span error at extended temperatures. For either amplified or millivolt output, sensor error bands are flat throughout all temperatures.

### Error band with Hydra-Electric



## Performance

- High-temperature amplified sensing (150°C and 225°C)
- High EMI interference immunity (DO-160, Mil-STD-461)
- Lightning protection (DO-160 Level 4)
- High common mode pressure and low differential pressure
- Impulse pressure spike protection
- 1 million to infinite pressure cycle life
- MTBF >300,000 hours to >1 million hours  
airborne uninhabited cargo environment
- 2x proof and 3x full scale burst pressure  
with the ability to scale higher
- Shock >100gs
- Vibration >60 g sine on random

## Versatility

- 5 to 30,000 psia, psig, psid ranges
- Amplified to any output range within 0 to 28 volts DC
- Millivolt bridge output
- High common mode pressure and low differential pressure
- Input voltage ranges 5 to 60 VDC

## Features

- Active thermal compensation with lightning protection and high-temperature electronics available
- Weight 2 to 4 ounces typical
- Ideal bridge millivolt output
- Power – Ratiometric or independent of power supply
- Combined pressure and temperature sensors, multiple pressure, redundant channels



# Switches

Hydra-Electric switches are the industry standard for performance and reliability.

- **Premium Quality** products from the industry pioneer and inventor of the first negative disc spring
- **Highest Level of Accuracy** for achieving the deadband
- **Capabilities** from custom design, enhanced design as well as many standard designs
- **Superior Manufacturability** from having perfected building the rough set

## Types of Switches

### PRESSURE

Gage

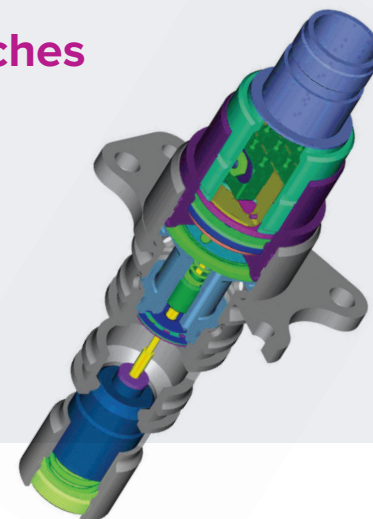
Absolute

Differential

### TEMPERATURE

### LIQUID FLOW

### MULTI-FUNCTION

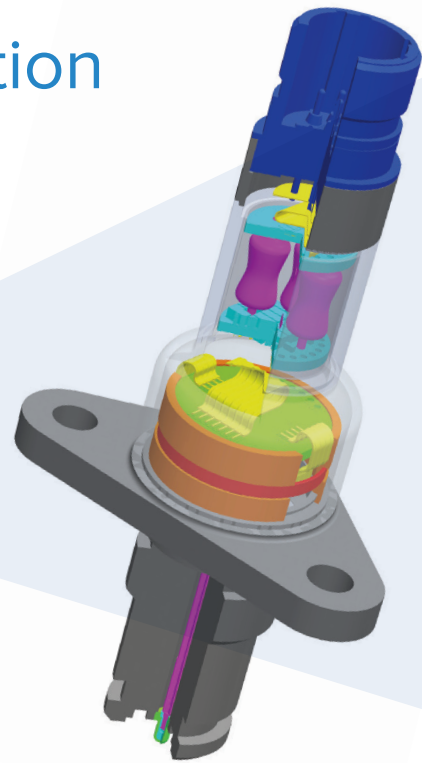


	8H Series	12H Series	15H Series	45H Series	60 H Series
<b>Type</b>	Pressure: Gage, Absolute & Differential	Pressure: Gage, Absolute & Differential	Pressure: Membrane (M); Piston Switch (PH)	Liquid Flow	Temperature
<b>Media</b>	Fuel, oil, air	Fuel, oil, air, water	Fuel, oil, hydraulic	Fuel, oil, hydraulic, coolant	Fuel, hydraulic, lube oil
<b>System to</b>	600 psi	M: 3300 psi; PH: 5000 psi	M: 3300 psi; PH: 5000 psi	250 psi	Varies
<b>Proof to</b>	1200 psi	375 psi	M: 4500 psi; PH: 7500 psi	375 psi	100°F (38°C) above actuation setpoint
<b>Actuation</b>	10 psi to 400 psi	1.5 psi to 125 psi	M: 150 psi to 3300 psi; PH: 150 psi to 4600 psi	0.25 gpm to 30 gpm	10°F (-12°C) to 500°F (260°C)
<b>Deadband</b>	10% to 40% of actuation set point	8% to 40% of actuation set point	12% to 40% of actuation set point	12% to 40% of actuation set point	12% to 40% of actuation set point
<b>Electrical</b>	Hermetically sealed SPDT or DPDT 1.5 mA to 7 A res. @5-32 VDC	Hermetically sealed (optional) SPDT or DPDT1.5 mA to 7 A res. @5-32 VDC	Hermetically sealed (optional) SPDT or DPDT1.5 mA to 7 A res. @5-32 VDC	Hermetically sealed (optional) SPDT or DPDT1.5 mA to 7 A res. @5-32 VDC	Hermetically sealed (optional) SPDT or DPDT1.5 mA to 7 A res. @5-32 VDC
<b>Temperature</b>	-65°F (-54°C) to +400°F (204°C)	-65°F (-54°C) to +400°F (204°C)	-65°F (-54°C) to +275°F (135°C)	-65°F (-54°C) to +275°F (135°C)	-65°F (-54°C) to +275°F (135°C)
<b>Vibration</b>	5 to 3000Hz up to 30 g's sine, 12 g rms random	5 to 3000Hz up to 30 g's sine, 12 g rms random	5 to 3000Hz up to 30 g's sine, 12 g rms random	5 to 3000Hz up to 30 g's sine, 12 g rms random	5 to 3000Hz up to 30 g's sine, 12 g rms random
<b>Shock</b>	100 g's	100 g's	100 g's	25 g's	50 g's
<b>Service Life</b>	100,000 cycles	150,000 cycles	M: 100,000 cycles; PH: 250,000 cycles	75,000 cycles	75,000 cycles
<b>Weight (approx.)</b>	3.5 oz	4 oz	3.5 oz	4 to 24 oz	3.5 oz

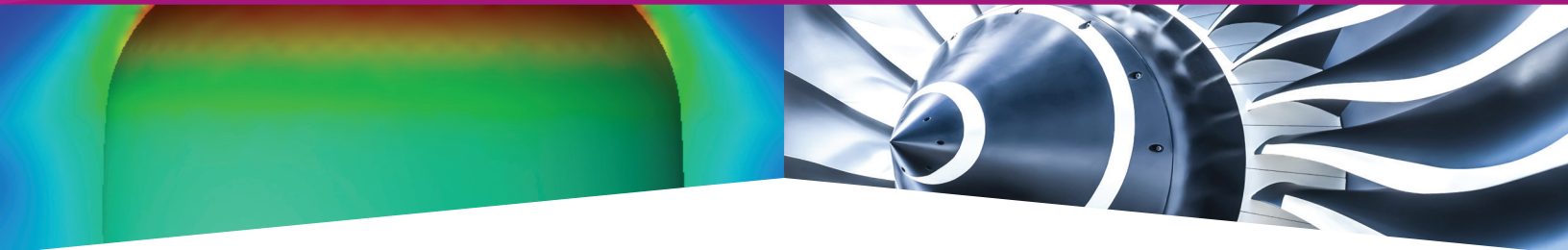
# Outperforming the competition in accuracy, reliability and robustness

*Hydra-Electric's superior sensing technology...*

- **AVOIDS** burst diaphragms
- **EVADES** broken wire bonds
- **SURVIVES** pump ripple fatigue
- **ENDURES** high speed impulses
- **ELIMINATES** pressure spike damage
- **WITHSTANDS** high cycle counts – one million or more cycles



## Customer Success Stories



### Surviving Pump Ripple

#### Issue

A Tier 1 manufacturer of hydraulic systems was encountering problems with high levels of pressure ripple due to impeller pump. Their existing configuration utilized sensors based on older technology which resulted in premature catastrophic unpredictable failure requiring part replacement.

#### Solution

Hydra-Electric worked with the manufacturer to understand the extent of the pump ripple problem. We were able to deliver a sensor based on our breakthrough thin film technology that does not fatigue or break during the full pressure ripple operation of the unit. The solution eliminated the possibility of failure due to pump ripple or pressure extremes.

### Linear Accuracy Throughout

#### Issue

A manufacturer of hydraulic systems was able to get accurate pressure readings (<1% error), but only within a limited temperature range (0-100°C). Once the operation exceeded this range, the readings became less reliable, with error rates as high as 2%. This resulted in either false positives, giving rise to unnecessary maintenance; or false negatives, causing critical levels to go unchecked.

#### Solution

Hydra-Electric incorporated technology which provides for a flat error band across the entire temperature and pressure ranges. This also includes hysteresis, repeatability and sensitivity. As a result, not only did the manufacturer have greater confidence in the pressure readings, it made possible a reallocation of the error budget to other components of the overall system.



## Aerospace Innovation Since 1948

Over six decades ago, Hydra-Electric developed and patented the snap action sensing of pressure by means of the negative rate disk spring, employing an additional trim spring for pressure adjustment. This environmentally superior powered snap action design has since become the standard for critical aerospace applications.

Hydra-Electric's designs were selected for numerous early military and space applications, including P80, F86, F100 through F104, X15, SR71, and U2 Aircraft; Mercury, Gemini, Saturn and Apollo Space Programs.

Hydra-Electric's products have been qualified for thousands of commercial and military platforms. The company continues to innovate today, providing customers with the most robust, accurate and reliable sensors and switches available in the marketplace.

## Company Highlights

- 95% in-house manufacturing
- Complete test lab on premises
- ISO9001 and AS 9100 Rev C (DNV certified)
- Substantial library of RTCA DO-160 and Mil-STD qualifications
- Lean Manufacturing and Continuous Improvement initiatives



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