



CALSCAN

reliable

temperature, pressure
& flow measurement

HAWK 9000

Surface Data Logger Overview

The Hawk 9000 is a reliable low power data logger with a suite of integrated sensors used to measure pressure, temperature and flow in hazardous locations.

Since the inception of the Hawk in 2000, it has logged millions of hours in a variety of harsh testing environments such as the Canadian arctic and the world's deserts. These challenging conditions have provided the test bench for improving reliability and the continuous development of new and improved sensors and software capabilities. As a result, today this precision instrument can be configured to provide a multitude of reliable measurement solutions.



Hawk 9000: Configured for Differential Gas Flow Measurement

Hawk 9000 Solutions

Surface Build Up Monitoring

By monitoring dry gas well buildups with a Hawk and using Cullender-Smith, the bottom hole pressure can be calculated. This is a much more cost effective alternative than using downhole gauges.

DFIT and Offset Well Monitoring

The Hawk can monitor all of its sensors at the same time, including gas flow, at a one second sample rate for rapidly changing data. On a Diagnostic Fracture Injection Test (DFIT), quality of data is very important as a derivative analysis will be used. The Hawk's ultra stable pressure sensors will provide the superior data your reservoir engineers will need.

Hydrostatic and Mechanical Integrity Testing (MIT)

The Hawk's stable pressure sensors and PDF reporting for pipeline, vessels and packer isolation tests bring accuracy and accountability to the hydrostatic pressure testing process. Optimized for portable or truck mounted applications the Hawk will simplify your testing procedures.

Production Testing and Flow Proving

Using the Hawk's built-in gas calculation algorithms the Hawk can use industry standard flow measurement sensors such as orifice plate, V-cone or gas turbine. This data can then be directly imported into Testpad, our production test reporting software. By using both it is the perfect tool to increase the efficiency, quality and accountability of your production testing.

Low Flow Gas Measurement

The lower the gas rate the harder measurement becomes. Our advanced 270 psia 0.040 %FS or ± 0.11 psi (0.744 kPa) pressure sensor combined with a low flow turbine or diaphragm meter, allow flow rates down to $0\text{m}^3/\text{day}$ with better than 2% total flow accuracy.

Precision CO₂/N₂/Air Flow Measurement

The volumes measured off trucks are notoriously inaccurate. By using a Hawk configured for gas turbine, highly accurate pump rates can be recorded with turndown ratios of 40:1

Drop Spool SRO for Optimizing Bottom Hole Tests

Measuring the pressure at surface while using downhole gauges you can determine exactly when an oil well has finished building up. The Hawk's intrinsically safe design requires no explosion proof connections to meet electrical codes, simplifying installations.

Hawk 9000 Advanced Features

Intrinsically Safe Quick Connects:

Hawk cables allow for quick, safe and reliable connections to sensors such as turbine or temperature probes. The intrinsically safe design allows the use of military grade Amphenol connectors overmolded with a polyurethane seal that bonds at the molecular level. This gives superior protection against the entry of rain, mud and snow from –50°C to 90°C.

SD Card Download:

The hazardous location approved SD card interface on the Hawk allows quick and easy downloads of data from the onboard memory onto a SD card, without checking for the presence of flammable gas.

Security:

The Hawk can be locked down with a password to prevent unauthorized access.

Custom Algorithms: The Hawk 9000 can be custom programmed with our RPN virtual machine. This allows advanced measurement equations to be easily added to the Hawk, such realtime Closed Chamber testing.

Stable Pressures: Pressure sensors are highly sensitive to changes in ambient temperature. The Hawks proprietary electronics and filtering algorithms ensure very stable pressures that remain with in the accuracy statement.

Low Pressure Accuracy: Typically with low flow gas measurement, the low pressure is dominate source of error. Calscan’s 270 psia (1860 kPaa) are specially made to maintain 0.040% FS or ±0.11 psi (0.744 kPa) of error across the calibrated range even with rapidly changing ambient temperatures.

Pressure Hyper Sampling: When you need high frequency pressure data, the Hawk can be programmed to sample up to 240 samples/sec on one pressure channel.

Smart Sample: The Hawk can be set to sample at a fast sample rate, such as one second, and only store if the pressure has changed by a specified amount or if a set amount of time has passed. This is useful for finding maximum pressures during medium duration tests to avoid running out of memory.

Haznet RS485 Port: Standard on the Hawk, this is an intrinsically safe Class 1 Div1 RS485 port that can be used to remotely monitor a Hawk9000 via a laptop or third part device. If you need to monitor more than one Hawk at the same time they can be daisy-chained together and up to 8 devices monitored at the same time.

Merging Data: Sometimes one Hawk cannot measure everything. With Calvin, the Hawk’s programming/presentation software, data from multiple Hawks, downhole recorders and 3rd party data can be merged together into one file. This allows the operator to view/graph/report all the data at once.

Reporting: After your data is logged, our Calvin interface software can view the data and do simple reports such as Hydrostatic and Extrapolated 24 hr Flow tests. Reports can be saved for later editing and exported to PDF.

Advanced Plotting: Calvin's graphing engine, unlike Microsoft Excel, can quickly handle millions of data points from many tools, with multiple axes, and annotations. Reports and graphs can be saved for later viewing and exported to PDF.

Hawk 9000 Accessories

Raven:

The Raven is a USB/RS232/RS485 intrinsically safe RS485 barrier. It allows a third party device, such as a laptop or a satellite radio, in a Division 2 or General Purpose zone to communicate safely with a Hawk in a hazardous area via a hardwired connection.

Corvus:

When attaching an optional sensor that would normally drain the onboard battery too quickly or for a portable SRO power supply this Class 1 Div 1 rated solar panel and battery can be added to provide power.

Gas Flow Testing Kit:

Calscan can supply complete kits including meter run for a variety of testing needs, such as low flow or high pressure.

Hawk Short Range Radio:

The Hawk SR Radio allows the extension of a HazNet network via a low power wireless connection. Adding a compatible wireless interface to a laptop or other third party device allows wireless communication over 3000 feet line of site with proper antennas.

Internet Connection:

The Hawk can have remote communication through the internet to allow viewing and downloading of the data through a Web page. One vendor that provides such a service is MRL Solutions www.mrlsolutions.com



Specifications

Gas Flow Rate Equations

Orifice: AGA3-92 or ISO5167-2000

V-Cone: McCrometer V-Cone®

Turbine: AGA7

Veris Accelabar

Gas Equations of State

AGA8-92 Detailed

AGA8-92 Gross

Redlich-Kwong with Wichert-Aziz sour gas correction

Liquid Volume Correction

API chapter 11.1-2004

Sensor Options

Two silicon pressure sensors

Three precision platinum temperature probes (RTD)

One low power differential pressure sensor (DP)

Four turbine inputs

One 4/20mA sensor input

Two Quartzadyne DSB301 quartz sensors

One downhole surface readout (SRO) input

Minimum Sample Rate

All sensors active: 1 second

One Silicon pressure sensor: Hyper Sampling to 240 samples/second

Sensor Specifications

Silicon Pressure Sensors

Pressure Ranges: 1500, 3500, 6000, 10000 & 15000 psig

Pressure Accuracy: 0.024 % full scale

Pressure Resolution: 0.0003 % full scale

Pressure Drift: < 0.02 % full scale/year

Pressure Range: 270 psia

Pressure Accuracy: 0.040 % full scale or ± 0.11 psi (0.744 kPa)

Temperature Accuracy: $\pm 0.4^{\circ}\text{C}$ ($\pm 0.20^{\circ}\text{C}$ typical)

Temperature Resolution: < 0.001°C

Differential Pressure (DP)

Differential Range: 400 inH₂O or 100 psi

Accuracy: ± 0.0375 % full scale

Stability: ± 0.01 % per year

Rangeability: 400 to 1

Quartz Pressure Sensors

Pressure Ranges: 5000, 10000, 20000 & 30000 psig

Pressure Accuracy: 0.02 % full scale

Pressure Resolution: < 0.02 psi

Pressure Drift: Negligible

Temperature Accuracy: $\pm 1^{\circ}\text{C}$ ($\pm 0.20^{\circ}\text{C}$ typical)

Temperature Repeatability: < 0.01°C

Temperature Resolution: < 0.005°C

External Temperature Probe (RTD)

Temperature Accuracy: $\pm 0.4^{\circ}\text{C}$ ($\pm 0.20^{\circ}\text{C}$ typical)

Temperature Resolution: < 0.05°C

Environmental

Hazardous Location CSA/UL Approved: Exia

Class 1 Division 1 Group A, B, C, D

Temp Code T5a max ambient 50°C

Operating Temperature: -40°C to $+80^{\circ}\text{C}$

Operating Humidity: 5 to 95% non-condensing

Communication

Intrinsically Safe HazNet RS485

Communication Protocols

CalTalk, Modicon or ENRON ModBus

Programming and Reporting

CalWin or Testpad for Windows XP/Vista/Win7

Power Requirements

Internal: Lithium C or A cell pack

External: Corvus Solar Battery

Raven or Zener barriered 24v dc

Battery Life

Depends on Active Sensors and Battery, examples below:

Active Sensors	Sample Rate	C Cells	A Cells
1 Pressure	1 second	70 days	31 days
2 Pressures	30 seconds	3 years	1.3 years
1 Pressure, 1 RTD, 1 DP	10 seconds	1 year	5 months

Data Capacity

Depends on Active Sensors, examples below:

Active Sensors	Number Samples	Sample Rate 30 Seconds	Sample Rate 1 Second
1 Pressure	1 245 000	432 days	14.4 days
2 Pressures	815 900	295 days	9.8 days
2 Pressures, 1 RTD	735 700	255 days	8.5 days
1 Pressure, 1 RTD, 1 4/20mA	647 400	224 days	7.4 days
2 Pressures, 1 RTD, 1 DP, 3 Turbines	476 000	165 days	5.5 days
1 Quartz sensor	1 079 100	374 days	12.4 days
2 Quartz sensors	703 700	244 days	8.1 days
2 Pressures and 1 SRO	647 495	224 days	7.4 days
1 Pressure and 1 SRO	851 960	295 days	9.8 days
1 SRO	1 245 000	432 days	14.4 days

Safety Compliance

C22.2 No O-M 1991 : Canadian Electrical Code Part II

C22.2 No 157-M 1992 : Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations

UL 913, Sixth Edition : Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, II, Division I, Hazardous (Classified) Locations



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