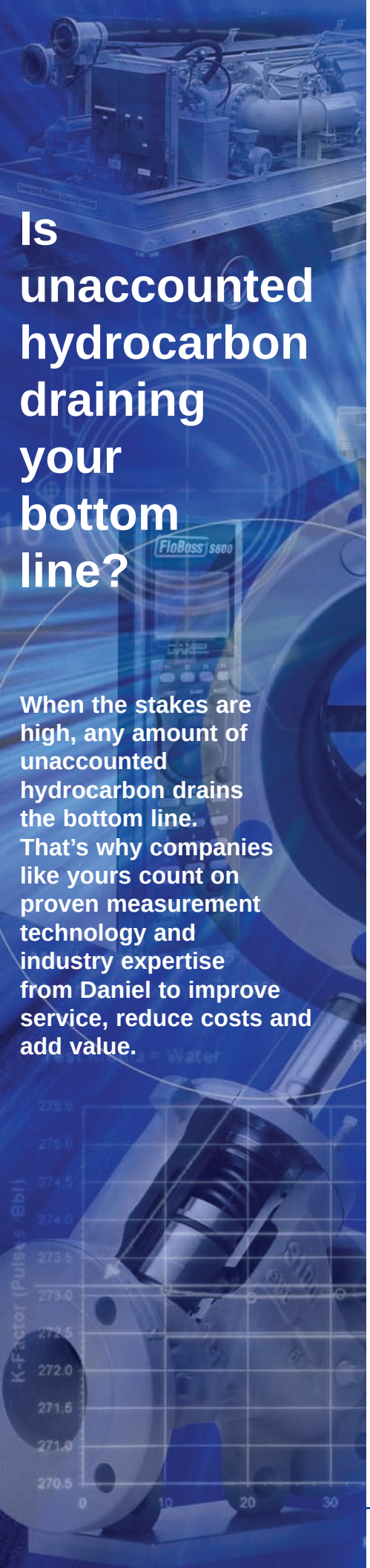
DANIEL®

Brooks® Compact Prover by Daniel®

EMERSON™
Process Management



Daniel® Company Overview

For more than 75 years, Daniel Measurement and Control, Inc. has served the fiscal custody transfer market. Daniel's natural gas and liquid flow measurement products, systems, and services are known around the world in the oil and gas industry. Daniel is synonymous with quality products, industry expertise and reliable and innovative engineering that deliver advanced technology. Daniel is well positioned to serve its customers with locations throughout the world.

Daniel empowers customers to achieve their business objectives by providing excellent service, helping to reduce costs, and adding value.

As Daniel continues to innovate and build its product technology and global organization, you can be confident that Daniel is stronger than ever. A subsidiary of Emerson Electric Co. ($15 billion revenue/NYSE:EMR) and part of the Emerson Process Management group of companies, Daniel has financial strength, staying power and proven history.

Change and continuous improvement mean success for Daniel customers. One commitment remains constant - to continue to earn and keep our customers' trust.

Brooks® Compact Provers™ by Daniel®

High Accuracy Calibration Solutions for All Applications

The Brooks® Compact Prover™ by Daniel® is the product of decades of development and engineering expertise, and offers the most cost-effective meter prover to the widest possible market.

The Compact Prover is used for rapid, accurate calibration of a wide range of flow measurement technologies. Applications range from load rack, crude and refined product pipelines and marine terminals to offshore platforms. Wherever meter verification is fundamental in reducing measurement variation, the Brooks Compact Prover can be used.

Simplifying Field Calibration

The Compact Prover is based on the principle of displacement proving. As defined by API, ***"All types of displacement provers operate on the principle of the repeatable displacement of a known volume of liquid from a calibrated section of pipe between two detectors."*** The Compact Prover utilizes a piston that travels through a measurement section (with detectors) displacing a known volume of liquid. At the same time a meter, in series, measures the corresponding volume of liquid.

Through the use of pulse interpolation, meter proving can be accomplished with less than 10,000 pulses per pass. This allows for reliable proving with smaller volumes.

The unique design of the Compact Prover enables a fast automated system for proving flow meters such as turbine, vortex, positive displacement, magnetic, Coriolis as well as liquid ultrasonic flow meters.

The Compact Prover brings significant benefits to liquid meter proving operations:

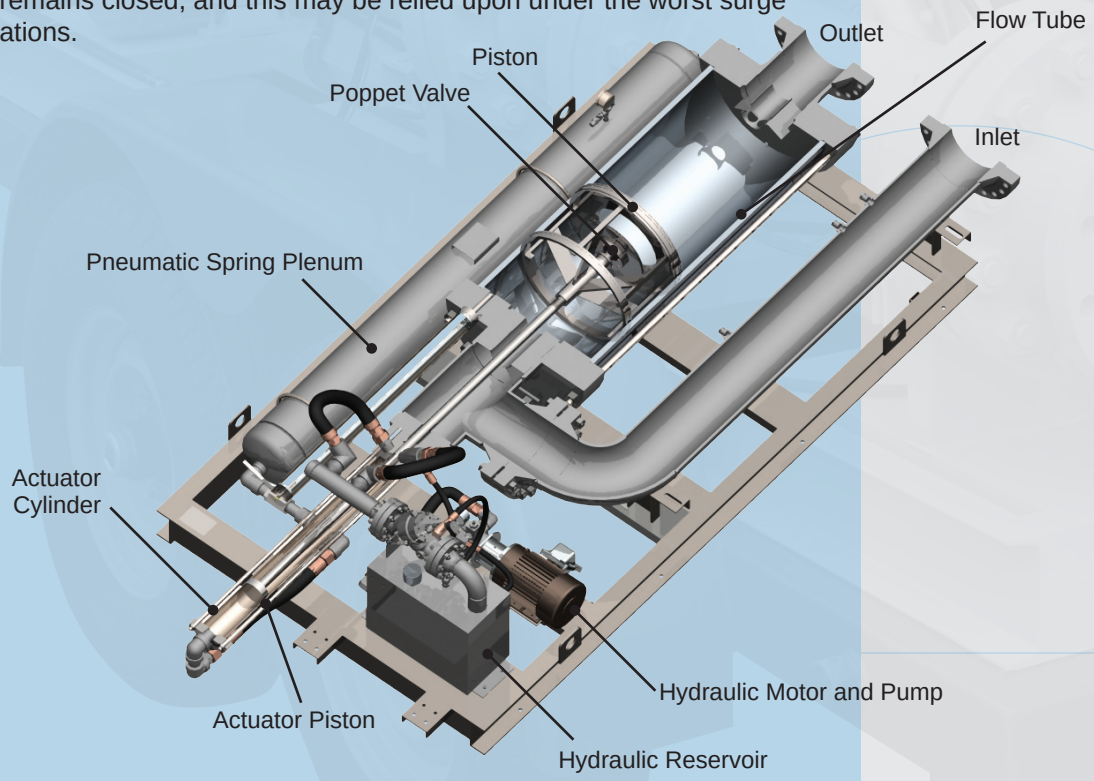
- **Small calibrated volume:**
  - Greater certainty of calibrated volume than with conventional ball provers
  - Reduced cross contamination and subsequent disposal costs
- **Calibration traceable to NIST**
- **Multiple volume proving**
- **Complies with API (MPMS Chapter 4.2 and 4.6)**
- **Reduced time per proof**
- **Global Weights and Measures approvals**
- **Turndown greater than 1000:1**
- **Totally enclosed self-contained unit:**
  - No vapor emission
  - No leak path
  - Minimum operator interface
- **Fast leak detection**
- **Mechanical fail-safe operation**
- **Positive valve closure pneumatic system**
- **Self contained hydraulic retraction system**
  - No external moving parts
  - Maximum operator safety
  - Exceptional longevity

The Compact Prover offers a highly flexible proving solution and is suitable in all applications where meter proving is required:

- **Marketing terminals**
- **Crude and refined product pipelines**
- **FSO and FPSO offloading**
- **Ship and barge loading/offloading**
- **Railcar loading/offloading**
- **Calibration laboratories**

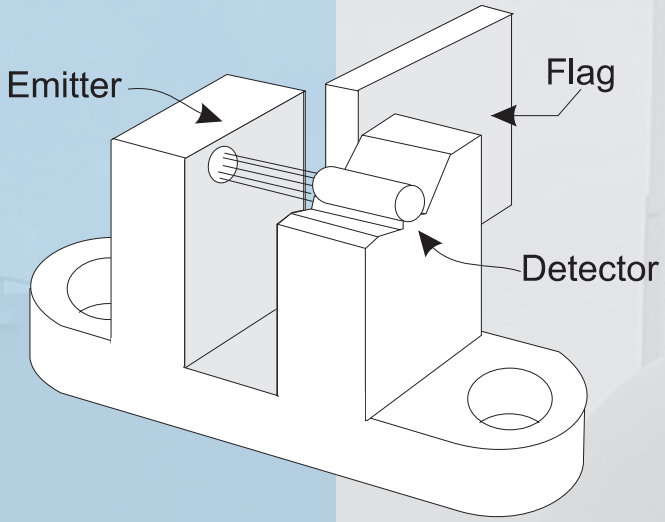
- **The Daniel Compact Prover is a highly refined displacement prover.**
- **The design offers trouble free operation with unsurpassed longevity.**
- **Using a Compact Prover will bring increased versatility, faster and more efficient proving, and will result in cost savings when compared with any other meter proving technique.**
- **Size is increasingly important in modern measurement installations. The cost of real estate on offshore platforms is such that the Compact Prover is the only device given serious consideration in the design of these installations because of it's small footprint and relative light weight.**
- **Compact Provers are often trailer mounted and used at a number of different metering sites. Trailer mounted Compact Provers have been used to replace many separate stationary provers on large ship loading jetties, for example.**

The Compact Prover and its component parts are shown below. The prover consists of a flow tube that houses a free floating piston with a coaxially mounted poppet valve. The poppet valve is contained within the prover piston and is connected via the actuator shaft to the piston actuator assembly. A set pressure in the pneumatic spring plenum, in combination with the hydraulic system, operates the piston. During the proving cycle, the poppet valve closes and the flowing stream displaces the piston over the calibrated volume. In conditions of pulsating flow or varying back pressure, it is essential to ensure the poppet remains closed during the proving cycle. The Compact Prover utilizes a nitrogen spring system to ensure the poppet valve remains closed, and this may be relied upon under the worst surge applications.



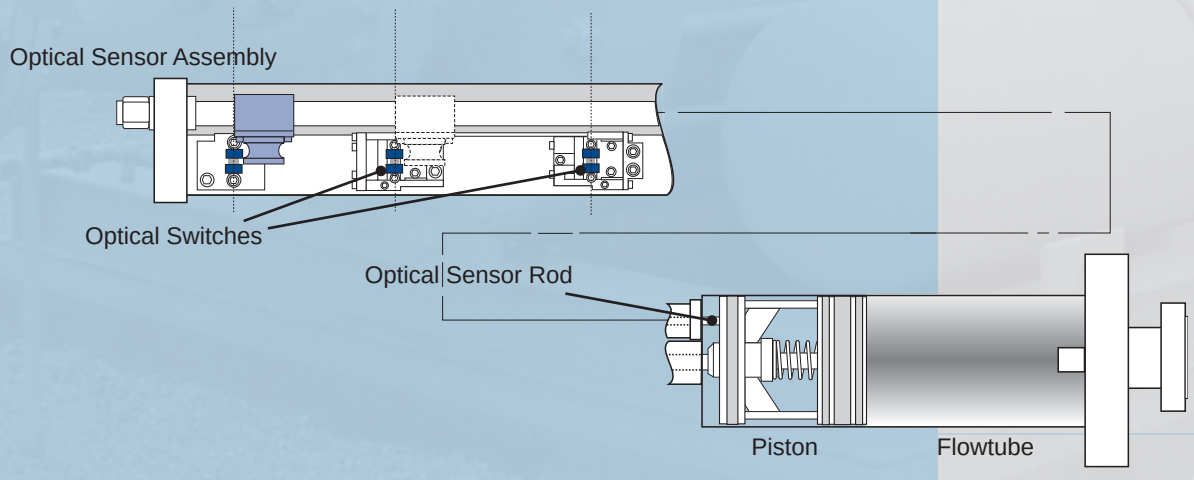
The hydraulic system opens the poppet valve, returns the piston upstream and holds the poppet valve open in the upstream position. The normal flow of the fluid will pass through the open valve.

The calibrated volume of the cylinder is detected by field replaceable optical switches, which are repeatable to within +/-0.0003" (0.0076mm). This very high resolution is achieved through the use of precision components and materials. Three switches are used: one for sensing the upstream position of the piston assembly and two for defining the displaced volume of the proving system. These signals are used to operate various timers in the prover electronics.



Compact Prover Optical Switch

In addition, the Compact Prover is the only prover on the market that minimizes the effects of ambient temperature changes on the volume through the use of Invar rods. Invar is a material which has an exceptionally low coefficient of thermal expansion (.0000008in/in/°F, .00000144mm/mm/°C) and two of these rods are used to maintain the distance between the volume detector switches, thereby minimizing the effect of temperature on the optical assembly.

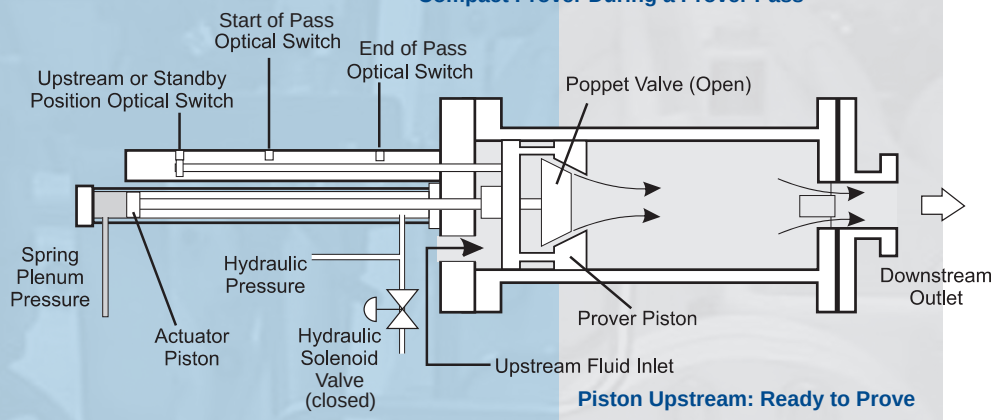


The prover is in standby mode when the piston is in the upstream position with the poppet valve open. The standby mode is achieved and maintained by applying hydraulic pressure to the downstream face of the actuator piston.

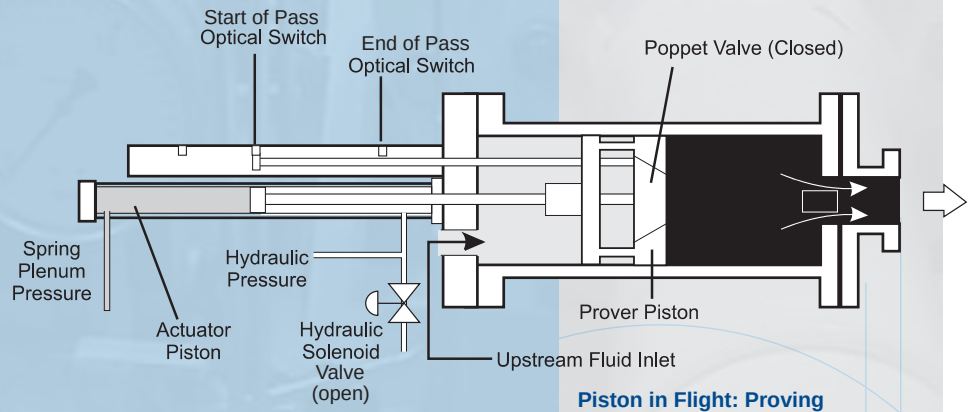
Initiating the start of a proving pass causes the release of hydraulic pressure in the actuator system, and the pneumatic spring plenum pressure overcomes the seal bearing friction, allowing the poppet valve to close. The closed piston assembly will move synchronously with the continuous stream of fluid through the prover. The nitrogen plenum system assures that the poppet valve remains closed during the proving pass. As the piston assembly moves downstream, the first volume detector switch is activated, signaling the beginning of the actual prove and counting of pulses from the flow meter under test.

At the end of the proving pass the final switch is activated, the prover pass is complete and the hydraulic system retracts the piston. During retraction the poppet valve is open, allowing flow through the prover, and once the piston has fully retracted it comes to rest in the upstream, standby mode ready for the next proving pass.

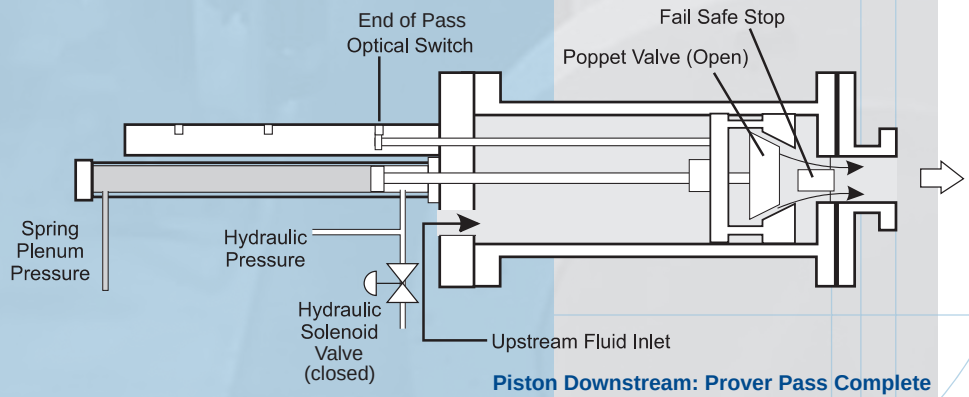
Compact Prover During a Prover Pass



Piston Upstream: Ready to Prove



Piston in Flight: Proving

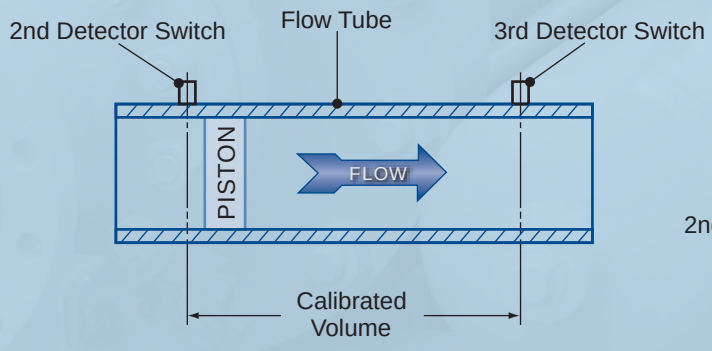


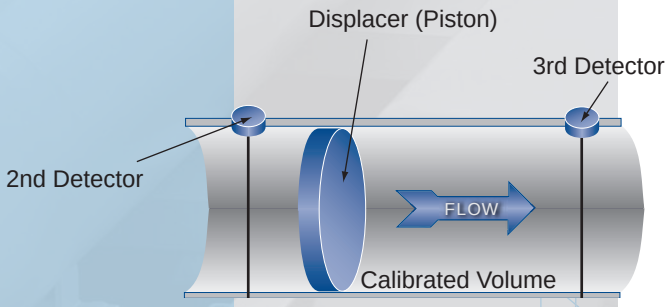
Piston Downstream: Prover Pass Complete

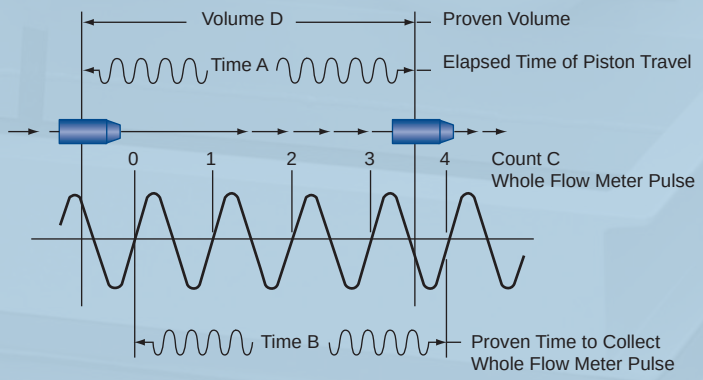
Double Chronometry Timing

Double chronometry pulse interpolation uses a high frequency master oscillator which increments time to within 0.000001 seconds. The master oscillator operates two counters, counter A and counter B. Counter A is started when the flag actuates the 2nd detector switch. Counter B is started with the leading edge of the first flowmeter pulse after counter A has started. Counter A is stopped when the flag actuates the final 3rd detector switch. Counter B is stopped with the leading edge of the first flowmeter pulse after counter A has stopped. Using the ratio of counter A and counter B allows for the determination of fractions of flowmeter pulses collected.

Normally the Compact Prover utilizes three detector switches, which include one for upstream (or “ready to prove” mode), with a brief pre-run to the 2nd switch, which signals the start of the calibrated volume, and the 3rd switch that signals the calibrated volume has been displaced. Daniel can supply a Compact Prover with four optical switches, which allows the use of two calibrated volumes. This set-up permits the more rapid proving of smaller meters. (For example, a 24-inch Compact Prover may be ideally suited to proving a 10-inch turbine meter, as well as a 3-inch turbine meter. The time taken to prove the 3-inch meter may be reduced many-fold by the use of a dual volume configuration in the prover).







k = Pulses per Unit Volume

$$k = \frac{A\ (\text{Time})}{D\ (\text{Volume})} \times \frac{C\ (\text{Pulses})}{B\ (\text{Time})}$$

D = Calibrated volume of the prover flow tube between detectors

A = Time required to displace volume D

C = Whole flow meter pulses counted during Time B

B = Time required to accumulate whole flow meter pulses C

New metering technologies offer various challenges in proving. Daniel has successfully engineered proving solutions utilizing the Compact Prover to prove new technologies and offers complete design, manufacturing, service and support packages.

Where meter technologies result in the production of a “manufactured” pulse output (i.e. meter electronics may produce irregular or delayed totalization pulses as a result of internal microprocessor activity), Daniel offers unparalleled expertise and application advice to allow the successful proving of such meters. For example, one preferred method of proving ultrasonic flowmeters is to package the Compact Prover with a turbine flowmeter. The compact prover proves the turbine meter, and the turbine is used as the Master Meter or “transfer standard” to prove the ultrasonic meter. The Master Meter proving technique complies to API Chapter 4.5. The addition of a densitometer to the prover allows for mass proving (as shown below) and offers a cost effective solution for proving mass meters such as Coriolis meters. The Compact Prover has been applied across many of these new technologies and Daniel is the predominant supplier of single source integrated proving solutions.

Compact Prover with Liquid Turbine Flow Meter and Fast Loop Densitometer

Pipeline Metering

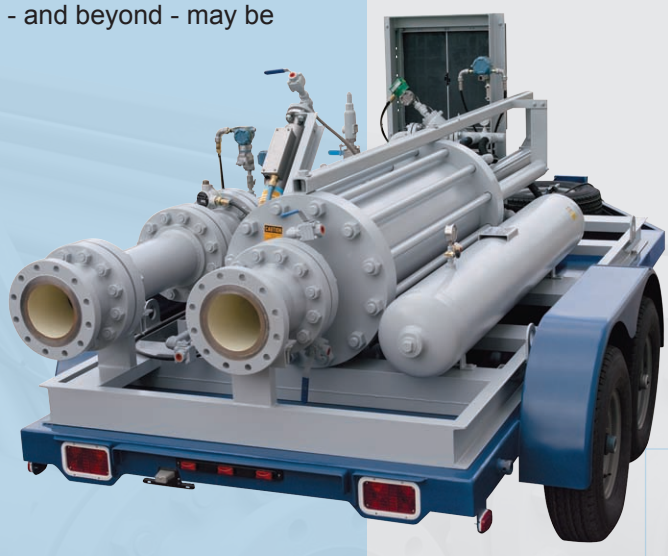
High throughput pipelines have realized operational improvements when utilizing dedicated Compact Provers for frequent proving. Due to the speed and ease with which a prove may be carried out with the Compact Prover, proving may be carried out on each transaction.

Available in both static and mobile configurations, the Daniel Compact Prover offers the most flexible and efficient way to prove pipeline flow meters, and offers today's pipeline operators the best solution for their proving needs, with customized engineering as part of the Daniel's core capabilities.

Compact Prover proving Coriolis flow meters on a mass basis

Portable Proving

The Compact Prover's small size and light weight allows any unit in the range to be truck or trailer mounted. These completely portable provers may then be used for calibrating various sizes of meters at numerous locations. The nominal rangeability of the Compact Prover is 1000:1, which means that any reasonable range of flowmeters - and beyond - may be proven with a single Compact Prover.



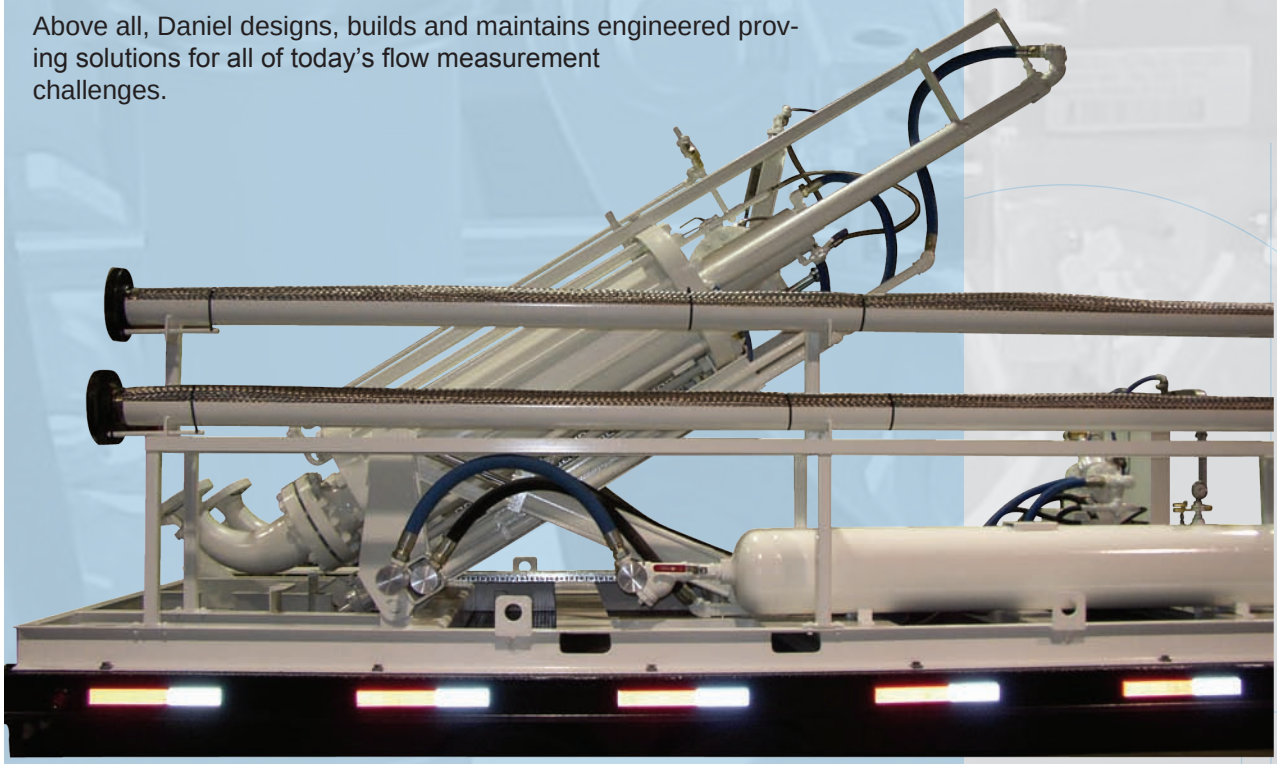
Engineered Proving Solutions

Daniel offers an engineered solution to all of today's proving challenges. From low pressure (150# ANSI) to high pressure (1500# ANSI) operations, to NACE certified materials, all aspects of the proving requirement are reviewed and the Compact Prover is engineered for safe, reliable service.

Compact Prover systems can be engineered to include:

- **Articulated and swivel arms**
- **Hydraulic arms**
- **Master Meters with flow conditioning**
- **Flexible hoses**
- **Inlet and outlet pressure and temperature measurement**
- **Insulated and jacketed provers**
- **Vertical lift and fixed vertical installation provers**
- **Specific configurations of valves and strainers**
- **Custom instrumentation packages**
- **Special materials ie: NACE compliant designs**
- **Local (hazardous area) electronics with UL and ATEX hazardous area approvals**
- **Local and remote proving flow computers**
- **Trailer mounting (horizontal and vertical lift)**
- **Integration in flow measurement skids.**

Above all, Daniel designs, builds and maintains engineered proving solutions for all of today's flow measurement challenges.



Vertical Compact Prover being raised into position

Standard Compact Prover Set-up Data

Nominal Flow Tube Dia.	Prover Flow Rate Ranges		Nominal Prover Base Volume	Inlet/Outlet Flange Size	Nominal Prover Shipping Dimensions (L x W x H)	Approximate Shipping Weight
	Minimum	Maximum				
8”	0.25 gpm 0.946 lpm 0.357 bph 0.057 m^3ph	250 gpm 946 lpm 257 bph 57 m^3ph	5 gal (20 liters)	2” 150/300/600 lb. ANSI	121” x 56” x 50” (307cm x 142cm x 127cm)	2,200 lbs (988 kgs)
12” Mini	1.0 gpm 3.78 lpm 1.43 bph 0.227 m^3ph	1000 gpm 3,780 lpm 1,430 bph 227 m^3ph	10 gal (40 liters)	4” 150/300/600 lb. ANSI	147” x 62” x 55” (373cm x 157cm x 140cm)	4,400 lbs (1,995 kgs)
12”	1.75 gpm 6.623 lpm 2.5 bph 0.397 m^3ph	1750 gpm 6,623 lpm 2500 bph 397 m^3ph	15 gal (60 liters)	6” 150/300/600 lb. ANSI	172” x 67” x 57” (437cm x 170cm x 145cm)	4,900 lbs (2,2223 kgs)
18”	3.5 gpm 13.247 lpm 5.0 bph 0.794 m^3ph	3,500 gpm 13,247 lpm 5,000 bph 794 m^3ph	30 gal (120 liters)	8” 150/300/600 lb. ANSI	193” x 76” x 56” (490cm x 193cm x 142cm)	7,300 lbs (3,311 kgs)
24”	7.0 gpm 26,495 lpm 10.0 bph 1.589 m^3ph	7,000 gpm 26,495 lpm 10,000 bph 1,589 m^3ph	65 gal (250 liters)	12” 150/300/600 lb. ANSI	220” x 96” x 66” (559cm x 244cm x 168cm)	13,400 lbs (6,078 kgs)
34”	12.6 gpm 47,691 lpm 18.0 bph 2.860 m^3ph	12,600 gpm 47,691 lpm 18,000 bph 2,860 m^3ph	100 gal (400 liters)	16” 150/300/600 lb. ANSI	230” x 102” x 74” (584cm x 259cm x 188cm)	19,200 lbs (8,709 kgs)
40”	17.5 gpm 66,237 lpm 25.0 bph 3.972 m^3ph	17,500 gpm 66,237 lpm 25,000 bph 3,972 m^3ph	170 gal (650 liters)	20” 150/300/600 lb. ANSI	240” x 130” x 77” (610cm x 330cm x 196cm)	35,000 lbs (13,876 kgs)

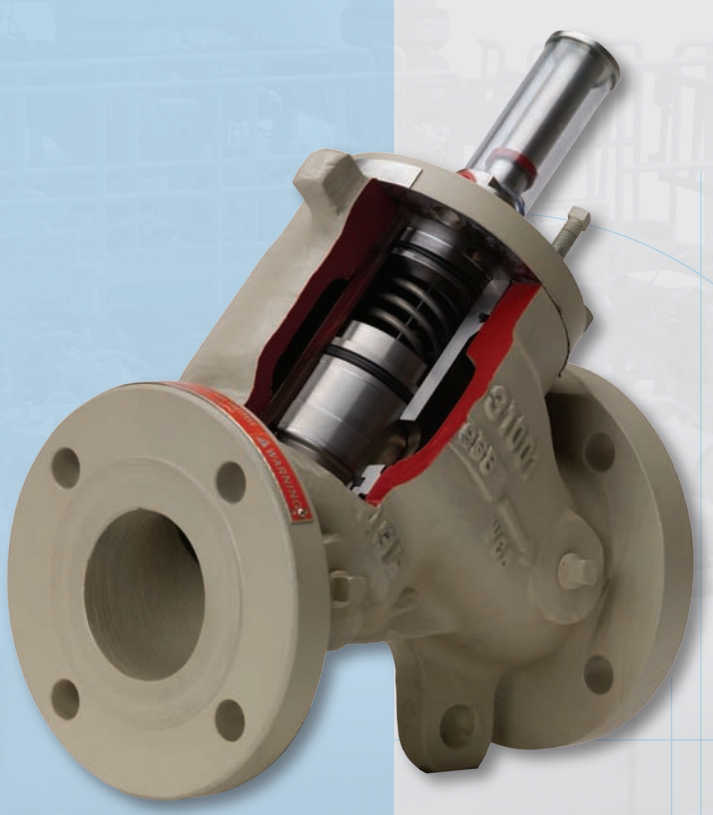
Daniel Liquid Measurement Products

Daniel liquid measurement products are found throughout oil production, refining, transportation and distribution applications—in onshore and offshore production facilities, refining and storage locations, crude oil and refined product transportation pipelines, as well as in all types of distribution facilities such as load racks.

Liquid Turbine Flow Meters - Daniel liquid turbine meters are preferred by marketing terminal and pipeline operators in both refined and crude oil applications. The Series 1200 and 1500 Turbine Flow Meters offer highly repeatable accurate measurement of all types of hydrocarbon liquids. These flow meters offer the highest levels of performance and reliability in custody transfer metering today.

Control Valves - Daniel offers a variety of control valves for terminal load racks, aircraft terminals, tank farms, pipelines and most loading and unloading applications. The range of high performance valves includes the 788 digital control valve, which is designed to provide precise flow rate control and batch delivery when used with an electronic batch control device. Other models in the range provide for precise control of back-pressure, surge relief, differential sensing and many other critical process and pipeline applications.

Electronic Presets - Daniel offers electronic preset controls designed to manage the loading and off- loading of liquid products into bulk storage tanks, tank trucks, rail cars, marine transport or anywhere inventory control is necessary.



Daniel Engineered Systems

Daniel Measurement and Control, Inc. is the industry leader in designing, constructing and commissioning of complex oil and gas metering systems to exacting standards.

This global organization offers decades of fiscal petroleum flow measurement application experience. Customers rely on Daniel's Engineered Systems Group's international fabrication facilities, customized engineering and success in field-testing and support. From the simplest single-stream skid to complex on-site installations, Daniel delivers both natural gas and liquid petroleum turn-key applications. The Daniel Engineered Systems team designs, constructs and commissions the metering project, blending up-to-the-minute technology with decades of understanding what customers need and expect.

Components of a Daniel Engineered System installation typically include meters, valves, provers, flow-control instruments, instrumentation and read-out equipment, and process management components. Computer software and hardware are integrated with the measurement system. Standard calculation methods include AGA 3 (now API-MPMS-14.3), ISO 5167, AGA 5/7/8, AGA 9 and the API Manual for Petroleum Measurement Standards.

Daniel DMSS-2000 Supervisory Control System utilizes a sophisticated Graphical User Interface, database server, and a dedicated PLC for the metering skid/MOV interface. Redundancy is often used for custody transfer systems and/or when system integrity is essential.

A dedicated project manager and project team are assigned to each measurement system project. This team is responsible for overall system design and project construction from start, to finish. A separate internal QA/QC group reviews all design details, inside and outside fabrication, assembly and system testing.

Whether it is a pipeline, offshore production facility, or a loading facility for ocean-going tankers, Daniel Engineered Systems is a proven, single-source solution for customers throughout the world.

Daniel Measurement Services

Daniel Service and Customer Training Daniel Measurement Services are comprised of a specialized group of service engineers and training personnel who are dedicated to complete customer satisfaction. Available twenty- four hours a day, this special global group responds to your requirements when they happen. Whether installation, start-up or on-site technical training, Daniel provides solutions to your every service need, any time, anywhere.

Service offerings include:

- **Start-up and commissioning**
- **On-site water draw calibrations**
- **Remote diagnostics and verification**
- **Technical training**
- **Third party diagnostics and witnessing**
- **Complete meter station auditing**
- **Proving services**
- **Turnkey services**
- **Periodic maintenance and calibration**
- **System integration, hardware and software**
- **Repair, upgrade and reapplication**
- **Telephone and internet consulting**
- **24-hour emergency service and spare parts**
- **Maintenance contracts**

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