



rotork[®]

Keeping the World Flowing
for Future Generations

Application Focus:
Metering Skids

The Custody Transfer Metering Skid Process

Multiple flow control systems operate together on a custody transfer metering skid to ensure low measurement uncertainty and high metering accuracy. These systems include provers to calibrate the all-important flow meters.

To comply with statutory regulations it is critical to maintain the measurement certainty throughout the validation process. Meter provers ensure flow meters are proved (checked and calibrated) at regular intervals without interfering with normal skid operation.

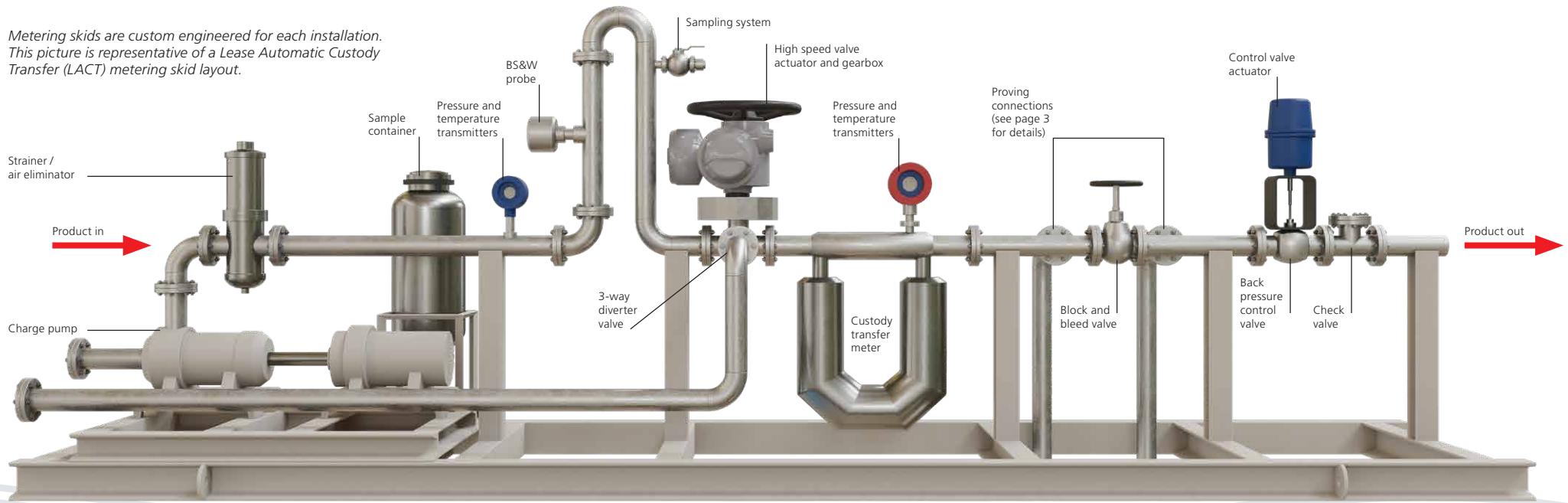
Flow control on metering skids must be highly accurate, reliable and provide safe valve operation at all times.

Product movement and the function of automated valves:

- › Product enters the skid (left side of diagram) via a charge pump and isolation valve.
- › Product is then fed through the strainer / air release mechanism to remove any unwanted air.
- › Product is then fed through the sampler system to ensure the quality of the product.
- › Any poor quality product is diverted via a 3-way diverter valve to storage and / or disposal.
- › Product is moved to the flow metering system where the quantity is measured accurately. Various valves are used to control this part of the process including valves to pass a quantity of product through the prover lines.
- › Meter provers check and calibrate the flow meter at regular intervals. Prover systems are a critical element of a metering skid.
- › Other operations include pressure balancing where control valves are used to ensure the correct balance of pressure between incoming lines.

In this document we identify the main challenges where modern, reliable flow control equipment provides solutions for metering skid designers.

Metering skids are custom engineered for each installation. This picture is representative of a Lease Automatic Custody Transfer (LACT) metering skid layout.



Prover Systems for Metering Skids

There are three main types of prover design:

Sphere Prover

- Based on sphere volume displacement principle
- Dual sensor design
- Controlled via 4-way diverter valves

The sphere is sent through the pipe and activates sensors to determine the correct volume. Uni and bi-directional continuous-flow systems can be used with the bi-directional system incorporating a 4-way diverter valve. This design features the best opportunity to control product flow via automated valves.

Small Volume Piston (SVP) Prover

- Based on piston volume displacement principle
- Compact design using small pistons
- Smaller footprint with good accuracy

The piston moves through a measurement section of pipe, displacing a known volume and activating sensors. Even with a smaller volume, the readings are highly accurate. However, 'time delay' and 'sample time' are major disadvantages when proving ultrasonic meters.

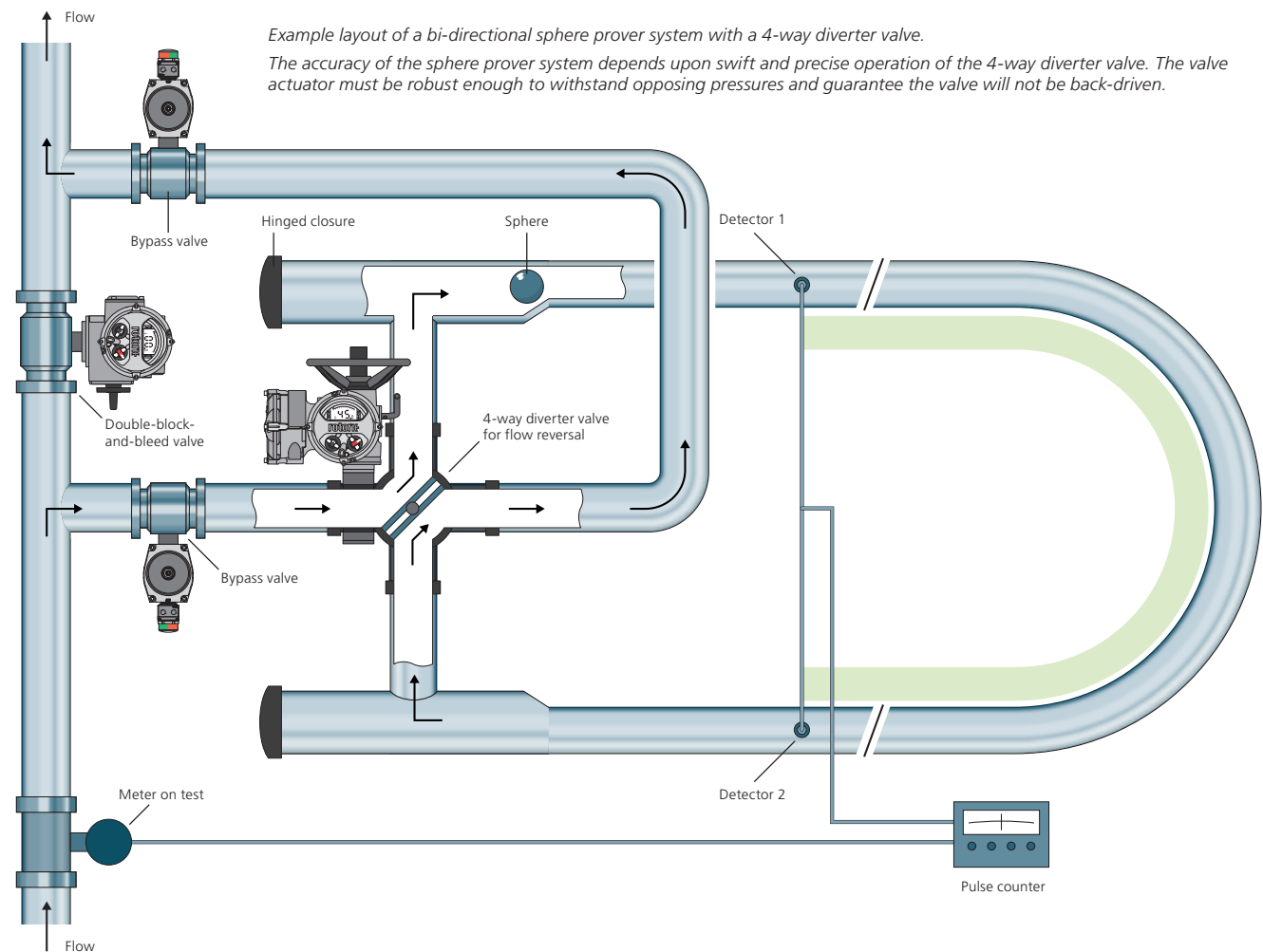
Master Meter Prover

- Higher uncertainty
- Cost effective design
- Small footprint

This method uses a turbine within the pipeline to meter the flow. It has the greatest uncertainty compared to direct proving methods, but is sometimes used for applications with logistical, time, space and cost constraints.

Accurate and reliable flow control is fundamental to the design of any prover system. There are many variables that must be taken into account when specifying flow control equipment including environmental conditions, control media, type of flow meter and control networks.

Rotork have supplied valve actuators and flow control equipment for metering skids and prover systems for over 60 years. We know the challenges faced in designing these systems and can provide guidance to help you.



Design Challenges for Metering Skids

Challenge:

Lightweight and compact skid design

Design of metering skids has to be as compact and lightweight as possible as skids are nearly always manufactured off-site and transported to their final location.

Solution

To ensure the requirements are met, skid manufacturers often specify small, compact valve actuation to allow for the pipe routing to be designed more efficiently.

Rotork engineers have always designed actuators that have high performance output in small enclosures. This philosophy has more recently been implemented across our instrumentation range, delivering compact solutions for metering skid design.

All of our products, from the smallest **GT pneumatic actuators**, to the largest **SI electro-hydraulic actuators** produce higher torque output for their size compared to other solutions on the market. This makes our product range highly suitable for the design and service demands of a metering skid.

Challenge:

Accurate and repeatable performance

Achieving high metering accuracy and low measurement uncertainty is paramount in the design and construction of metering skids. Correct equipment specification is critical.

Solution

The entire flow process of a metering skid is modelled and equipment specifications are dictated to ensure all the skid equipment works together in harmony to achieve the levels of accuracy demanded by the process.

Rotork CVA and CMA electric actuators have been designed to deliver highly accurate and repeatable valve positioning with high resolution of movement for precise flow control. CVA and CMA are used on control valves on metering skids to control the flow of product leaving the skid and moving to its next location.

CVA and CMA provide levels of accuracy normally associated with pneumatically powered actuators. However, being electrically powered not only means they are easier to install, it also means they are completely non-polluting in operation, unlike pneumatic actuators that bleed motive gas to the environment.

Challenge:

Reliable actuation with diagnostics

Product volume is measured at arrival, storage and export. These are time consuming operations. It is important to ensure they are not interrupted by unplanned stoppages and breakdowns.

Solution

Reliability is key to ensuring continuous operation. Advanced diagnostics like the data logger on the IQ can be used for predicting early failures by analysing torque variation in valve operation over time.

Our entire product range has one thing in common - reliability. The founding principle of Rotork was to deliver simplified and reliable automated valve control.

Rotork IQ electric actuators with inbuilt data loggers deliver reliability with modern connectivity. They continually monitor valve performance and torque requirements, communicating with network control systems to assist plant management programmes. The IQ can provide diagnostic data to ensure reliability and prevent unplanned shutdowns.

Rotork have been supplying valve actuators to the oil and gas industry for more than 60 years and we are still servicing some actuators installed over 40 years ago.

Design Challenges for Metering Skids

Challenge: Safety and Emergency Shutdown

Transport and movement of hazardous and flammable hydrocarbons through metering skids requires high equipment safety levels and fail-safe systems to be in place.

Solution

Emergency Shutdown (ESD) operation of isolation valves will shut off the product flow in an emergency and prevent further damage. ESD valves require spring-return pneumatic or electro-hydraulic actuation to ensure fast, safe, high torque valve closure when required.

Rotork IQ electric actuators with IW gearboxes are suited for ESD applications. They provide an ESD function with partial stroke capability to ensure operation on demand.

Rotork SI electro-hydraulic and **CP pneumatic actuators** are also specified in ESD systems. SI actuators are highly reliable and are capable of closing valves within 0.5 seconds should the process require it.

IQ, SI and CP actuators are certified for use in SIL safety related applications and Safety Instrumented Systems (SIS). IQ and SI actuators also feature advanced diagnostic functions for process monitoring and help with predictive maintenance and lifetime management programmes.

Challenge: Reliable, cost effective, network control

Complex skids with multiple product lines, pipelines and actuated valves require central control capabilities which can increase complexity of control wiring.

Solution

Using a central 2-wire network can reduce cabling costs and help provide a robust, reliable control philosophy throughout the skid. Rotork 2-wire control systems incorporate redundancy loop technology, ensuring plant operability in the event of cable break or earth fault. Each actuator field control unit has a loopback circuitry that switches in the event of a fault providing a continuous loop connection on the 2-wire system.

Rotork Pakscan™ Classic redundant loop network has been the technology of choice for actuator control for over 30 years. Using robust current loop technology, up to 20 km loop lengths and 240 field devices are possible.

Our *Pakscan* system provides efficient low cost installation. A standard twisted pair instrumentation cable (one pair) is required for the network loop and there are no requirements for external repeaters or network termination.

Challenge: Fast operation of complex valves

Sphere prover systems with bi-directional continuous-flow systems incorporating a 4-way diverter valve require fast operation and positive valve seating to ensure accuracy.

Solution

Meter provers ensure flow meters are proved (checked and calibrated) at regular intervals without interfering with normal skid operation. Accuracy, reliability and speed are all important characteristics for 4-way valve actuation. The actuation method also needs to be self-locking to prevent back-driving of the valve.

Rotork IQH electric actuators provide a high output speed with integral epicyclic gearing. Gearing is optimised to be irreversible and provide a self-locking function for the valve.

IQH actuators have been developed for diverter valves in meter prover process that require fast operation with positive seating and zero back-driving.

Our extensive range of flow control equipment is suitable for all the service demands of a custody transfer metering skid. Specifying flow control solutions for precision, coordinated valve operation and control system integration is dependant on skid design specifications.

IQ Range Part-turn and Multi-Turn Electric Actuators



Heavy-duty valve control and diagnostics

Reliability and Diagnostics

- Provides accurate, reliable actuation of multiple valve types
- Robust and reliable isolation duty
- Compact, minimal weight to power ratio
- Built for efficient skid construction
- Data logger monitoring of valve performance, preventing unplanned shutdowns
- SIL capability to IEC 61508
- IQH high-speed model provides fast and accurate control for diverter valves with self-locking design

CVA/CMA Ranges Part-Turn and Linear Electric Control Valve Actuators

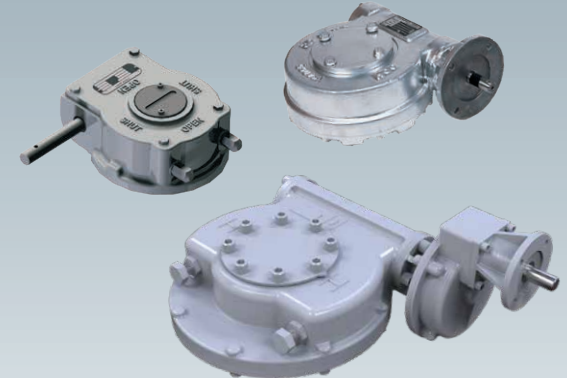


High precision control valve operation

Accuracy and Repeatable Performance

- Reliable high definition linear, quarter-turn and rotary valve operation
- Precise actuation of control valves involved in the pressure and flow control process
- Compact and powerful, with a 0.1% resolution capability
- Maintains tight process specifications
- Reduces measurement uncertainty
- Internal fail-safe super-capacitors on some models

IW (Part-Turn), MTW (Multi-Turn) and AB (Manual) Gearboxes

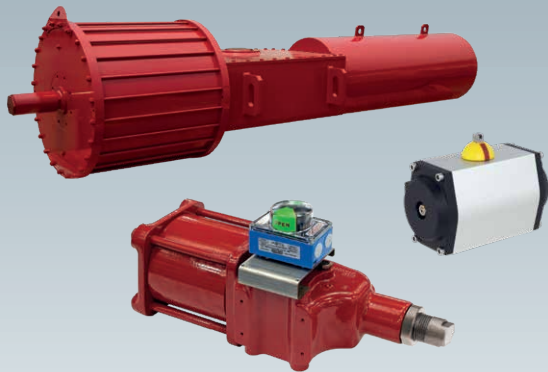


Emergency Shutdown and all skid applications

Lightweight and Compact

- Can be deployed in conjunction with the IQ range or stand-alone for manual actuation
- Control various types of valves including ball, butterfly and plug
- Built to meet the most demanding process requirements
- Robust and compact
- Increase torque requirement without compromising on space and weight

Pneumatic Actuators



Reliable actuation across all skid applications

Safety and ESD Capability

- Deployed for safe isolation of metering skid main input and output lines
- Added security available with spring-return functionality with automatic closure on air pressure loss or ESD event
- Small and compact GT product available for lower torques
- Mid-sized CP product deployed for moderate torques and for main line isolation (designed for ESD service)
- GP product for high torque operation of larger valves

Control and Communication



Valve control and monitoring

Reliable Network Control with Reduced Cabling Complexity

- Multiple options available for control and communication between the PLC and actuators
- From simple, effective hard-wired digital control, to variable 4-20 mA and high-end digital networks with options including Profibus®, Modbus®, Foundation Fieldbus® and Rotork's proprietary Pakscan™ network
- Network options reduce the need for multiple cable runs
- Minimised cabling costs
- Maintained integrity

Service and Aftermarket Solutions



All plant operations

Lifetime Management

A complete solution to the risks associated with the life cycle of your equipment

Intelligent Asset Management

Advanced analytics to improve reliability and availability of key assets

Spares

Comprehensive OEM spares available worldwide

Life Cycle Management

Controlled strategies for managing the risks of ageing equipment



A full listing of our worldwide sales and service network is available on our website

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