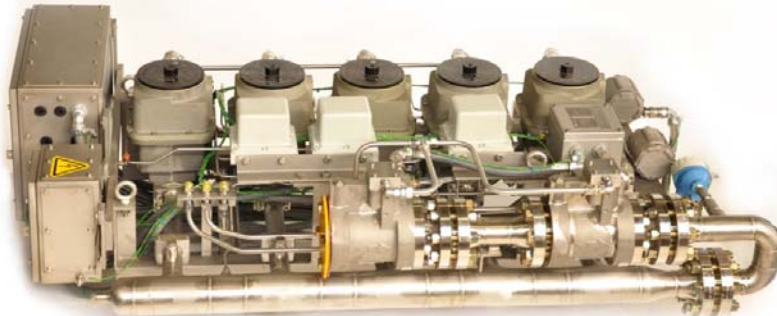


# Fuel Metering Systems

## DLE/DLN for Aeroderivative Turbine Platforms



5-valve GS6 parallel metering with integrated shutoff, temperature, pressure, and electrical junction boxes (~35 MW)

### Applications

Woodward Fuel Metering Systems or “Fuel Skids” are a complete fuel metering product line incorporating the essential components needed for DLE engine operation for industrial aeroderivative gas turbine platforms involved with applications such as electrical power generation, gas compression, and mechanical drive systems.

This fully validated, reliable, and simple drop-in solution is designed specifically for rigorous DLE requirements. Woodward system solutions provide high value-added content at cost-effective prices.

Metering system products perform with all-electric valves and instrumentation to eliminate the need for hydraulic or pneumatic input. Woodward has established a pedigree of highly accurate flow metering valves and instrumentation as well as highly effective system level solutions. Customers can benefit from this expertise and expect high reliability, quality, service, and performance from these products.



### Description



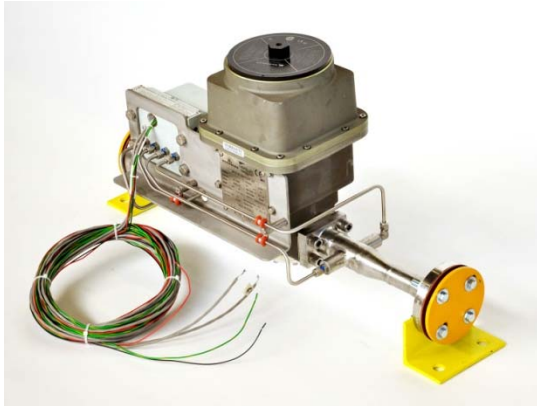
Woodward fuel metering skids consist of multipath metering legs, each individually controlled by a Woodward metering valve to the various combustor manifolds or cans. For each flow path, high-accuracy, high-bandwidth pressure-sensing transducers are incorporated in the fluid path to measure pressure. Temperature-sensing devices are also placed within the flow path to transmit the fuel temperature to the turbine control. The combination of these signals with the engine flow

demands to each leg allow the turbine control to compute the valve positions necessary to provide the correct flow to the engine. When integrated shutoff valves are incorporated, the skid can isolate the pressure supply from the engine in the event of a system shutdown. Vent connections are provided in various locations to allow a customer-connected exhaust gas stack.

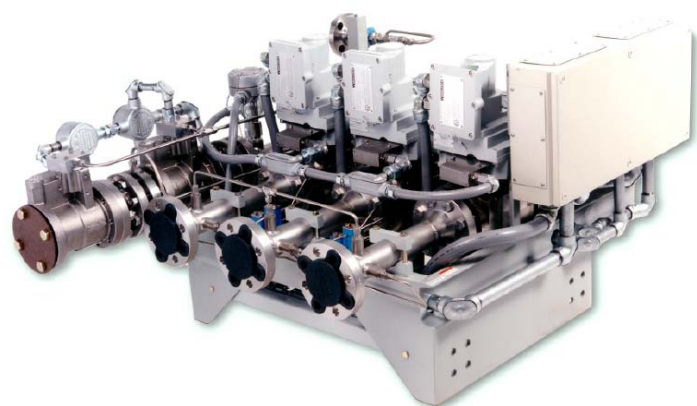
- Ideal for demanding DLE/DLN applications
- Integrated, optimized systems solution design
- Exceptional accuracy & precise fuel flow metering
- Common P1 Manifold Pressure Compensation
- Reduces commissioning cost and time
- Scalable, modular designs for various applications
- Maximum availability and minimum mean time to repair
- All-electric actuation with fast, repeatable dynamic performance
- Certified for use in many hazardous environments

## Installation

Woodward fuel skids are custom designed to fit into customer-specified turbine package envelopes. Easy drop-in capabilities help to reduce cost and time during installation. Our fuel skids make compliance and quality inspections easy with the supplied detailed documentation.



Single GS6 Flow Leg with integrated pressure measurement



3 valve 3103/EM-35MR parallel metering with integrated shutoff, temperature, pressure, and electrical junction boxes (~45 MW)

## Product Differentiators

### Pedigree

Woodward has over 20 years of design and system level control experience for aeroderivative fuel metering systems, with over 250 units in the field. Our goal is to supply durable, high quality and reliable Woodward metering technologies. Woodward fuel metering systems incorporate customer-focused design solutions to enable a winning combination of speedy time to market and drop-in turnkey products to meet customer needs.

Our engineering capabilities range from customizable hardware designs to system-level optimization analysis. Woodward has in-house dynamic and steady-state flow testing in our state-of-the-art flow facility to fulfill rigorous technical qualification requirements.

### Product Features

- High accuracy, high precision metering technologies
- Digital communications allowing interface to multiple customer engine control platforms with the highest level of accuracy
- High-speed real-time synchronous control capabilities
- All-electric products
- Scalable, modular, customizable, compact
- Designed for ease of maintenance and access
- Alternative fuels—Capable of metering blended and low-energy fuels

### Compliance

Woodward has exceptional competencies in conforming and understanding industrial hazardous location compliance and installation practices for most regulating entities.



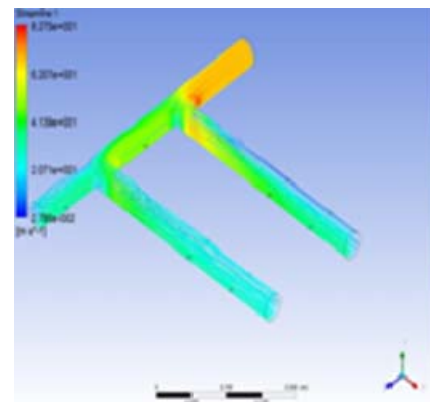
### Common P1

Common P1 is a cost reduction feature that utilizes a compensation model to optimize the skid performance to a particular engine flow profile. The model algorithms predict multi-path pressure losses simultaneously in the piping to reduce the number of pressure-sensing elements required in the system from as many as 20 sensors to 12. The model maintains system-sensing redundancy and system pressure measurement accuracy. Ask Woodward how this solution can be applied to your system for pressure-sensing cost reductions.

## System Integration Capabilities

### Systems Analysis

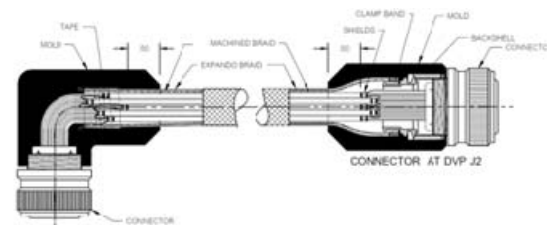
- Numerical Analysis:
- CFD—Computational Fluid Dynamics
- FEA—Finite Element Analysis of system parameters
- Design-to-cost product optimization
- Algorithm validation for third-party control implementation
- Utilize the Woodward platforms or your control platform
- Applied system knowledge of DLE engine operation
- System FMEA and risk analysis



### Integrated Solutions

Woodward offers world class integration features of OEM-qualified Woodward products and commercial catalog components to minimize the burden of customer sourcing labor.

- High speed shut-off valves
- Integrated sensing elements
- Custom and standard cable, connector, and interconnect solutions
- Built-in redundancy
- Localized customer junction and terminal enclosures



## Specifications

Valve Parameters—Many specifications vary based on application and valve requirements. Contact Woodward for more information.

Typical Gas Flow Range:	4.5 kg/h to 18 144 kg/h (10 lb/h to 40 000 lb/h)—Minimum and maximum flow capacity is dependent upon gas conditions, engine demand, port size, and valve type.
Gas Supply Pressure:	345 kPa to 5170 kPa (50 psig to 900 psig)—Minimum and maximum pressure range is dependent upon gas conditions, application, port size, and component ratings.
Gas Filtration Recommendations:	25 $\mu$ m absolute
Valve Metering Port Size:	Dependent upon gas conditions, applications, and valve type
Supported Valve Driver Types:	Digital Valve Positioner (DVP) [off-Board], Valve Position Controller (VPC) [on-board], EM Digital Driver [off-board]
Supported Valve Types:	GS16DR, GS6, 3103/EM-35MR
Valve Position Demand Signal:	Varied based on valve and driver type—Typical signals are analog (4–20 mA), CANopen, RS-485, or DeviceNet *.
Valve Position Feedback Signal:	Varied based on valve and driver—Typical signals are analog (4–20 mA), CANopen, RS-485, or DeviceNet *.
Ambient Temperature:	Varies per design and customer requirements—Typical range $-20^{\circ}\text{C}$ to $+80^{\circ}\text{C}$ ( $-4^{\circ}\text{F}$ to $+176^{\circ}\text{F}$ )

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